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Ecosystem Services in Rating Systems

– Evaluating rating systems for sustainable design through case studies of ecosystem services in residential yards.

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Ecosystem Services in Rating Systems

– Evaluating rating systems for sustainable design through case studies of ecosystem services in residential yards.

Ecosystemtjänster i bedömningssystem
– Utvärdering av bedömningssystem för hållbar design genom fallstudier av ekosystemtjänster i bostadsgårdar.

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Abstract

In a world where climate change is a fact, there is an imminent need for a more sustainable development. Design that includes ecosystem services is an important part of creating more sustainable cities. However, in most development projects the short-term economic interest gets to determine how the development is executed. Therefore there is a need to put a numerical value on the green environment in order to ensure that ecosystem services are included in the planning. Rating systems intended to provide sustainable outdoor environments is one way to do this. However, there is a need to examine the rating systems in order to ensure that they provide a good measurement of ecosystem services.

This thesis examines the rating of ecosystem services in three rating systems, through the research question; *What differences are there in the way that CEEQUAL, Sustainable Sites Initiative and Biotope Area Factor (as used in Årstafältet, Stockholm) rate ecosystem services, and which of the three systems can be expected to lead to the most sustainable outdoor design?*

In the first part of the thesis five ecosystem services are chosen to be used in the research; (1) food production, (2) aesthetic value, (3) habitat for animals, (4) air filtering in vegetation, and (5) stormwater management. In the second part of the thesis the three rating systems CEEQUAL, SITES and BAF are examined to see where and how they rate the five ecosystem services. These parts of the rating systems are then applied on six case studies located in Malmö, Sweden.

The results show that all three rating systems are able to detect the difference between projects that include ecosystem services and the projects that doesn't. However, the rating systems have very different ways to do this. Biotope Area Factor will enhance the inclusion of vegetation and permeable materials and is easy to use. However, BAF has no method for reinforcing the requirements. CEEQUAL is focused on the construction and the material of a site. While CEEQUAL provides a good measurement of sustainability, it is not focused specifically on creating ecosystem services. SITES has its main focus on creating ecosystem services, and is focused on landscape architecture projects. While it is a new system that has not undergone enough research, it shows great potential to be used to ensure the sustainability of an outdoor design.

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1. INTRODUCTION

Background

Personal interest

As a student of landscape architecture my goal has always been to increase the greenery of cities - not only in order to increase the beauty of the cities, but also to make cities more sustainable. Vegetation and green solutions can have many benefits to humankind, ranging from recreational values to water purification. These *ecosystem services* are not always easy to put a value to and therefore they are often neglected in new developments, where short term economic benefits often decide what the money is spent on. In order to counteract this there are *rating systems*, that try to enhance the use of vegetation and green solutions in a site by valuing the solutions in numerical terms. The goal is to encourage or force developers to create more sustainable environments. For me this has always been fascinating - can we create a system that puts a numerical value on something as complex as vegetation and ecosystem services? In 2015 I wrote a paper comparing parts of the Sustainable SITES Initiative with the Biotope Area Factor as it was used in Västra Hamnen, Malmö. It was difficult to reach any conclusions in such a limited study and afterwards I felt intrigued to continue my research of rating systems.

Sustainability and ecosystem services

There is no doubt now that climate change is happening, though there are different predictions of how severe it will be (Morse, 2010, p. ix). The difference in the predictions depends on the actions of humans; if we respond with a swift shift towards green technologies and global solutions to global warming, we can create a best case scenario and minimize the damage we do (Morse, 2010, p. ix). According to Morse (2010, p. x) sustainable development is a requirement to reduce the damage we do to the environment. Sustainable development is development in which we use the ecosystems in a way and at a rate where they can still provide survival and quality of life to the present and future generations (UN, 1987, p. 4). The emphasis on quality of life means that we not only want to make it possible for future generations to have access to food and water, we also want to allow for a world which provides quality of life, including a reasonable income, education, healthcare and recreation (Morse, 2010, p. x). According to Rogers *et. al.* (2008, pp. 22-23) several scientists regard sustainability as including a concept of maintaining an economic growth. Thereby one can distinguish between survivability and sustainability, where survivability means that welfare only has to be above a threshold, whereas in sustainability things will keep getting better, or at least include a non-decreasing well-fare (Rogers *et. al*., 2008, p. 23).

Climate change is already affecting ecosystem services and biodiversity. Changes in temperature and precipitation are affecting the distribution and rhythm of plants, and therefore shifting the balance between ecosystems (Smith, 2009, p. 195). At the same time as climate change is affecting ecosystems, ecosystems can provide important services to mitigate and adapt to climate change. According to Guadagno *et. al.* (2013, p. 405) governments are now increasingly considering conservation and enhancement of green infrastructure as important measures to protect citizens and investments from natural hazards. These actions can range

from small-scale measures, such as green roofing and green windbreaks, to city-wide initiatives, such as preserving and restoring green areas and water bodies (Guadagno *et. al.*, 2013, p. 405). Green solutions and the ecosystem services they create are an important part of sustainable development, in the words of Rodríguez-Rodríguez *et. al.*;

> "Ecosystem services is a concept which is closely linked to sustainability. Both concepts are aimed at improving natural capital while providing economic and social benefits to humans."
> (Rodríguez-Rodríguez *et. al.*, 2015, p. 13)

Sustainable development includes three parts; environmental sustainability, social sustainability and financial sustainability (UN, 1987, pp. 57-58). In strong sustainability all three parts are increasing (Rogers *et. al.*, 2008, p. 28). Often though, sustainability is viewed as a sum of all three kinds of capital, and one kind is allowed to be substituted by another (Rogers *et. al.*, 2008, p. 28; Morse, 2010, p. 3). Morse states that politicians often view environmental sustainability as a sub-branch of economics, and allows economic and social parts to get more attention than the environmental part (Morse, 2010, p. 3). According to Morse (2010, p. 3) and Rogers *et. al.* (2008, p. 28) there is a need in society to address this predominance of social and economic sustainability by placing a larger focus on environmental concerns. The goal should be to work with financial, social and environmental sustainability on equal terms.

Many researchers have come to the conclusion that ecosystem services are constantly undervalued by society, if they are valued at all (e.g. Daily *et. al.*, 2009, p 21; TEEB 2010, p. 4; Kareiva, 2011, p 4). When ecosystem services remain unaccounted for the degradation of them will continue (Daily *et. al.*, 2009, p. 21). Often we do not even realize the value of ecosystem services until after they are gone, as in the aftermath of hurricanes or cyclones (Daily *et. al.*, 2009, p. 21). In order to include ecosystem services into decision-making there are systems which apply a numerical value to ecosystem services. These systems can help stakeholders understand the value of ecosystem services and the impact that changes to ecosystems will have on human well-being (Kareiva, 2011, p 5).
One way to put a numerical value on ecosystem services is to use a system for sustainability certification. A sustainability certification provides an evaluation of the sustainability of a project, based on sustainability criteria created by a third-party organization (Wangel *et. al.*, 2016, p. 210). This kind of certification ensures that sustainability issues are included in the decision-making of a project, something which, according to Wangel *et. al.* (2016, p. 201), is not always the case. Certification systems are important because they provide a common framework for stakeholders on how to work with sustainability issues (Haapio, 2011, p. 167; Wangel *et. al.*, 2016, p. 201; Ek & Brinkhoff, 2013, p. 15). Certification systems are voluntary and therefore build on the idea that the certification of a project will bring publicity to the property owners, landlords, architects and municipalities (Haapio, 2011, p. 167; Wangel *et. al.*, 2016, p. 201; Ek & Brinkhoff, 2013, p. 15).

The Swedish context

Only 2 of Sweden's 16 environmental goals will be possible to achieve in the set time-frame (Ek & Brinkhoff, 2013, p. 5). At the same time the greenspace in urban areas is still decreasing, despite us knowing of the importance of ecosystems and their services (Boverket, 2007, p. 9; Emanuelsson & Persson, 2014, p. 7). In 2007 Sweden's National Board of Housing, Building

and Planning (Boverket, 2007, p. 61), wrote that Sweden needs law requirements regulating the quality and content of the outdoor environment. Boverket wrote that the lack of laws for greenspace was one of the reasons greenspace is often ignored or forgotten in new developments, and suggested that each municipality should add demands in their zoning regulations containing a minimum requirement of what the design of outdoor environments should contain (Boverket, 2007, p. 61). Many municipalities have followed this suggestion, and are using Biotope Area Factor (BAF) as a way to ensure an ecologically sustainable outdoor environment (Delshammar & Falck, 2014, pp. 11-12).
In 2015 there was a change in Swedish building laws, that now prevent municipalities from having additional demands on new development beyond the requirements of the law (Plan- och bygglagen, 2010, 8 Kap. 4 a §). Many were critical to the new law (e.g. Klimatkommunerna, 2013; Klefbom, 2012; Bock, 2012; Westholm, 2013), as it prevents municipalities from developing neighborhoods with a focus on sustainability. The law was still implemented, since the requirements of the municipalities made it more expensive to build and were considered a barrier for new development (Statens offentliga utredningar, 2012).
New ways are therefore needed to ensure the quality of the outdoor environments in our urban areas. Ek & Brinkhoff (2013, p. 2), as well as Lund municipality (Wiklund, 2015, p. 3) names certification systems as a way to meet this need.

Objective

There is a question of whether or not BAF will be possible to use in Sweden in the future, and certification systems have been named as a possible replacement for sustainable development. However, there is a need to explore which certification systems can be used in a similar way as BAF, and there is also a need to explore if these systems provide good measurements of sustainability.
This thesis will examine two certification systems; CEEQUAL and Sustainable Sites Initiative, and compare them to the Biotope Area Factor as used in Årstafältet, Stockholm. CEEQUAL is a British system, it has been used in eight construction projects and one housing project in Sweden (CEEQUAL, 2015a). In the CEEQUAL manual (CEEQUAL, 2014, p. 10), they mention the possibility to use CEEQUAL as a way for the client to set a certain standard and to ensure the sustainability throughout the project, in the same way BAF is used now. It is therefore interesting to examine if CEEQUAL could be used in the same kind of projects as BAF. Sustainable Sites Initiative (SITES) is an American system which was released in 2015. SITES has only been used to certify projects in the U.S. SITES is aimed at landscape architecture projects and has ecosystem services as the core of the program (SITES, 2015, p. vii). It is therefore important to examine if SITES provides a good measurement of ecosystem services, and if the system is adaptable to the Swedish context.

Goal

In this thesis I will examine the three rating systems CEEQUAL, Sustainable Sites Initiative and Biotope Area Factor (as used in Årstafältet, Stockholm) and how they include ecosystem services in their ratings. The aim of this research is to provide an understanding for how these three rating systems include ecosystem services in their ratings and if using the rating systems will lead to more sustainable outdoor environments.

Research question

- What differences are there in the way CEEQUAL, Sustainable Sites Initiative and Biotope Area Factor (as used in Årstafältet, Stockholm) rate ecosystem services, and which of the three systems can be expected to lead to the most sustainable outdoor design?

Methodology

The first part of this thesis is a literature study of ecosystem services. From this literature study five ecosystem services will be selected that will be used to test the rating systems.
The second part of this study will examine the rating systems BAF (as used in Årstafältet, Stockholm), SITES and CEEQUAL. The systems are presented and examined to see where they include the five ecosystem services. These parts of the systems will then be applied to six residential yards which will act as case studies. By examining previous research done on the case study area, discussions with Annika Kruuse at the City of Malmö, and through site visits, I will examine how well the yards have included ecosystem services in their design. From this study I will select three examples of yards that show many indicators of ecosystem services (e.g. a high quantity of vegetation and stormwater features), and three examples of yards that lack ecosystem services in their design.
By applying the rating systems to the residential yards I will examine how the three systems rate ecosystem services and how they advance sustainable design. This research will examine if the rating systems will create sustainable projects that include ecosystem services. By conducting an empirical study instead of a literature study I will get a more thorough understanding of how the rating systems work in real projects, and how adaptable they are to the local site. CEEQUAL has only been used in seven construction projects and one housing project in Sweden and SITES has never been used in Sweden, therefore it is important to examine if these certification systems are applicable in Swedish projects, and not just in theory. This research will also examine how the certification systems perform compared to BAF, the most commonly used rating system for outdoor environments in Sweden.

One of the problems with a study of finished projects is to get access to information concerning the construction of the sites, something which is of great importance to the ratings of all three systems. The drawings that are accessible to the public are the ones which were handed into the municipality when given permission to develop the lots. These drawings and my visual assessment at the site visits is the information I will build my research on. This means I will not be able to examine e.g. soil depths, permeability of substructure and the location of the outflow of drainage pipes. In these cases I will make personal assessments. In order to make the result as reliable as possible I will make the same assessment for all projects, e.g. if there is information of soil depths in the plans I will assume the information is correct, and if no other information is provided I will assume the soil depth of green roofs is 30mm, and that all water that goes into the drainage pipes is managed off-site, rather than in vegetation beds on site.

Limitations

The focus of this thesis is on rating systems that are relevant for urban landscape architecture projects. The two certification systems, CEEQUAL and Sustainable SITES Initiative have been

chosen since they have a focus on the outdoor environment, have international recognition and potential to be used in Sweden. BAF has been used as a reference, as it is the most commonly used rating system for outdoor environments in Sweden. I will only examine one kind of BAF, and have chosen to focus on the BAF used in Årstafältet, Stockholm, as it includes a wide range of ecosystem services. I will not examine other certification systems, or other kinds of BAF.
Delshammar and Flack (2014, p. 16) points out that one problem with BAF is that it might replace other important aspects of planning and design, e.g. yards that are large enough for the residents to use. In my research I have not examined whether or not the rating systems will create yards that are better or more appreciated by residents, only if they provide more ecosystem services.
Calkins (2005, p. 44) writes that the lack of knowledge on the monetary benefits of ecological design solutions is one of the big reasons that they are not implemented. Therefore it would be relevant to examine the monetary value of ecosystem services. One way to do this is to examine what the credits of the rating systems can show concerning the value they assign different ecosystem services. However, due to the limitations of this thesis, the question of monetary value has been left out.

Previous research

This is a presentation of the research done on BAF, CEEQUAL and SITES, with a focus on literature relevant for the Swedish context.

Biotope area factor

In Sweden BAF was first used in Bo01 in 2001. The year after the first study of the results was conducted by Jallow and Kruuse (2002). Jallow and Kruuse showed that only 8 of the 17 yards in their research had a BAF of 0.50 or higher (which was the requirement). In a master thesis, Ekström showed that in 2012 the BAF rating had decreased, and only 5 of the yards were above 0.50. Beside Ekströms study, there have been many other student works on the subject, such as Andersson (2008), Gard (2012) and Centervall (2012). Gard (2012) was not able to detect a relation between using BAF and achieving a higher amount of greenery. Andersson (2008) conducted a small study of four residential yards, and saw that the ones that used BAF was greener and provided a beautiful yard but left little room for activities. Centervall (2012) conducted a study of 20 yards and her results showed that the yards with BAF had more green walls and roofs, but not more trees and water. Centervalls conclusion was that there is only a weak connection between BAF and ecosystem services.

Two reports on BAF were conducted in 2014 at the Swedish University of Agricultural Sciences. Emanuelsson and Persson (2014) wrote a report on the BAF used in Miljöbyggprogram SYD in order to develop a new BAF for Göteborg, Sweden. They conducted a research of literature and found four major problems with MBP SYD; (1) There is a lack of local adjustment, (2) it only values biodiversity and stormwater management, (3) it is unclear how the surfaces has been valued, (4) there is not enough diversity in the rating of water surfaces (Emanuelsson & Persson, 2014, p. 19). Delshammar and Falck (2014) presented a report on the use of BAF in Sweden. Through literature studies and interviews with municipalities they examined how BAF is used in Sweden and what research has been done on the subject. Their conclusion was that

BAF is used in at least 15 Swedish municipalities and that there is a lack of systematic research examining if BAF contributes to enhance ecosystem services.
Green *et. al.* (2014) wrote a report on how BREEAM COMMUNITIES, BREEAM-SE, CEEQUAL and BAF (as used in Norra Djurgårdsstaden, Stockholm) include ecosystem services. Their study showed that the certification systems had outspoken criteria for working with ecological values, though none of them used the term ecosystem services. Their study also showed that BAF was a good monitoring tool for ecosystem services, and suggested it could be combined with a certification system.

CEEQUAL

The report written by Green *et. al.* (2014) also examined ecosystem services in CEEQUAL. The conclusion was that CEEQUAL shows a holistic approach to sustainability which includes many planning disciplines and ecosystem services (Green *et. al.,* 2014, p. 15). Despite this there is a lack of questions aimed at creating new ecosystem services (Green *et. al.,* 2014, p. 16).
Ek & Brinkhoff (2013) wrote a report on the advantages and disadvantages of using CEEQUAL in landscape and construction projects in Sweden. Their study consisted of a compilation of experiences of using CEEQUAL in Sweden. The result showed that CEEQUAL works well because it allows for international comparison of the sustainability of a project, but that it is time consuming and not adapted to Swedish conditions.
There are also two student works written on CEEQUAL. Catapano and Kadir (2014) conducted a study on CEEQUAL certified projects. Their results showed that using CEEQUAL was time consuming, though there is a potential to include the system in the decision-making of a company and thereby make the process smoother in the future. Johansson (2011) showed similar results, that there was a need to include CEEQUAL in the planning process in order to reduce the time effort for each project, but that it was an overall good tool for working with environmental and social issues.

Sustainable Sites Initiative

SITES is a new system and therefore no independent studies has yet been released. Steiner (2014) mentions SITES in his research paper, as a certification system based on an understanding of ecological processes and ecosystem services. Steiner also suggests several research questions, such as “How are ecosystem services advanced through rating systems such as SITES and LEED?”, “How can SITES be adapted in other nations?”, and “How might case studies about SITES pilot projects, and eventually SITES certified projects, advance our understanding of ecosystem services?” (Steiner, 2014, p. 306). In an article in the Dirt, experiences of using SITES are presented (Green, 2013). However, Steiner is a Professor at the University of Texas at Austin and the Dirt is an online magazine released by American Society of Landscape Architects (ASLA). It is important to note that the University of Austin and the ASLA are two of the four creators of SITES, and therefore information from these sources cannot be considered independent and unbiased.

Implications for my study

The literature research shows that there is still a considerable lack of research of these three rating systems, especially the two certification systems. There are no studies on how SITES

could be used in Sweden, and all of the studies done on CEEQUAL in Sweden has focused on construction work, no studies have examined whether it is a good system to certify landscape and urban projects. There is not enough research on how CEEQUAL and SITES include ecosystem services, and there are no comparisons of the three systems. This literature study shows that my research will provide an important contribution to the knowledge on the way BAF, SITES and CEEQUAL include ecosystem services, and the possibility to use the systems for urban landscape projects.

Disposition

The first chapter of this thesis provides the background to the subject, and also the methodology, definitions and limitations of the thesis.
Chapter two and three provide the information needed to conduct the study. Chapter two concerns ecosystem services, what they are, why they are important and which ecosystem services I have selected for my study. Chapter three describes the rating systems I will examine and how they include the selected ecosystem services.
In chapter four and five the case study is reported. Chapter four provides an introduction to the case study area, and chapter five gives an overview of the results of the study.
The final part of the paper contains a discussion in chapter six and the conclusion and further research in chapter seven.

Definitions

Though many have tried to create unified definitions for ecosystem services, there are still much debate on what terms should be used (TEEB, 2010, p. 10). Though there is no commonly accepted framework for the definitions of terms involved in ecosystem services, there is a need to define the terms for the context of this thesis. Since I want my work to be relevant in an international context I will use the definitions created in the frameworks of CICES (Haines-Young & Potschin, 2013) and accepted by MAES (MAES, 2013). These systems are frameworks designed to create a unified mapping and assessment of ecosystems in the EU (MAES, 2013, p. 4). According to Naturvårdsverket (2012, p. 29) CICES and MAES are likely to become the international standard of ecosystem services assessments. Hermann *et. al.*, also mentions CICES as a helpful framework, and argue that the general structure of their diagram is widely agreed upon, but the distinction between function, service and benefit is still under discussion and the real world relationships are never this linear (Hermann *et. al.*, 2011, p. 9).

Sustainable development

Sustainable development is “the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations” (UN, 1987, p 4). Sustainable use doesn’t only include biological diversity though; the Brundtland Report (UN, 1987, pp. 57-58) came to the conclusion that environmental sustainability has to build on a foundation of social and financial sustainability, a statement which is now generally accepted.

Ecosystem

An ecosystem is “a complex of living organisms with their (abiotic) environment and their mutual relations” (MAES, 2013, p. 22). To make this definition more appropriate for mapping and assessment MAES has limited the definition to ecosystems at the scale of a habitat or landscape (MAES, 2013, p. 22).

Ecosystem function

Ecosystem functions are the processes, traits and structures which provides services, whether or not they are useful for humans (MAES, 2013, p. 20).

Ecosystem service

Ecosystem services are “the contributions that ecosystems make to human well-being” (MAES, 2013, p. 33). Ecosystem services are seen in the MAES report as deriving from living organisms (MAES, 2013, p. 33).

Ecosystem benefit

Ecosystem benefits are “things that people create or derive from final ecosystem services” (Haines-Young & Potschin, 2013, p. 9). These are no longer connected to the ecosystems, but have been turned into products or experiences (Haines-Young & Potschin, 2013, p. 9).

2. ECOSYSTEM SERVICES

The history of ecosystem services

The term ecosystem services was first used by scientists in the 1980s to point out how society and the economy is dependent on ecosystems and their services (Hermann *et. al.*, 2011, p. 5). However, it wasn't until the late 1990s that ecosystem services received widespread attention, when several papers were published on the subject (TEEB, 2010, p. 7). These papers together with later studies created the foundation for the Millennium Ecosystem Assessment (MA) (TEEB, 2010, p. 7).
The MA is based on a large study conducted between 2001 and 2005, and released a report in 2005 (MA, 2005, p. v). The MA report aimed at assessing the relations between human well-being and the ecosystem, and to establish a foundation for improving conservation and the sustainable use of ecosystems (MA, 2005, p. v). This was the first big effort to categorize and measure ecosystem services and their importance to the well-being of humans (Kareiva, 2011, p 3). The conclusion of the report was that ecosystems provide essential benefits to the well-being of humans, in the words of Döhren and Haase: "Ecosystems are the basis for all life on Earth, particularly for human life and well-being." (Döhren & Haase, 2015, p. 490). One of the conclusions of the MA was that approximately 60% of ecosystem services are being degraded or used in an unsustainable way (MA, 2005, p. 1). The facts presented in the report made a huge impact on world leaders and managed to raise people's awareness of the importance of ecosystem services, and since then efforts to conserve ecosystems have increased (Kareiva, 2011, p 3; Hermann et al., 2011, p. 5).

In 2008 The Economics of Ecosystems and Biodiversity (TEEB) attempted to conduct a monetary valuation of the global costs of losing ecosystem services. TEEB concluded that the costs of the loss of ecosystem services each year is 7% of the world's BNP, and that was only the terrestrial ecosystem services, aquatic ecosystem services were excluded (Naturskyddsföreningen, 2013, p. 3). The final report of the TEEB study was presented at the 2010 Convention for Biodiversity in Nagoya, Japan, where it made a big impact on the leaders of the world (Naturskyddsföreningen, 2013, p. 3). During the convention global commitments were made to work towards the goals set up by the convention, these goals were; (1) Improve the knowledge of the importance of biodiversity; (2) integrate the value of biodiversity in decision-making and accounting; (3) change from harmful subsidies to environmental compensations and; (4) achieve sustainable production and consumption (Regeringen, 2013, p. 26).
In order to meet the global commitments accepted under the convention, the EU incorporated these goals into the EU Biodiversity Strategy 2011-2020 (MAES, 2013, p. 6). The aim of the EU Biodiversity Strategy is to stop the degradation of ecosystems in EU by 2020, and to restore them as far as possible (MAES, 2013, p. 6). The Biodiversity Strategy also calls for its members to assess and map their ecosystems and ecosystem services by 2018 (MAES, 2013, p. 4). As a member of the EU, Sweden has to fulfill the requirements of the EU Biodiversity Strategy. Therefore the Swedish government set up their own biodiversity goals in 2010, which includes securing ecosystem services for the future (Regeringen, 2013, p. 14). In 2012 the government added intermediate targets, which includes that by the year 2018 biodiversity and the value of ecosystem services should be known by the Swedish public and should be integrated in financial and political decision-making (Regeringen, 2013, p. 14). In order to reach these goals,

Sweden and the EU need to identify an appropriate method for analyzing ecosystem services (Regeringen, 2013, p. 36). The first objective, according to MAES (2013, p. 4), is to set up an analytical framework to ensure that the work is coherent in all member states.

Categorizing ecosystem services

There have been several attempts at creating systems for classification and assessment of ecosystem services. According to Naturvårdsverket (2012, p. 18), three of these have gained international recognition and are now the most commonly used; the Millennium Ecosystem Assessment (MA, 2005), The Economics of Ecosystems and Biodiversity (TEEB, 2010) and Common International Classification of Ecosystem (CICES; see Haines-Young & Potschin, 2013). The MA was the first large ecosystem assessment and provides a framework which has been further refined by TEEB and CICES (MAES, 2013, p. 30). They are similar to each other, but have some differences due to the purpose of the specific system (MAES, 2013, p. 30).

The goal of the MA was to highlight the connection between human well-being and the services provided by ecosystems (Kareiva, 2011, p 3). The MA organizes ecosystem services into four groups; (1) Provisioning, (2) regulating, (3) cultural, and (4) supporting (MA, 2005, vi). Provisioning services includes e.g. food, water and fiber; Regulating services are services which affect climate e.g. floods, disease and water quality; Cultural services provide recreational, aesthetic and spiritual benefits; Supporting services are e.g. soil formation, photosynthesis and nutrient cycling (MA, 2005, v).
The MA was later criticized, mainly because of the inclusion of the last category - supporting services (Fish & Turner, 2008, p. 1167). The reason being a fear for double counting, when the ecosystem function is counted as well as the resulting ecosystem service that the function provides (Fisher and Turner, 2008, p. 1167). Because of the risk for double counting, Fisher and Turner (2008, p. 1167) argue that the system proposed by the MA is impossible to use for valuations and landscape management purposes.
The aim of TEEB was therefore to make adjustments of the MA in order to make it possible to assess the economic loss caused by degradation of ecosystem services (TEEB, 2010, p. 4). TEEB follows the MA classification in large, but instead of supporting services (which they consider to be ecological functions), TEEB has made habitat services a category of its own (TEEB, 2010, p. 19). The reason for making habitat services a category was to highlight the importance of ecosystems as habitats for migratory species and as gene-pool protectors (TEEB, 2010, p. 19).

The Common International Classification of Ecosystem Services (CICES) was developed to assist in the exchange of information between different frameworks for ecosystem services and to be functional in many different contexts (Haines-Young & Potschin, 2013, p. 1). CICES follows the international standard for environmental-economic accounting set up by the UN System of Environmental-Economic Accounts (SEEA), and the aim is to create a common framework which can become the new international standard for mapping and assessing ecosystem services (Haines-Young & Potschin, 2013, p. 2). Therefore CICES has set up a system with five levels of detail, with the intent that ecosystem services can be mapped or assessed on different levels of detail depending on the need (Haines-Young & Potschin, 2013, p. 3). The top level is named “section” and contains three categories; (1) Provisioning, (2) regulating & maintenance, and (3) cultural, which corresponds to the categories of the MA and

TEEB (Haines-Young & Potschin, 2013, p. 3). Below this are four more levels; (1) Division, (2) group, (3) class, and (4) class-type (Haines-Young & Potschin, 2013, p. 3). CICES provides the example that the class-type level can be used for mapping and assessment of ecosystem services, while the group or the class level is more appropriate for accounting purposes (Haines-Young & Potschin, 2013, p. 4).

Like TEEB, CICES uses the typology from the MA but excludes the supporting services, though CICES choose not to include a fourth category at all (Haines-Young & Potschin, 2013, p. 8). The reason for this is the same as in TEEB, they want to make a clear distinction between ecosystem functions and ecosystem services and avoid double counting (Haines-Young & Potschin, 2013, p. 8). In CICES, abiotic services (ie. services that are not connected to living organisms) are considered ecosystem functions, rather than ecosystem services (MAES, 2013, p. 30-31).

MA categories	TEEB categories	CICES groups
Food (fodder)	Food	Biomass [Nutrition]
		Biomass (Materials from plants, algae and animals for agricultural use)
Fresh water	Water	Water (for drinking purposes) [Nutrition]
		Water (for non-drinking purposes) [Materials]
Fibre, timber	Raw Materials	Biomass (fibres and other materials from plants, algae and animals for direct use and processing)
Genetic resources	Genetic resources	Biomass (genetic materials from all biota)
Biochemicals	Medicinal resources	Biomass (fibres and other materials from plants, algae and animals for direct use and processing)
Ornamental resources	Ornamental resources	Biomass (fibres and other materials from plants, algae and animals for direct use and processing)
		Biomass based energy sources
		Mechanical energy (animal based)
Air quality regulation	Air quality regulation	[Mediation of] gaseous/air flows
Water purification and water treatment	Waste treatment (water purification)	Mediation [of waste, toxics and other nuisances] by biota
		Mediation [of waste, toxics and other nuisances] by ecosystems
Water regulation	Regulation of water flows	[Mediation of] liquid flows
	Moderation of extreme events	
Erosion regulation	Erosion prevention	[Mediation of] mass flows
Climate regulation	Climate regulation	Atmospheric composition and climate regulation
Soil formation (supporting service)	Maintenance of soil fertility	Soil formation and composition
Pollination	Pollination	Lifecycle maintenance, habitat and gene pool protection
Pest regulation	Biological control	Pest and disease control
Disease regulation		
Primary production, Nutrient cycling (supporting services)	Maintenance of life cycles of migratory species (incl. nursery service)	Lifecycle maintenance, habitat and gene pool protection
		Soil formation and composition
		[Maintenance of] water conditions
	Maintenance of genetic diversity (especially in gene pool protection)	Lifecycle maintenance, habitat and gene pool protection
Spiritual and religous values	Spiritual experience	Spiritual and/or emblematic
Aesthetic values	Aesthetic information	Intellectual and representational interactions
Cultural diversity	Inspiration for culture, art and design	Intellectual and representational interactions
		Spiritual and/or emblematic
Recreation and ecotourism	Recreation and tourism	Physical and experiential interactions
Knowledge systems and educational values	Information for cognitive development	Intellectual and representational interactions
		Other cultural outputs (existence, bequest)

*Figure 1. Comparison of the three most common categorization systems for ecosystem services. Biodiversity information for Europe (*n.d.*).*

There are still some uncertainties as to which of these three systems that will become the international standard in the future (Naturvårdsverket, 2012, p. 29). For the EU, guidelines have been set up by The Mapping and Assessment of Ecosystems and their Services (MAES) in order to create a common framework (MAES, 2013, p. 1). In MAES the EU stated their intention to use CICES as the framework for their continued work, since CICES provides a flexible classification which can be adapted to the different needs of their member states (MAES, 2013, p. 33).
The Swedish government has decided to follow these guidelines to ensure the comparability with other EU member states (Naturvårdsverket, 2012, p. 29). Naturvårdsverket (Swedish Environmental Protection Agency) has made some adjustments to CICES in order to make the system fit the Swedish context (Naturvårdsverket, 2012, p. 29). One major adjustment is that they added some supporting services from TEEB to their classification, since Naturvårdsverket consider these to be important in their own right (Naturvårdsverket, 2012, p. 29). In the report they highlight certain ecosystems which are considered important in Sweden, one of them being urban areas (Naturvårdsverket, 2012, p. 131). According to the definition of Naturvårdsverket (2012, p. 131) all of the case studies in this study are located in an urban ecosystem, and therefore a more thorough description of the condition of urban ecosystems follows below.

Urban ecosystem services

Since the year 2007 more than half of the world's population live in urban areas, and the number continues to increase (Müller & Werner, 2010, p. 4). At the same time as the cities grow, the amount of resources consumed by citizens are also increasing (Rodríguez-Rodríguez et al., 2015, p. 14). Urban areas consume huge amounts of ecosystem services (e.g. land, food, water, energy), at the same time as they produce very few ecosystem services and a huge amount of waste (e.g. pollutants, heat and noise) (Rodríguez-Rodríguez et al., 2015, p. 14). As a consequence urban areas now cover 2% of the world's surface, but are responsible for 75% of the resources consumed worldwide (Müller & Werner, 2010, p. 4). This make cities the main source of negative impact on the global environment (Rodríguez-Rodríguez et al., 2015, p. 14).
The increasing importance of green solutions in urban areas, in combination with the huge amount of ecosystem services they consume, has made urban areas the focal point for efforts on sustainability (Rodríguez-Rodríguez et al., 2015, p. 14). Since a large portion of the land in urban areas is hardscape, additions of green and blue infrastructure can provide much needed ecosystem services, which is an efficient way to deal with some of the social and environmental problems of cities (Rodríguez-Rodríguez et al., 2015, p. 14). To include efforts to increase sustainability in urban areas is not only of importance for the local ecosystem, but is seen as an important part of responding to environmental, economic and social problems worldwide (Müller & Werner, 2010, p. 4). What is needed, according to Steiner (2014, p. 304), is a fundamental change in how we plan and design communities, landscapes, cities and regions, a challenge which Steiner thinks landscape architects and urban planners should be well equipped to take on.

In their report, Naturvårdsverket highlight certain ecosystem services which are important in each ecosystem. For urban areas Naturvårdsverket writes that the cultural ecosystem services are usually stronger in urban areas, while supporting services are weaker. Regulating services

are important and as climate change is ongoing, the need for regulating services is increasing (Naturvårdsverket, 2012, p. 131).

Ecosystem services for this project

From the list of ecosystem services that are mentioned as important in the ecosystem urban areas (Naturvårdsverket, 2012, p. 131-136), I have chosen five ecosystem services to focus on in this thesis; (1) Food production, (2) aesthetic value, (3) habitat for animals, (4) air filtering in vegetation, and (5) stormwater management. These ecosystem services are categorized in the CICES classification system as shown in figure 2. In this study the ecosystem services are assessed on the "class" level of the CICES classification.

Section	Division	Group	Class
Provisioning services	Nutrition	Biomass	Cultivated crops
Cultural services	Physical and intellectual interactions with biota ecosystems, and land-/seascapes (environmental settings)	Intellectual and representative interactions	Aesthetic
Regulation & maintenance	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and genepool protection	Maintaining nursery populations and habitats
Regulation & maintenance	Mediation of waste, toxics and other nuisances	Meditation by biota	Filtration/sequestration/ storage/accumulation by microorganisms, algae, plants, and animals
Regulation & maintenance	Mediation of flows	Liquid flows	Hydrological cycle and water flow maintenance

Figure 2. Categorization of the ecosystem services in this project. CICES classification spreadsheet (2013).

Aesthetic value is a cultural service, food production is a provisioning service, the other three are under regulating services (habitat is mentioned twice, both as a regulating services, and as one of the added supporting services). By selecting ecosystem services from the three different sections of the CICES classification, this study will cover a wide range of ecosystem services.

In Naturvårdsverket (2012, p. 131) the only provisioning service mentioned is "cultivated crops", or food production, and it will therefore represent the provisioning services in this study.
Cultural services are mentioned by Naturvårdsverket (2012, p. 131) as strong in urban areas, and the cultural service aesthetic value is highlighted as especially important for the health and well-being of urban citizens. According to Hermann *et. al.* (2011, p. 16) the aesthetic ecosystem service is difficult to measure. Because of this difficulty it is also relevant to examine how the three rating systems rate the aesthetic ecosystem service.

According to Naturvårdsverket (2012, p. 131) ecosystem services in the section "regulation & maintenance" are especially important in urban areas, and the importance of these ecosystem services is only increasing as the climate changes. Because of the importance of regulating and maintaining ecosystem services, three of the ecosystem services in this study are from this section. Air filtering in vegetation and stormwater management are mentioned by Naturvårdsverket (2012, p. 132-134) as important services in order to maintain a habitable

environment in urban areas. The importance of green spaces in urban areas for the maintenance of habitat services for fauna is mentioned both by Naturvårdsverket (2012, p. 132), and by the classification systems themselves. TEEB considers habitat services important enough to give them their own category (2012, p. 19).

The five ecosystem services that have been selected will cover a wide range of the many benefits that ecosystems provides to humans, and will provide way to examine if the rating systems have a holistic approach to ecosystem services. Below follows a more in-depth explanation of the five ecosystem services and why they are important.

Food production

Urban agriculture is increasingly important in a global perspective. As the world's population grows, there is an ongoing debate concerning how many people the world can feed (Rogers et al., 2008, p. 20-21). Today we are able to provide for 6.5 billion people but in order to do so we are seriously compromising ecosystem services (Rogers et al., 2008, p. 20-21). There is still an uncertainty as to how seriously the world's ecosystems have been degraded, and how much more room there is for a growing population who wants to keep developing (Rogers et al., 2008, p. 21). The growing awareness of climate change and resource scarcity has created an urban agriculture trend in Sweden and internationally (Naturvårdsverket, 2012, p. 132).
It is not only a trend though, for many the home-grown vegetables are a vital part of the food provision for the household. In Africa and Latin America about 390 million people are engaged in urban agriculture, and in Detroit in America, where the population is shrinking and many are impoverished, urban agriculture is an important food source (Delshammar, 2011, pp. 9, 21).
In Sweden urban agriculture is part of the culture (Delshammar, 2011, p. 9). The food produced by amateurs in Sweden is an important resource, and has potential to become even more so. There is a big interest in Sweden for growing food, and according to studies made by Fritidsodlarnas riksförbund (FOR), 88% of Swedish households are growing edible plants, though these numbers are based on a small sample and include edible plants in windows and on balconies (Björkman, 2012, p. 26). In total, all plants (including everything from spices to potatoes) grown by amateurs in Sweden can yield 700 000 tons of home-grown edible plants on a good year (Björkman, 2012, p. 27). Though the research by FOR shows that only a tenth of the production is actually consumed, the home-grown products still amount to about 9% of the total consumption of vegetables and fruit in Sweden (Björkman, 2012, p. 27-29).
Urban agriculture is also an important recreational activity (Delshammar, 2011, p. 51). According to FORs research, gardening is the second most common outdoor recreational activity (Björkman, 2012, p. 16). Many urban agriculture projects are community gardens, which have an important social function (Delshammar, 2011, p. 18). Locally grown food is also important in order to reduce transportation to cities, which is an important part of creating more sustainable urban areas (Delshammar, 2011, pp. 9, 22).

The food production I will focus on in this study is agriculture, not reared animals. In the CICES classification (2013, spreadsheet), the class for this is called "cultivated crops".
In the rating systems I will look for points or other indicators which concern trees and shrubs with edible berries or fruit and areas for agriculture.

Aesthetic value

A good city has to provide a healthy, attractive living environment to its citizens (Boverket, 2014, p. 28). With increasing densification, which is occurring in many cities, the quality of the greenspace becomes more important (Boverket, 2014, p. 28). Urban greenspace is used for recreation and social activities, and can be a significant source of aesthetic inspiration (Naturvårdsverket, 2012, p. 135). The aesthetic ecosystem service also contributes to human health and well-being. Studies show that people who live close to greenspace live longer, and that just the sight of vegetation can lower stress level and blood pressure (Naturvårdsverket, 2012, p. 136). Research has shown that patients in a hospital with rooms facing a park had 10% faster recovery and needed 50% less pain-relieving medication compared to patients in rooms facing a building wall (Bolund & Hunhammar, 1999, p. 297).
The aesthetic value of greenspace also affects the monetary value of housing in its proximity. The access to and the quality of parks has been shown to be important for the demand and price of housing (Naturvårdsverket, 2012, p. 135). A study conducted in Sweden in 1993 showed that people were willing to pay 360-530 SEK more per month to live close to a park (Bolund & Hunhammar, 1999, p. 297).

Factors that create high quality greenspace are not easy to measure however. Naturvårdsverket states that the aesthetic value is dependent on vegetation, clean water, and the climate regulating and noise absorbing qualities of nature (Naturvårdsverket, 2012, p. 135). This shows that vegetation and water features are important, as are calm and quiet spaces in the outdoor environment. Hermann *et. al.* (2011, p. 16) mention the difficulty of finding indicators for cultural ecosystem services, and argue that aspects to consider should include size, form, borders and spatial connectivity, and has to be assessed over spatial and temporal scales.

In the CICES classification (2013, spreadsheet), the class is called “aesthetic”. In the rating systems I will look for points intended to elevate the experience of the outdoor environment, for example encouraging borders, seating, space creating, visual pleasure. In some cases, points for decorative plant choices or water features can be considered as indicators for the aesthetic ecosystem service.

Habitat for animals

Habitat services are one of the most important ecosystem services, and in order to highlight this service the TEEB made habitat services its own category in their categorization system (TEEB, 2010, p. 19). In an assessment of ecosystem services provided in European cities the majority of Swedish cities are ranked high, Malmö is the only city which stands out and has a significantly lower value than other Swedish cities (Larondelle *et. al.*, 2014, p 125). Larondelle *et. al*. (2014, p. 125) attributes this to the fact that Malmö is located in the heavily agricultural area of southern Sweden. Intense agriculture is a problem worldwide and Gaston *et. al.* (2010, p. 36) writes that in some parts of the world intensive agriculture has led to natural and semi-natural vegetation being diminished to small and fragmented areas. As the rural areas become less attractive to wildlife, the urban areas have become increasingly important habitats (Gaston *et. al.*, 2010, p. 36). It is therefore an important factor to consider when designing greenspace in urban areas. Goode (1998) also emphasizes that the need to create habitats is as relevant in dense urban areas as it is on the countryside.

> "The integration of nature can be achieved on a number of different scales. It is possible to accommodate a great deal more naturalistic planting within the built-up environment, for example in courtyards or even through the creation of rooftop habitats."
> (Goode, 1998, p. 591)

Gardens and parks are usually richer in flowers and have a higher diversity of plant species than the common forest- and agricultural lands; the result of this is that pollination is usually better accommodated in urban areas (Naturvårdsverket, 2012, p. 132). Parks and greenspace often contain old trees which provide important habitats for many threatened species (Naturvårdsverket, 2012, p. 132). For the preservation of fauna, the size and the quality of the green areas are important. An area with a variety of biotopes will have a large amount of ecological niches which can be occupied by many different species and thereby increase biodiversity (Bolund & Hunhammar, 1999, p. 299). There is also a big variation in biodiversity depending on the type of vegetation – e.g. a short cut lawn will not be able to support any pollinators (Naturvårdsverket, 2012, p. 132).

In the CICES spreadsheet (2013), the class level of the habitat service is called "maintaining nursery populations and habitats". In Naturvårdsverket (2012, p. 145) habitat service is mentioned both under regulation & maintenance, and as one of the supporting services they have chosen to include.
In the rating systems I will look for credits for constructing habitats or biotopes, and for adding nests. Fruit and berries are important as food for certain fauna and can be an indicator for habitat services.

Air filtering in vegetation

Pollution is a major environmental and public health problem in urban areas (Bolund & Hunhammar, 1999, p. 295). The air quality in cities is often bad, and research has shown that the air quality in some parts of the Swedish capital Stockholm doesn't achieve the required environmental quality standards of EU and Sweden (Naturvårdsverket, 2012, p. 136).
Studies have shown that there is 85% less air pollution in a park, and 70% less air pollution in a street with trees compared to a street without trees (Naturvårdsverket, 2012, p. 134). In 1997 there was an estimate that the trees of the Chicago region removed 5500 t air pollutants, thereby providing an air quality improvement worth more than 9 million US dollar per year (Bolund & Hunhammar, 1999, p. 296). A study in Stockholm showed that the ecosystems of Stockholm County are able to absorb a carbon dioxide amount equivalent to 40% of the carbon emissions from the traffic in the county (Naturvårdsverket, 2012, p. 134).

Vegetation reduces pollution in two different ways; (1) Pollutants which have been captured by the stormwater are filtered in the soil and the nutrients will be absorbed by the vegetation (Naturvårdsverket, 2012, p. 134) and, (2) vegetation filters pollutants, e.g. carbon dioxide, and particles, e.g. dust, from the air (Bolund & Hunhammar, 1999, p. 295).
The filtering capacity of vegetation increases with the leaf area, and is therefore higher for trees than it is for shrubs or grass (Bolund & Hunhammar, 1999, p. 295). Coniferous trees have a greater surface area, and can filter larger quantities than trees with deciduous leaves (Bolund & Hunhammar, 1999, p. 295, Naturvårdsverket, 2012, p. 134). Another advantage of coniferous trees is that they are evergreen, which is especially valuable since the air quality is worse in

wintertime (Bolund & Hunhammar, 1999, p. 295, Naturvårdsverket, 2012, p. 134). However, coniferous trees are sensitive to air pollution, while deciduous trees are less sensitive and better at absorbing gases - therefore a mix of species is the best alternative (Bolund & Hunhammar, 1999, p. 295, Naturvårdsverket, 2012, p. 134). Although the location and structure of vegetation is important for the ability to filter air, Bolund & Hunhammar (1999, p. 295) writes that more vegetation is in general better.

Air filtering in vegetation is in the class “filtering/sequestration/storage/accumulation by microorganisms, algae, plants and animals” in the CICES categorization.
The things I will look for in the rating systems are points delivered for vegetation. As the amount of vegetation is the most important element in the filtering of pollutants, I will focus on points given for increasing the amount of vegetation in general, or points for big trees or shrubs.

Stormwater management

The permeable surfaces of vegetated areas allow water to infiltrate and the vegetation to absorb the water and release it into the air through evapotranspiration (Bolund & Hunhammar, 1999, p. 297). The result of this is that in vegetated areas only 5-15% of the rainwater result in run-off, compared to vegetation-free areas in which about 60% of the rainwater is directed to storm water drains (Bolund & Hunhammar, 1999, p. 297). The impervious surfaces of urban areas cause alterations in the water flow and the high proportion of surface-water run-off results in increased peak flood discharges (Bolund & Hunhammar, 1999, p. 297).
Urban areas are also increasingly affected by natural hazards, such as floods and droughts (Guadagno *et. al*., 2013, p. 391). According to Guadagno *et. al*. (2013, p. 395) this is a result of urban growth and its depletion of ecosystems. The protection of ecosystems and natural buffers are important to mitigate floods, storm surges and other hazards, and to adapt to climate change (Guadagno *et. al*., 2013, p. 405). This is something which governments are realizing, and according to Guadagno *et. al.* (2013, p. 405), governments are now increasingly considering conservation and enhancement of green infrastructure as important measures to protect inhabitants and investments from natural hazards.
In order to mitigate natural hazards green and blue infrastructure should be incorporated in the urban areas (Naturvårdsverket, 2012, p. 134). Actions can range from green roofing and green windbreaks, to city-wide initiatives such as preserving and restoring green areas and water bodies to retain stormwater (Guadagno *et. al*., 2013, p. 405). Green infrastructure systems can reduce the costs of the community by increasing the efficiency of service provisions and thereby reducing the strain on the existing infrastructure systems (Steiner, 2014, p. 307).

One problem today is that many citizens change permeable surfaces to impermeable surfaces on private yards, which increases the amount of stormwater in the municipal stormwater system (Naturvårdsverket, 2012, p. 134). Another reason that flooding is an increasing problem in urban areas today is that climate change is creating more frequent extreme weather events, which makes the need for new solutions to prevent flooding of the stormwater system increasingly important (Naturvårdsverket, 2012, 134). This is a huge problem in urban areas with combined sewage systems, in which case an overflow of the stormwater system will cause stormwater and sewage water to mix and lead to contamination of the area where the stormwater system is released (Naturvårdsverket, 2012, p. 134). Permeable surfaces will reduce the flow peaks and total amount of water which needs to be accommodated by the stormwater system

(Naturvårdsverket, 2012, p. 134). Green infrastructure can therefore help to create more climate-change resilient urban environments, which are also more attractive to people, with cleaner air, water and soil (Steiner, 2014, p. 307).
Impermeable ground material will reduce soil moisture, which can cause damages on buildings and infrastructure, especially on clay soils (Naturvårdsverket, 2012, p. 132). Permeable ground prevents subsidence of the soil and is one way to mitigate this kind of damages (Naturvårdsverket, 2012, p. 132).

The two most common surfaces that have been used in the case study area in order to retain and infiltrate stormwater are green roofs and permeable pavers. In order to be able to examine the stormwater management of a site I will need to know how good these surfaces are at retaining stormwater.
There have been a lot of studies on the stormwater retaining capabilities of green roofs. One of the earliest studies on a green roof was conducted in Karlsruhe, Germany by Steusloff (1998). This study on green roofs shows a big difference in stormwater retention depending on the season. For extensive green roofs the average retention during summer months is 97%, in fall and winter the average is 58% (Steusloff, 1998, p. 145). Calculated over the whole year this gives an average retention of 77.5%. For a semi-intensive green roof this year-round average is instead 86.9%, with the retention during summer months close to 100% (Steusloff, 1998, p. 145). This shows that the depth of the planting bed and the species planted are important factors for the retention capability of green roofs.
Gregoire and Clausen (2011, p. 964) collected results from twelve different studies on water retention of green roofs, the results show an average retention of 56% of the precipitation. Gregoire and Clausen (2011, p. 963) also noted that the differences in the results of the different studies are partly due to differences in the time of year, the climate and the sampling method. Steusloff's study was conducted in southern Germany and might not be applicable in the Swedish climate. Another study which was included in the study of Gregoire and Clausen (2011, p. 964) was conducted in Malmö, Sweden by Bengtsson *et. al.* (2005). Since climate is an important factor for the retention of stormwater in vegetated systems the result of this study might be the most relevant in my case studies. This study shows a somewhat lower result than the average, at just below 50% of stormwater retained (Gregoire & Clausen, 2011, p. 964). This is the number I will use in my study.

In the study I need a measurement for the permeability of permeable pavements. Brattebo and Booth (2003) conducted a study in Seattle on the long-term performance of permeable paving. This was done in four sites, six years after construction. Their study showed that all four permeable pavement systems that were examined infiltrated almost all precipitation, even during intense storms (Brattebo & Booth, 2003, p. 4375). Brattebo and Booth (2003, p. 4375) point out that the conditions of the studied sites are favorable for infiltration. Therefore the study conducted by Münchow & Schramm (1998) in Leipzig in the middle of Germany is more relevant for my case study. The results from the study by Münchow and Schramm will therefore be used as a guide when assessing the infiltration of ground covers in the case study.
Four surfaces were examined in the study by Münchow & Schramm (1998, p. 183); (1) Concrete block pavements with grass joints, (2) concrete grid pavements with grass, (3) block pavement with drainage opening filled with compacted sand clay, and (4) sand surface with a synthetic resin binder. The surfaces were tested for one rainfall of 30-35 mm/h and one of 70mm/h (Münchow & Schramm, 1998, p. 183).

The study showed that for the sand clay areas the infiltration varies greatly depending on the material (Münchow & Schramm, 1998, p. 184). A sand clay surface with a high content of fine grains had the lowest infiltration rate, close to zero. Sand clay with a low content of fine grains did somewhat better at just below 20mm/h. Of the sand clay surfaces the one with resin binder showed the best results, at 45mm/h.
For concrete pavers with drainage openings the material in the openings made a big difference. For pavers with drainage openings of silt loam the infiltration measured around 15mm/h, while the ones filled with chippings had a 100% infiltration for both the rainfalls simulated (Münchow & Schramm, 1998, p. 184).
Münchow and Schramm (1998, p. 185) measured two surfaces of concrete grid pavement with grass, one with less grass and one with more grass. The one with a high amount of vegetation was able to infiltrate the low intensity rainfall, and about 45mm/h in the heavy rainfall. For the surface with a low amount of vegetation the infiltration was about 10mm/h (Münchow & Schramm, 1998, p. 185).
The concrete block pavement with grass joints was tried for two surfaces, one surface with a low grass cover (less than 5%) and one with a high amount of grass (more than 75%). The surface with a low amount of vegetation infiltrated about 5mm/h, and the surface with a high amount of vegetation infiltrated an average of 20mm/h (Münchow & Schramm, 1998, p. 185).

Stormwater management is located in the class “hydrological cycle and water flow maintenance” in the CICES classification.
The things I will look for in my case studies are points for green and blue stormwater managements features, which will allow for stormwater to be infiltrated into the soil and at the same time be filtered for pollutants in the soil. I will also look for points for permeable ground. In the cases where I have to make an assessment of the permeability of the ground I will look at the numbers presented above. This means that green roofs will be measured to retain 50% of stormwater and for the permeable pavements I will look at the numbers presented in Münchow and Schramm (1998).

3. RATING SYSTEMS

Introduction to certification systems

Environmental certification systems have existed for a long period, the first arrived shortly after the Brundtland Report coined the term sustainable development in 1987 (Kyrkou & Karthaus, 2011, p. 206). The first certification systems were focused on assessing the sustainability of buildings (Berardi, 2013, p. 1574). The most internationally recognized certifications for buildings are BREEAM, which was established in 1990 in the U.K. and LEED which was created shortly thereafter in the U.S, modelled after BREEAM (Kyrkou & Karthaus, 2011, p. 206). In the beginning of the 21st century certification systems for communities and urban design was developed (Berardi, 2013, p. 1574).The first certification system for urban areas was CASBEE-UD from Japan, released in 2001, which was then followed by BREEAM Communities (BREEAM-C) from the UK in 2008 and LEED Neighborhood Development (LEED-ND) from the U.S. in 2010 (Haapio, 2011, p. 166). As stated in the introduction, there is not much research done on CEEQUAL and SITES, which are the two certification systems examined in this thesis. However, many studies focus on BREEAM-C and LEED-ND (e.g. Wangel *et. al.,* 2016; Kyrkou & Karthaus, 2011; Haapio. 2011). BREEAM-C is closely related to CEEQUAL and has released a Swedish version which is promoted through the same organization as CEEQUAL, the Sweden Green Building Council (SGBC). LEED-ND is closely related to SITES, though SITES was developed by other stakeholders, the system is now distributed through the U.S. Green Building Council (USGBC), and parts of SITES has been incorporated within the LEED certification. Therefore some similarities between the systems for sustainable communities and the systems for sustainable outdoor environments might be expected.

Previous studies on BREEAM-C and LEED-ND

According to the research of Calkins (2005, p. 46), a major problem with certification systems is that they are complex to use. Wangel *et. al.* (2016, p. 200) also writes that the certification systems are complex, and that the complexity makes it difficult to understand what a branding means in terms of what has been assessed. Wangel *et. al*. (2016, p. 201) argue that one of the problems arise due to of a lack of transparency on how the aggregation and weighting of the credits are made. Kyrkou and Karthaus (2011, p. 208), also criticize the lack of transparency. While LEED-ND is available for purchase online (as is SITES), BREEAM-C (and CEEQUAL) are only available to certified assessors. Kyrkou and Karthaus (2011, p. 209) argue that the lack of access to BREEAM-C makes it impossible for anyone outside BREEAM-C to know how a project has been assessed and on what basis it received its. Kyrkou & Karthaus (2011, p. 208) writes that a high transparency will allow for better comparison of the merits of each system and will help to promote the sharing of best practices.
The importance of transparency is also highlighted by Berardi (2013, p. 1576), who writes that research shows that assessors will influence the criteria and benchmarks that are considered, depending on their point of view and the time of the assessment. Therefore Berardi argue that the assessment has to be conducted by more than one person and that it has to be consequent, transparent and objective (Berardi, 2013, p. 1576).

Both BREEAM-C and LEED-ND make it possible for a project to leave out non-mandatory aspects (Wangel *et. al.*, 2016, p. 201). This makes it possible to address only a few

sustainability aspects, while large environmental impacts can be neglected, which means a project can be certified on the highest level and without actually being sustainable (Wangel *et. al.*, 2016, p. 201). However, this same aspect also makes it possible to adjust the system to the local conditions (Wangel *et. al.*, 2016, p. 201). This is also noted by Kyrkou & Karthaus (2011, p. 205) who argue that the sustainability challenges differ between projects and the certification systems need to be adaptable to this. The certifications also need to be adaptable to different countries. Haapio (2011, p. 169) argues that certification systems usually depend on the laws and culture where they were created and there is usually a need for changes if they are to be used elsewhere (Haapio, 2011, p. 169).

One of the problems Wangel *et. al.* (2016, p. 201) noticed is that the BREEAM-C and LEED-ND have a heavy focus on environmental sustainability, and not as much on social and financial sustainability. The three-dimensions of sustainability need to be included if a certification is to be a true measurement of sustainability (Kyrkou & Karthaus, 2011, p. 205).

Biotope Area Factor

In 2001 the Biotope Area Factor (BAF) was introduced in Sweden in the development of the housing exhibition area Bo01 in Malmö (Emanuelsson & Persson, 2014, p. 7). The inspiration came from the Biotopflächenfaktor which had been used in Berlin (Emanuelsson & Persson, 2014, p. 4). BAF has since then become increasingly popular in Scandinavia, and has been used in 15 municipalities in Sweden alone (Emanuelsson & Persson, 2014, p. 7; Delshammar & Falck, 2014, p. 11).
BAF is not a certification system, but a planning tool which is used to require a certain amount of green and blue space at a project site (Delshammar & Falck, 2014, p. 6). BAF will give each surface area a number between 1 and 0. In the BAF used in Bo01, areas covered with water or vegetation is the “eco-efficient surface”, which had a value of 1, the hardscape had a value of 0 (Delshammar & Falck, 2014, p. 6). Points are given for green roofs and walls, which can somewhat compensate for lack of greenery on the ground (Delshammar & Falck, 2014, p. 6). Depending on the design of the project site it will receive a score according to this rating, and this score has to match the requirement of the municipality (Delshammar & Falck, 2014, p. 6).
Delshammar and Falck (2014) examined several studies conducted on BAF. The results indicate that the use of BAF has made it easier to argue for the inclusion of a larger amount of vegetation and water in the planning process (Delshammar & Falck, 2014, p. 16). Since BAF converts the green infrastructure into numbers it is easier to argue for greenery on the same term as other planning issues, e.g. the number of parking lots (Delshammar & Falck, 2014, p. 16).

Miljöbyggprogram SYD

There are many kinds of Biotope Area Factor, almost every city that used BAF has developed their own version, adapted to the local needs and circumstances (Delshammar & Falck, 2014, p. 11-12). The one that has been used in Malmö since 2009, is called Miljöbyggprogram SYD (MBP SYD; Environmental building program SOUTH), and was developed by the municipalities of Malmö and Lund in collaboration with Lund University (MBP SYD, 2012, p. 6). MBP SYD provides three different environmental classes; C, B and A. Environmental class C is good (somewhat better than the demands by law), class B is very good and class A is the highest

environmental level (MBP SYD, 2012, p. 6). In order to get permission to build on a property owned by the municipality of Malmö, developers have to achieve at least class C (MBP SYD, 2012, p. 6). For areas with an environmental focus the municipality can demand a higher level of ambition than C, and the developers themselves can also chose to have a higher ambition level (MBP SYD, 2012, p. 6).
The developer has to report the results in three stages; (1) A contract of ambition when the ground is divided (markanvisning), (2) show the results when the project is finished, and (3) report on the maintenance two years after the project is finalized (MBP SYD, 2012, p. 7). The two last reports have to show the same, or better results than the ambitions, and if one of the reports is excluded, the project failed to meet the demands (MBP SYD, 2012, p. 7).

MBP SYD includes six focus areas; (1) Energy, (2) moisture safety, (3) indoor environment, (4) urban biodiversity, (5) building acoustics, and (6) noise from traffic (MBP SYD, 2012, p. 6). Urban biodiversity is the area that focuses on the outdoor environment. As with other kinds of BAF, this will provide an approximation of the amount of green and blue infrastructure on a property in the form of a value between 0 and 1 (MBP SYD, 2012, p. 64). Points are given for the material of the ground cover, and additional points for infiltration, trees, shrubs, and other greenery, the total score is then divided by the total surface areas of the property (MBP SYD, 2012, p. 64)
MBP SYD has its primary focus on biodiversity, and Emanuelsson and Persson (2014, p. 19) mentions this as one of the major problems with MBP SYD, that it only measures two ecosystem services; biodiversity and stormwater management. As stated in the introduction, the three-dimensions of sustainability need to be included if a certification is to be a true measurement of sustainability (Kyrkou & Karthaus, 2011, p. 205). Though MBP SYD does not provide a holistic measurement of sustainability, there are other kinds of BAF that provides a more holistic frame for rating sustainability. One of these is the BAF that is used in Stockholm. The first version of this BAF was developed for Norra Djurgårdsstaden and was based on the version developed by Malmö (Stockholms Stad, 2011, p. 4). The aim of using BAF in Norra Djurgårdstaden was to create climate resilient and green residential yards which would; (1) Mitigate the negative effects of climate change, (2) add social values in residential blocks and yards and, (3) increase the biodiversity of the area (Stockholms Stad, 2011, p. 4). By broadening the scope to cover more than just biodiversity, this kind of BAF should be able to assess a bigger quantity of ecosystem services compared to MBP SYD.
Some parts of BAF for Norra Djurgårdsstaden are very specific to the area where it was implemented, such as the extra points given for oaks. These were considered important for the area Norra Djurgårdsstaden (Stockholms Stad, 2011, p. 27), but are rare in the Malmö area. When Årstafältet in Stockholm was developed, a new version of BAF for Norra Djurgårdsstaden was created which was adapted to the conditions at Årstafältet. This area is located in agricultural landscape and the BAF used for Årstafältet was therefore focused on habitats in agricultural and cultural landscapes (Stockholms Stad, 2011, p. 4). Since Malmö is also located in an agricultural landscape, BAF for Årstafältet is more appropriate for the situation in Malmö, and therefore this is the one I will examine in my thesis. From now on when I refer to BAF it is the BAF used in Årstafältet, if nothing else is stated.

Biotope Area Factor for Årstafältet

Just as Miljöbyggprogram SYD, BAF in Årstafältet is a value that represents an average of the amount of green on the lot (Stockholms Stad, 2012, p. 12). First the groundcover is measured and given points depending on the depth of the soil and the permeability of the groundcover (Stockholms Stad, 2012, p. 12). Besides the points for ground material, there are additional points given for other features. In this system the same feature can receive points in many categories simultaneously, e.g. a tree can get credits for biodiversity, social value and climate regulation (Stockholms Stad, 2012, p. 12). The credits are divided into three functions - Biodiversity, social values and for climate regulation (Stockholms Stad, 2012, p. 13). These three functions have been weighted against each other and the yard has to achieve at least 60% in each category (Stockholms Stad, 2012, p. 13). This BAF is complex and while MBP SYD only has six additional credits, the BAF used in Stockholm has 41 additional credits (Emanuelsson & Persson, 2014, p. 12).

Previous studies on BAF

In a study of BAF in Sweden (Delshammar and Flack, 2014, p. 16) the results indicate that the use of BAF makes it easier to argue for a larger amount of vegetation and water in the planning process. Delshammar & Falck (2014, p. 16) point out that vegetation and water doesn't necessarily mean high quality outdoor environments, or that there are more ecosystem services at the site. However, Delshammar and Flack conducted a general study of BAF in Sweden, and it is unclear which BAF they are criticizing. A study by Green *et. al.* (2014) focused on the integration of ecosystem services in the BAF used in Norra Djurgårdsstaden. Their study showed that BAF included many different ecosystem services and provided a good tool for integrating ecosystem services into planning and design (Green *et. al.,* 2014, p. 16). Another problem brought up by Delshammar and Flack concerning ecosystem services is that BAF isn't site specific, and therefore might promote ecosystem services where they are not needed, e.g. the reduction of urban heat island effect is only necessary if there is a problem with high temperature (Delshammar & Flack, 2014, p. 8).

In their research Delshammar and Flack interviewed municipalities that use BAF. Some problems that were brought up by the respondents was that the system would work better in a dense urban environment than in smaller towns, that it increases the workload for the building permit department, that it is difficult to ensure the regulations are followed and that it is a complicated system (Delshammar & Falck, 2014, p. 14-15).

Emanuelsson and Persson (2014, p. 18) points out that BAF is not a general solution and cannot do everything. There are limitations to BAF, and Emanuelsson and Persson (2014, p. 18) writes that BAF has to be complemented with other methods in order to achieve a sustainable outcome. Green *et. al.* (2014, p. 16) also writes that BAF is a good tool to combine with other tools, since BAF makes it possible to measure ecosystem services before and after the design and will also act as an inspiration during the process.

CEEQUAL

CEEQUAL is a British system which was first launched in 2003, and in 2013 a Swedish version was released (CEEQUAL, 2013). According to Ek & Brinkhoff (2013, p. 5) CEEQUAL is the first certification system for outdoor environments that has been used in Sweden. The interest for CEEQUAL has grown quickly in the last couple of years (Ek & Brinkhoff, 2013, p. 2).

The name CEEQUAL stands for Civil Engineering Environmental QUALity assessment and awards scheme (CEEQUAL, 2014, p. 2), although with version 5 the methodology is changed to sustainability assessment and awards for civil engineering, infrastructure, landscaping and public realm works (CEEQUAL, 2014, p. 2). This marks a change in the system; while CEEQUAL was originally designed to be used for construction work, they have now broadened the scope, and the system is also able to certify landscaping and public realm projects. The aim of CEEQUAL is to raise awareness of sustainability in the field, create an environmentally driven strategy for projects and contracts, enhance the sustainability results of projects, contracts, construction and production, and to acknowledge and enhance better results in all three aspects of sustainability at all kind of ground and construction works (CEEQUAL, 2014, p. 3).

In CEEQUAL points are divided between different questions, and the questions are divided between nine sections. These sections are; (1) Project strategy, (2) project management, (3) people and communities, (4) land use and landscape, (5) the historic environment, (6) ecology and biodiversity, (7) water environment, (8) physical resources use and management and, (9) transport (CEEQUAL, 2014, p. 11). During a project there is a local assessor who helps to collect data on the questions in CEEQUAL, after the project is completed an external CEEQUAL-appointed verifier will verify the assessment, and finally the result is ratified by CEEQUAL (CEEQUAL, 2014, p. 4).
The idea behind CEEQUAL is that projects should perform higher than the law requirements and the projects are judged by how much better they are compared to the minimum requirements set up by the government (CEEQUAL, 2014, p. 6). The minimum in CEEQUAL is that the project has to be 25% better than the law requirements, if it's 40% better it is considered "good", 60% better is "very good", 75% better is "excellent" (CEEQUAL, 2014, p. 6). There are two different kinds of certifications available; (1) Sustainability strategy & performance assessment, which uses all 9 sections of the manual, and (2) sustainability performance assessment, which only looks at section 2-9 (CEEQUAL, 2014, p. 7). In addition to this, there are also different kinds of certifications depending on which stakeholders partake in the certification; if the designer, the construction crew or client is involved, or a combination of two or three of these (CEEQUAL, 2014, p. 7). CEEQUAL certifies different parts of the project depending on which of the involved stakeholders who want to participate, and for each question there is a matrix showing if the question is relevant depending on which stakeholder is involved in the certification, as some questions might not be possible for certain actors to work with (CEEQUAL, 2014, p. 13).

The weighting of points in CEEQUAL for UK & Ireland has been made considering the specific requirements there, and they have to be adapted in order to use the manual outside of the U.K. (CEEQUAL, 2014, p. 12). In the present manual for Sweden (CEEQUAL, 2013, p. 2-3) it is stated that the weighting of the Swedish manual is the same as for the British manual, but that a weighting exercise for Scandinavia will be conducted in 2013.
In 2016 there were eight CEEQUAL certified projects located in Sweden on the CEEQUAL website (CEEQUAL, 2015a). Most of them are construction works, e.g. traffic intersections and bridges. One of the eight projects is a housing area, Åkvarteren in Lomma (CEEQUAL, 2015b). The project is located on former industrial ground and according to the statement on the website, a big part of the success of Åkvarteren was that they were able to reuse a lot of the excavated material on site, and also preserve old willows on the site (CEEQUAL, 2015b).

Previous studies on CEEQUAL

Green *et. al.* (2014, p. 15) writes that CEEQUAL has a holistic approach to sustainability which includes many planning disciplines and ecosystem services. Despite this, the creation of new ecosystem services is not enhanced in CEEQUAL according to Green *et. al.* (2014, p. 16). Green *et. al.* (2014, p. 22) argue that it is a problem that CEEQUAL provides a framework where the developer can chose which questions to work with. According to Green *et. al.* (2014, p. 22) this makes it uncertain if a CEEQUAL certified project includes a good management of the existing and potential ecosystem services.

Ek and Brinkhoff (2013) have made a thorough research of CEEQUAL and the advantages and disadvantages of using the system for constructions and landscape work in Sweden. One major advantage mentioned by Ek and Brinkhoff (2013, p. 2) is that CEEQUAL will contribute to a more systematic inclusion of sustainability. CEEQUAL can therefore be used to ensure that sustainability is included in all parts of a project and the system can help in finding sustainable solutions for a project (Ek & Brinkhoff, 2013, pp. 13-14).
Using CEEQUAL will also help spread the knowledge of how to work with sustainability, both inside the organization and to others in the field (Ek & Brinkhoff, 2013, p. 14-15). Since it's an international system, it will allow for international comparison of the sustainability of a project (Ek & Brinkhoff, 2013, p. 2). That the system is international is also a problem though; Since CEEQUAL is adapted to British regulations, the high standard of Swedish requirements means that the quality of Swedish project might be so good that the certification in Sweden could get hollowed out (Ek & Brinkhoff, 2013, p. 17). This seems to be a general problem in CEEQUAL. According to Ek & Brinkhoff (2013, p. 18), 67% of all projects rated in 2011 got the highest scoring.
Though Ek and Brinkhoff (2013, p. 16) writes that CEEQUAL has been careful to create a good weighting of the points, they also write that the system does not provide a good measurement of all three parts of sustainability. According to Ek and Brinkhoff (2013, p. 18), CEEQUAL should include more of the social issues, such as the working environment of the construction workers, and a financial part.
A major advantage for the companies using a certification system can be that it is an advertisement - it shows customers that the firm is knowledgeable in sustainability efforts, and is also important in recruitment, where the next generation of employees is looking for companies that are working with "soft values" such as sustainability (Ek & Brinkhoff, 2013, p. 15). In certifications for buildings, certification often leads to a financial advantage. However, the kind of projects that could be certified in CEEQUAL is usually ordered by governmental institutions or municipalities and therefore the demand for certification is not as high as it is in the construction of buildings (Ek & Brinkhoff, 2013, p. 19).
There are also other reasons to use a certification. In a certification the organization has to show proof of the actions taken, which would ensure that environmental demands placed by the client is actually implemented, something which is otherwise often ignored if there is no follow-up (Ek & Brinkhoff, 2013, p. 14).

Finally, there are two important problems brought up by Ek and Brinkhoff, first that it takes a lot of time to get to know the system and to collect the necessary data, and secondly, the assessment is somewhat precarious. The assessment is conducted by an assessor inside the company, and then by an external verifier. Since there are two persons involved, Ek and Brinkhoff (2013, p. 17) argues that the assessment is quite safe, though it will still be somewhat

subjective. However, the verifier will have a short timespan to judge the project afterwards, which means that not all the data is examined by the verifier (Ek & Brinkhoff, 2013, p. 17).

Sustainable Sites Initiative

SITES has never been used in Sweden, and was released in the U.S. in 2014. It is a certification system for sustainable outdoor environments (Delshammar & Falck, 2014, p. 5), and where CEEQUAL doesn't mention ecosystem services at all in its manual, SITES states in their introduction that ecosystem services are at the core of their system (SITES, 2015, p. vii). SITES can be used on projects such as open spaces, streetscapes, commercial areas, residential areas, educational institutions, infrastructure and industrial areas (SITES, 2015, p. xv). SITES focuses on the area from the building skin outwards, though in the cases where a part of a building (e.g. a green roof or wall) is used for SITES credits, the exterior building materials must be included in the rating (SITES, 2015, p. xv).
SITES is distributed by the U.S. Green Building Council (USGBC), and the certification of SITES can be pursued together with another certification from USGBC, such as Leadership in Energy & Environmental Design (LEED) (SITES, 2015, p. xv). SITES v. 1 was released in 2009 and then tested in the field for two years (SITES, 2015, p. viii). The information provided in the field testing was then used to improve the system, and in 2014 version 2 was released (SITES, 2015, p. viii). Of the 160 pilot projects that were registered to test SITES v. 1 only 30 achieved the certification (Steiner, 2014, p. 306). Even though some international projects registered, only U.S. projects have been certified so far. The SITES developers claim that the program can be used abroad, though international project teams has to find comparable resources in the cases where SITES references are specific to the U.S. (SITES, 2015, p. xv).
The rating consists of 18 prerequisites and 48 different credits with 200 points distributed between the credits (SITES, 2015, p. xvi). The prerequisites and credits are organized in 10 sections that follows a design and construction phase, as follows; (1) Site context, (2) pre-design assessment and planning, (3) site design: water, (4) site design: soil and vegetation, (5) site design: materials selection, (6) site design: human health and well-being, (7) construction, (8) operations and maintenance, (9) education and performance monitoring, and (10) innovation or exemplary performance (SITES, 2014, p. xvi-xx).
The certification has four levels depending on how many points the project gets; "certified" for 70 points, "silver" for 85 points, "gold" for 100 points and "platinum" for 135 points (SITES, 2014, p. xxv). According to the SITES manual, the weighting of the points is based on the potential of a certain credit to meet the goals of SITES (SITES, 2015, p. xiii). These goals are; (1) Create regenerative systems and foster resiliency, (2) ensure future resource supply and mitigate climate change, (3) transform the market through design, development, and maintenance practices, and (4) enhance human well-being and strengthen community (SITES, 2015, p. xiii).

47 projects are certified according to the SITES website (SITES, 2016) and include projects such as universities, company headquarters, parks, plazas and private residences.
Despite SITES being a new system it already appears to have gained recognition among landscape architects in the U.S. According to one article in the Dirt, 80% of respondents in a Green Business Certifications Inc. (GBCI) survey say they plan to implement SITES in their organization (The Dirt contributor, 2016). In the 2016 facilities standards for the public buildings services document, the U.S. General Services Administration (GSA) has included the guidelines of SITES (Gabriel, 2016). This document contains the design standards for new buildings,

infrastructure projects, alterations and work in historical structures conducted by the Public Buildings Service, which is one of the largest public real estate organizations in the world (Gabriel, 2016). GSA has stated that SITES offers a highly effective and efficient way to enhance environmental performance (Gabriel, 2016). According to Green (2013) many landscape architects had hoped for this inclusion of SITES in the GSA documents, as this might mean that SITES is becoming mainstream, and that the landscape materials industry will provide more sustainable options (Green, 2013).

Previous studies on SITES

There is still a lack of independent research on SITES and the results of using the certification. In their own text SITES states that benefits of using SITES is that it will; (1) Advance the best practices in landscape architecture, (2) help professionals in the area of design to fulfill their health, safety and welfare responsibilities, (3) assure the clients that their project is sustainable, (4) make it possible for clients to market the certification, and (5) contribute to protecting natural systems and preserving ecosystem services for future generation (SITES, 2014, p. vii).
Steiner (2014, p. 306) writes that SITES will provide a good complement to certifications for buildings, such as LEED, and provide a focus on the benefits of ecosystems (Steiner, 2014, p. 306). Steiner does not evaluate the system further, he only proposes questions which would need to be examined further; e.g. *how are ecosystem services advanced through rating systems such as SITES and LEED?*, *how can SITES be adapted in other nations?*, and *how might case studies about SITES pilot projects, and eventually SITES certified projects, advance our understanding of ecosystem services?* (Steiner, 2014, p. 306).

In the Dirt, an online newspaper by American Society of Landscape Architects (ASLA), an article with interviews with landscape architects and developers on the experiences of using SITES is presented (Green, 2013). It is worth noting that ASLA is one of the founders of SITES and therefore not an independent source.
In the article the overall reason for clients to certify a project appears to be that the client has a goal concerning sustainability, either social (e.g. to improve health in the area), environmental (e.g. to create a sustainable water front) or economic (e.g. to reduce maintenance) (Green, 2013).
One of the landscape architects who has certified a project using SITES, Signe Nielsen, says to the Dirt that in her project, which was located in an urban brownfield site, there were three categories of SITES they were not able to get points for and they could therefore only achieve two stars (Green, 2013). As a response to this, Jose Alminana, landscape architect and according to the article “one of the guiding forces behind SITES”, said that the point of SITES is not to achieve a high score and that that should not be the main focus when using SITES (Green, 2013).
Nielsen also mentions that SITES was a useful tool because it provides a new way for landscape architects to determine how much they have reduced noise, saved water, and reused materials, and that SITES therefore provides a good framework for accountability (Green, 2013). According to Nielsen, the metrics are crucial since it helped the clients to understand the value of the work done by the landscape architects (Green, 2013).

Ecosystem services indicators in Biotope Area Factor

Since the BAF of Årstafältet is divided into functions, it was easy to see what each credit is meant to rate, and divide the credits depending on the ecosystem service.

All points in BAF are given per square meter and will be divided by the total area of the lot. Shrubs are counted per m^2 that they occupy, solitary bushes are counted as 4 m^2 (Stockholms Stad, 2012, p. 19). Each tree is counted as 25 m^2, but is only counted if they are planted in a soil deeper than 800 mm. (Stockholms Stad, 2012, p. 19). For elements, such as birdhouses, each element is counted as 5 m^2. (Stockholms Stad, 2012, p. 22). Water elements, such as fountains, are counted as 25 m^2 (Stockholm Stad, 2012, o. 26).

Food production

For this service, the factors will be found under the additional credits given for recreational values. The relevant credits are the following:

1. Cultivation areas - 0.5 points for areas on ground level that are dedicated to cultivation (Stockholms Stad, 2012, p. 21).
2. Balconies, patios and greenhouses prepared for cultivation - 0.5 points for the area which is possible to cultivate (Stockholms Stad, 2012, p. 21).
3. Bushes with edible berries - 0.2 points (Stockholms Stad, 2012, p. 22).
4. Trees with edible fruits - 0.2 points for trees that are older than 6 years when planted (Stockholms Stad, 2012, p. 22).

Aesthetic values

In BAF the features mentioned as important for aesthetic values are:

1. Visible green roofs - 0.05 points for green roofs placed in a way that they are visible from the surroundings, and/or on buildings at the lot where people dwell (Stockholms Stad, 2012, p. 21).
2. Floral splendor - 0.2 points for plantings with perennials, herbs, or bulbs (Stockholms Stad, 2012, p. 22).
3. Shrubs with experiential values - 0.1 point for shrubs or hedges that contribute to the creation of rooms, or to the experience of the seasons or similar (Stockholms Stad, 2012, p. 22).
4. Shrubs with edible berries and fruits - 1.0 points. Shrubs with edible berries are mentioned twice, both as food source and due to their high experiential values, therefore I will count them both under food production and as an aesthetic aspect (Stockholms Stad, 2012, p. 22).
5. Trees with experiential values - 0.5 for trees that are very important to the character of the residential yard (Stockholms Stad, 2012, p. 22).
6. Fruit trees and flowering trees - 1.0 for fruit trees older than 6 years when planted, and for other flowering trees with a trunk width of more than 20 cm (Stockholms Stad, 2012, p. 22).
7. Pergolas - 0.3 points per m^2 of pergola. This is counted since pergolas contribute to the creation of rooms (Stockholms Stad, 2012, p. 22).

8. Birdhouses - 0.2 points, since the view of birds contribute to the experience of the yard (Stockholms Stad, 2012, p. 22)
9. Open water - 1.0 points, since they have high visual values (Stockholms Stad, 2012, p. 26).
10. Biologically accessible waters, experiential values - 1.0 points. This is due to the visual values of the animals which can be attracted to this environment (Stockholms Stad, 2012, p. 26). To receive this point, the water has to be accessible for animals, but not provide a risk for small children (Stockholms Stad, 2012, p. 26).
11. Fountains, circulation structures and water constructions that create water sounds - 0.3, counted as 25 m^2 for each fountain or circulation structure. This will contribute to the attractiveness of the yard (Stockholms Stad, 2012, p. 26).
12. Common roof terraces - 0.2 points, but only if there are at least 50 m^2 green roofs with more than 300 mm soil depth (Stockholms Stad, 2012, p. 21).
13. Greenspace facing the street - 3.0 points (Stockholms Stad, 2012, p. 22)
14. Trees facing the street - 2.0 points (Stockholms Stad, 2012, p. 19)

Habitat for animals

For this ecosystem service, I will look for biodiversity credits that are meant to enhance the animal habitats of the yard, they are:

1. Diversity in the groundcover - 0.7 points for a groundcover with a high diversity in plant species (Stockholms Stad, 2012, p. 18).
2. Native plants selection - 0.5 points for areas with at least 50% of the plants from the local, historical nature and cultural landscape. Native plants should be chosen over exotic plant material since it is better for the local fauna, according to Stockholms Stad (2012, p. 18).
3. Diversity on green sedum roofs - 0.1. (Stockholms Stad, 2012, p. 18).
4. Butterfly restaurants (Fjärilsrestauranger) - 1.0 point for plantings with herbal plants meant to attract butterflies, e.g. herbs or flowers with a lot of nectar (Stockholms Stad, 2012, p. 18).
5. Shrubs with berries - 0.4 for shrubs with berries that are appreciated by birds (Stockholms Stad, 2012, p. 19).
6. Trees with berries - 0.4 for trees with berries that are appreciated by birds (Stockholms Stad, 2012, p. 19).
7. Houses for birds and more - 0.5 for houses for different kinds of bird species (Stockholms Stad, 2012, p. 20).
8. Biologically accessible permanent water - 4.0 for water which is present at least 6 months of the year (Stockholms Stad, 2012, p. 25).
9. Moist areas with temporary water - 2.0 for areas which hold water during part of the year, up to 6 months. Counted as the largest area under water at some point during the year (Stockholms Stad, 2012, p. 25).

Air filtering in vegetation

In BAF there is a special system for counting shrubs and trees, and since these are stated as the most important for filtering air pollutants, I will focus on this system. They are;

1. Shrubs general - 0.2 for all shrubs (Stockholms Stad, 2012, p. 19)
2. Big trees - 2.4 for trees with a trunk larger than 30 cm (Stockholms Stad, 2012, p. 19).
3. Mid-size trees - 1.5 for trees with a trunk of 20-30 cm (Stockholms Stad, 2012, p. 19).
4. Small trees - 1.0 for trees with a trunk of 16-20 cm (Stockholms Stad, 2012, p. 19).
5. Vegetation on walls - 0.5 points. Counted for that part of the wall and for the height the vegetation can be expected to reach within 5 years, up to a maximum of 10 meters (Stockholms Stad, 2012, p. 17).

Stormwater management

For this ecosystem service I will examine the credits for measuring permeability of the ground/roofs, and points given for stormwater features.

Permeability of ground:

1. Vegetation on ground, no substructure - 2.0 points (Stockholms Stad, 2012, p. 16).
2. The depth of the plant bed is more than 800 mm, but has a substructure – 1.5 points (Stockholms Stad, 2012, p. 16).
3. The depth of the plant bed is 200-800 mm - 0.2 points (Stockholms Stad, 2012, p. 16).
4. Green roof, more than 300 mm thick plant bed - 0.4 points (Stockholms Stad, 2012, p. 17).
5. Green roof 50-30 mm thick plant bed - 0.1 points (Stockholms Stad, 2012, p. 17).
6. Integrated plantings on balconies - 0.3 points for plant beds on balconies, terraces and patios with a depth of more than 300 mm (Stockholms Stad, 2012, p. 17).
7. Water surfaces -1.0 point - for water which is there even in dry periods (Stockholms Stad, 2012, p. 24).
8. Hardscape with permeability - 0.3 points. E.g. reinforced grass (Stockholms Stad, 2012, p. 24).
9. Hardscape with some permeability - 0.2 points. E.g. permeable asphalt, gravel, sand, and similar (Stockholms Stad, 2012, p. 24).
10. Hardscape with joints - 0.05 points. E.g. slabs and cobblestone surfaces, also fake grass and rubber asphalt (Stockholms Stad, 2012, p. 24).
11. Impermeable surfaces - 0.0 points. Roofs, asphalt, concrete without any possibility to create biotopes or allow any stormwater to percolate (Stockholms Stad, 2012, p. 24).
12. Moist areas with temporary water - 2.0 for areas which are holding water during part of the year, up to 6 months. Counted for the area which is under water at some point during the year (Stockholms Stad, 2012, p. 25).
13. Retention of stormwater from impermeable surfaces and hardscape with joints in surface waters and moist areas - 0.2 points for the impermeable surface area, if the stormwater feature can retain at least 20 liters per m^2 of dewatered surface (Stockholms Stad, 2012, p. 25).
14. Retention of stormwater from impermeable surfaces and hardscape with joints in underground magazines - 0.1 point for the impermeable surface area, if the stormwater feature can retain at least 20 liters per m^2 of dewatered surface (Stockholms Stad, 2012, p. 25).
15. Impermeable surfaces and hardscape with joints which drains into surrounding vegetation - 0.1 point for the impermeable surface area, but limited to a maximum of the

total area of the vegetation surface area into which the stormwater is directed (Stockholms Stad, 2012, p. 25).

Ecosystem services indicators in CEEQUAL

In CEEQUAL there are a lot of interesting questions, which touch upon the subjects I want to examine, but the point is missed slightly. I have chosen the most relevant questions.

Food production

No questions in CEEQUAL concerns food production.

Aesthetic value

There first question in the CEEQUAL manual that concerns the aesthetics of a project is question 3.7.4: Enhancement beyond functional requirements (Förbättring utöver funktionella krav) (CEEQUAL, 2013, p. 52); Are there proof that the stakeholders involved has improved the design of the project and made it more aesthetically pleasing for the users, or has added facilities which favors the user besides the functional demands of the site - and that these goals has been realized in the production? (CEEQUAL, 2013, p. 52).
For this question the stakeholders can get a total of 20 points; 6 for the client, 10 for design and 4 for production. In the CEEQUAL manual proof can be drawings, specifications and other documents that proves functions has been included which will benefit the users (CEEQUAL, 2013, p. 52). In this case CEEQUAL is clearly directed towards construction work, as the examples include things such as building an outlook at a road project (CEEQUAL, 2013, p. 52). However there is also the example of how the details are executed, if all technical solutions are well designed and integrated and if the pedestrian streets are well adapted to the environment (CEEQUAL, 2013, p. 52). These examples are relevant for the residential yards, and I will look at the materials and the constructions to see if they have been carried out in a way that advances the design. I will also look at how functional the yards are for the users.
CEEQUAL recognizes that this question is a subjective one (CEEQUAL, 2013, p. 51). My assessment of this question will therefore also be based on a personal assessment.

The question of aesthetics is also included in question 4.4.1 Landscape and visual elements (Landskap och visuella faktorer) (CEEQUAL, 2013, p. 68). The question is; are there proof that questions concerning landscape and visual elements have been considered by a qualified landscape expert in each phase of the project? (CEEQUAL, 2013, p. 68). The question gives 19 points if the plans are made by a landscape professional, and an additional 12 points if they are carried out, giving a total of 31 points (CEEQUAL, 2013, p. 68).
As the focus of this thesis is on the outdoor environment this question is important to answer. In the building permit I will look for evidence that landscape architects have been involved in the design of the yard. In the cases where there is no evidence on the building permit plans I will make subjective assessment of the outdoor environment to determine whether the design and the plantings have been designed by a professional. If there is proof that a landscape architect has done the original design but the design has not been fully carried out, I will give the project 19 points.

The third question concerning the aesthetic value is 4.4.2 Local landscape character (Lokal landskapskaraktär) (CEEQUAL, 2013, p. 69). The question is: are there proof that the design of the project has been adapted to the local landscape character in six areas; (1) The shape and level of the ground, (2) material, (3) plantings, (4) style and details, (5) scale, (6) landscape or city pattern (CEEQUAL, 2013, p. 69). For each question that is answered yes, the project receives four points, which can give a total of 24 points. In the manual is stated that using Swedish plant material, or the same plants as the neighbor is not enough, the planting should reflect a genuine local landscape biotope or structure, and also that the plants are chosen in respect to the soil (CEEQUAL, 2013, p. 69).
In order to examine this question the local landscape and city character needs to be defined. Though the areas Flagghusen, Fullriggaren and Kappseglaren have their own size and pattern, the design of the yards should also speak to the size and patterns of Bo01, the first neighborhood of Västra Hamnen. As for the landscape character, plantings should have their inspiration from the local Scanian landscapes. The material should speak to the local materials used in Malmö as a whole.

Habitat for animals

There are three questions that mention habitats for animals.
The first question is question 6.4.1 New wildlife habitats (Nya livsmiljöer för djur och växter) (CEEQUAL, 2013, p. 93). The question is; have recommendations or possibilities to create new habitats for plants and animals been identified by relevant specialist and been incorporated into the project? (CEEQUAL, 2013, p. 93). The rating in CEEQUAL is the following: If there is a plan - 4p, if the plan includes very threatened species or habitats - 4 p, if these plans are incorporated into project - 7p, and if they are then built - 7p (CEEQUAL, 2013, p. 93). In my examination of the residential yards I will focus on what I can see on site, therefore I will look for habitats that are built, and if they exist I will give the project the full 22 points.

The second question concerning habitat for animals is question 6.4.2 Special structures or facilities for wildlife (Särskilda strukturer eller anläggningar för vilda djur och växter) (CEEQUAL, 2013, p. 93). The question is: have there been recommendations to include artificial nesting boxes, chambers for birds, green bridges or wildlife tunnels? (CEEQUAL, 2013, p. 93). If there was plans - 7p, built - 14 p. According to the directions these features should be placed in accordance to recommendations by an ecologist or someone with similar competence (CEEQUAL, 2013, p. 93). I will not be able to assess whether the features are placed in accordance to recommendation by an ecologist, I will only assess whether nests and other features for wildlife are present in the site.

The third question concerning habitats for animals is question 6.4.3 Improvement of areas/features with high values (Nettoökning av område/företeelser med stort värde (CEEQUAL, 2013, p. 94). The question examines if there has been an improvement of the ecologically valuable surface on the site (CEEQUAL, 2013, p. 94). Points are given after how much the area is improved; 5-25% - 5 points, 25-50% - 10 points, 50-75% - 15 points, more than 75% - 21 points (CEEQUAL, 2013, p. 94). I will therefore calculate the percentage of the lot area that is covered in vegetation. I will not assess if the vegetation is ecologically valuable.

Air filtering in vegetation

There are many questions in the manual concerning the reduction of pollution from the construction work itself, but few questions concerning how to create vegetation for reduction of pollutants in the future design of the site. Though question 6.4.3 includes points for increasing the vegetation of the site, that question is aimed at creating habitat, and not aimed at the air filtering capacity of vegetation.

Stormwater management

There are two questions which focus on this ecosystem service. Question 7.3.3 b Sustainable drainage systems (Hållbar dagvattenhantering) (CEEQUAL, 2013, p. 100) is; are there proof that sustainable drainage systems have been put into place in the project where it is deemed appropriate? (CEEQUAL, 2013, p. 100). This question will give a total of 22 points. As examples of sustainable drainage systems, they name ponds, moist beds, green roofs and vegetation beds for collecting stormwater (CEEQUAL, 2013, p. 100). In the design of these amenities, CEEQUAL refer to the SuDS Manual (Woods Ballard *et. al.*, 2015). This is the manual I will use to see if a stormwater feature has been designed in the correct way. There is no part of this question that specifies a minimum amount of size of the stormwater feature; therefore I will give this point if there are one or more sustainable drainage systems on the site.

Question 7.3.4 Managing run-off at source (Hantering av avrinning vid källan) (CEEQUAL, 2013, p. 101) is also very relevant. The question reads as follows; how big percentage of the total stormwater surface run-off from the project is treated at the source through infiltration? Up to 30% -8 p, up to 60% - 16 p, up to 90 % - 24 p, more than 90% - 32p of the stormwater is treated. This will be difficult to assess in a site examination, but I will make an estimation based on permeability of the ground and an estimation of run-off direction and destination.

Ecosystem services indicators in Sustainable Sites Initiative

In the SITES manual vegetated area is defined as all portions of the sites that will support vegetation (SITES, 2015, p. xxv).
In SITES each credit states the intent of the credit and it is therefore easy to see which credits are intended to measure which ecosystem service.

Food production

There is a prerequisite which demands a limitation of development on farmland: P1.1 Limit development on farmland (SITES, 2015, p. 3). All the residential yards in the Western Harbor are all located on old industrial land, and will therefore pass this requirement.

Besides the prerequisite, SITES also rates the presence of food production at the site. This is done in: Human Health + Well-being credit 6.7: Provide on-site food production - 3-4points (SITES, 2015, p. 206). In order to achieve 3 points there has to be on-site food production including vegetable gardens, edible nut or fruit-bearing plants (SITES, 2015, p. 206). To achieve this at least 10% of the sites final vegetated area has to be dedicated to food production (SITES, 2015, p. 206). In order to achieve this credit, there also has to be a maintenance plan

which includes detailed practices for food-production (SITES, 2015, p. 206). I will not be able to examine the presence of a maintenance plan, but will look for areas which devoted to food production.
To achieve 4 points, the first requirements have to be fulfilled. There also has to be a way to distribute or sell food produced to site users and the community, e.g. farmers' market, restaurants, schools, or community supported agriculture (SITES, 2015, p. 206).

Aesthetic value

In section 6, Site Design - Human Health + Well Being, SITES addresses credits which are aimed at creating sites which are equitable, restorative and supports social interactions (SITES, 2015, p. 186). Of the credits for human health and well-being, the one which gives design specifications that will promote a more aesthetic outdoor design is Human Health + Well-Being Credit 6.4: Support mental restoration (SITES, 2015, p. 198). This credit will give 2 points if five requirements meant to provide restorative and aesthetic experiences are included in the design (SITES, 2015, p. 198). The site has to provide; (1) Seating for 5% of total site users, (2) visual and physical access to vegetation, (3) elements that reduce noise and mitigate negative distractions, (4) elements that address microclimate and other site-specific conditions (e.g., sun, shade, wind), (5) unobstructed views of vegetation from 50% of common spaces (examples provided include office spaces, living areas, dining rooms) (SITES, 2015, p. 198). The site user is defined as someone who will occupy, work at or pass through the site (2015, p. 199).
I will make an estimation of the total amount of residents and see if the seating in the yard provide enough space for 5% of them. I will also make an estimation to see if 50% of rooms have views from which vegetation is visible. I will look for elements such as hedges and pergolas which creates spaces protected from wind and sun.

Habitat for animals

There are several prerequisites which won't be relevant for my research, but would potentially be important in other projects, such as: P1.3 Conserve aquatic ecosystems, P1.4 Conserve habitats for threatened and endangered species, and P5.1 Eliminate the use of wood from threatened tree species.

There are two credits intended to provide good habitats for wild animals. One enhances the use of native plants, and the other the restoration of native plant communities. These two credits are based on the native plants calculator, which is not made available until project is registered (SITES, 2015, p. xxvi). It does say that "native plant calculations are measured by surface area of final vegetated area, using estimated vegetated cover within 10 years of installation" (SITES, 2015, p. 121). I will therefore make a calculation of what proportion of the vegetated area that consists of native plants.

Credit 4.6: Conserve and use native plants: 3-6 points (SITES, 2015, p. 121). This will give a credit depending on the native plant score. The credit given is: 20% total native plant score - 3 points, 40% total native plant score - 4 points, 60% total native plant score - 6 points (SITES, 2015, p. 121).

The second is credit 4.7 Conserve and restore native plant communities (4-6 points) (SITES, 2015, p. 126). The goal of this credit is to "contribute to regional diversity of flora and provide habitat for native wildlife by conserving existing native plant communities and installing vegetation that contributes to plant communities native to the ecoregion" (SITES, 2015, p. 126). The calculation is similar to credit 4.6, but instead of calculating the individual plant, this calculates plant communities and is determined using the native plant communities calculator (SITES, 2015, p. 126). The score is similar; 20% total native plant community score - 4 points, 40% total native plant community score - 5 points, and 60% total native plant community score - 6 points (SITES, 2015, p. 126). The calculations should be made by surface area of vegetated area, using estimated cover within 10 years of installation (SITES, 2015, p. 126). Each area has to be contiguous and have a minimum of 185.81 m^2 (SITES, 2015, p. 126). Similar to credit 4.6 I will make an estimation of how much of the vegetation that consists of native plant communities.

Air filtering in vegetation

The amount of vegetation is rated in credit 4.8: Optimize biomass, 1-6 points (SITES, 2015, p. 129). The intent of this credit is to support the water, nutrient, atmospheric gas, and climate regulation ecosystem provided by vegetation (SITES, 2015, p. 129). The project has to conserve and/or restore the vegetation biomass to a level appropriate to the site's region. The project will also get a score depending on the vegetation of the area, which is measured in Biomass Density Index (BDI) (SITES b, 2015, p. 130-131). This is similar to BAF in that it gives each surface a rating which is then divided by the total area of the lot, however it differs from BAF in that the BDI of the site before construction is compared to the site design 10 years after construction, and the difference between these values is what provides the final score (SITES, 2015, p. 129). This score also varies depending on the terrestrial biome of the site (SITES, 2015, p. 131).

The score provided for each area is as follows (SITES, 2015, p. 130):

1. Trees with understory - 6 points.
2. Trees without understory - 4 points.
3. Shrubs - 3 points.
4. Perennials - 2 points.
5. Desert plants - 1.5 points.
6. Annual plantings - 1.5 points.
7. Managed turf, more than three inches - 3 points.
8. Managed turf, less than three inches - 2 points.
9. Unmanaged grass layer, more than nine inches - 2 points.
10. Unmanaged grass layer, less than nine inches - 1.5 points.
11. Wetland (not open water) - 6 points.
12. Impervious cover, removed invasive plant, bare ground not shaded by vegetation or vegetated structure - 0 points.
13. Additional points for other vertical or horizontal surfaces, e.g. green walls, trellises, pergolas - 1 point.

As mentioned, the final BDI depends on the terrestrial biome. The 4 terrestrial biomes to choose from are, (1) temperate broadleaf/mixed/conifer forests, (2) tropical and subtropical

coniferous/dry broadleaf forests, (3) deserts, and (4) Mediterranean forests, woodlands and scrubs/temperate grasslands, savannas and shrublands/ boreal forests and taiga/tropical and subtropical grasslands, savannas and shrublands/flooded grasslands and savannas. (SITES, 2015, p. 131-132)
Malmö is located in the biome “temperate broadleaf/mixed/conifer forests”. This will give the following score, measured as the increase in BDI after construction, compared to the BDI before construction: Same = 1 point, 1 more point = 3 points, 2 more points = 5 points and, more than 4 more points = 6 points. (SITES b, 2015, p. 131)

Stormwater management

In SITES it is a prerequisite to manage the precipitation on site: P3.1 Manage precipitation on site (SITES, 2015, p. 67). This will be the first thing I have to examine. In SITES the site has to retain the precipitation volume of the 60th percentile precipitation event, this is defined by the U.S. EPA and is not applicable in Sweden. I will also not be able to conduct the examinations needed to calculate the amount of water that is retained on site. In my site visits I will therefore make estimations of the direction and destination of the run-off and if the run-off is discharged into drains or is retained on the site.

Besides the prerequisite there is also a credit for designing stormwater features as amenities; credit 3.5 Design functional stormwater features as amenities: 4-5points (SITES, 2015, p. 89). If at least 50% of stormwater features are treated as amenities the project receive 4 points, if all of them are treated as amenities the project receive 5 points (SITES, 2015, p. 89). Stormwater features that use precipitation as their sole source of water and that function as stormwater management elements (e.g. bioswales, raingardens and vegetated roofs), must be visually and physically accessible to site users from high-use portions of the site (SITES, 2015, p. 89).
To assess this I will have to make a subjective judgement, but SITES do provide some strategies that give a feel for what they consider to be stormwater features that are also amenities. These are e.g. to design water features as natural ecosystems, to have rainwater systems which are functional and aesthetically pleasing, and to use site design techniques which mimic natural infiltration-based hydrology (SITES, 2015, p. 90).

4. INTRODUCTION TO CASE STUDIES

Ecological sustainability in Västra Hamnen

Malmö is the third largest city in Sweden and according to Anderson (2014, p. 11) Malmö has one of the most ambitious programs for sustainable planning and development in Sweden. Västra Hamnen (Western Harbor) was the first big sustainability project in Malmö, and is undergoing a transformation from being an old harbor and industrial area to being an area for knowledge and sustainable living (Malmö stad, *n.d.*a). At present, mainly the eastern and western parts of Västra Hamnen are exploited, but it is projected that the area will entail 11,000 homes, three schools and 17,000 jobs (Malmö stad, *n.d.*a).
Since the start of the Västra Hamnen development, Malmö has received several international awards and honors, such as Livable Communities Award in 2007, Urban Best Practice Expo award in Shanghai 2010, World Habitat Award 2010 and Earth Hour Capital award 2011 (Anderberg, 2015, p. 222). According to Anderson (2014, p. 15) Malmö has become “synonymous with innovation, creativity, resident participation and sustainability”.

The development of Västra Hamnen started with a housing expo, Bo01 - City of Tomorrow, which was designed to be a leading example of sustainable urban development (Anderberg, 2015, p. 216). One of the central challenges that faced the planners was how to create a modern, compact city that would still provide space for biodiversity and water (Anderberg, 2015, p. 220). In order to create green and blue infrastructure, the Biotope Area Factor was used (Anderberg, 2015, p. 220). Even though the result from using BAF in Bo01 has been questioned (Delshammar o Flack, 2014, p. 16), the City of Malmö considered the results overall positive and the tool has been developed and used in later development projects in Malmö (Malmö stad, *n.d.*b).
After the housing expo the development of Västra Hamnen continued in the northern parts of the area, here three residential areas are being built, surrounding the new park Varvsparken. These newer areas have been the focus of this thesis. The areas are Flagghusen 2004-2008, Fullriggaren 2009-2013 and Kappseglaren 2011-2016 (Anderberg, 2015, p. 225). Even though the areas have been heavily influenced by the sustainability concept deployed in Bo01, they are regular development projects and have therefore had a considerably smaller budget than Bo01 (Anderberg, 2015, p. 225). Bo01 had a quarter of a billion SEK in governmental grants (Dalman *et. al.*, 2010, p. 10), differentiating it from the newer development projects. In order to create a sustainable area on a small budget the City of Malmö therefore had to work with different methods.
As Västra Hamnen is still under development, and in the continued work here the municipalities need to address the new law requirement, it is relevant to examine how sustainable the residential yards here are, and if there are other tools to ensure a more sustainable outcome in future development in Västra Hamnen

Figure 3. Bo01 area to the left, Flagghusen to the right, Johanna Spjuth, 2013.

Flagghusen

Flagghusen was the first area to be developed after Bo01. The goal of this area was to make sustainability mainstream and prove that it is possible to build sustainable housing at a reasonable cost (Institutionen för hållbar stadsutveckling *et. al.*, *n.d*, p. 1). In order to achieve this, the City of Malmö started *Det goda samtalet* (the good conversation) together with developers and engaged citizens (Dalman *et. al.*, 2010, p. 6). This dialogue resulted in a program that focused on four aspects of sustainability; (1) High architectural quality, (2) social sustainability, (3) financial sustainability, and (4) ecological sustainability (Dalman *et. al.*, 2010, p. 6). Ecological sustainability was divided into different areas, where high biodiversity and local stormwater management was one part (Dalman *et. al.*, 2010, p. 6). A program was developed in order to achieve a high biodiversity which was based on the BAF used in Bo01, but had a stronger focus on biodiversity (Institutionen för hållbar stadsutveckling *et. al.*, *n.d*, p. 1). The idea was to promote yards with rich vegetation that provided housing and food for animals, as well as recreational values for humans (Institutionen för hållbar stadsutveckling *et. al.*, *n.d*, p. 1). In order to achieve this, at least one biotope had to be included in each yard, each yard also had to include three kinds of nests, and trees and shrubs to provide fruit or nectar (Institutionen för hållbar stadsutveckling *et. al.*, *n.d*, p. 2).

According to Dalman *et. al.* (2010, p. 9) the stakeholders were happy with the results of using *Det goda samtalet*. One of the developers, Olle Berglind from Tornahem, conclude the results by saying “jämför man med allt annat än Bo01 tycker jag att Flagghusen är ett område som håller mycket hög kvalitet.” (If one compares with anything besides Bo01, I consider Flagghusen to be an area of very high quality), as quoted in Dalman *et. al.* (2010, p. 9). This quote reflects some of the disappointment with the results in Flagghusen, something that was also expressed by a jury set out by Institutionen för hållbar stadsutveckling, the City of Malmö and Malmö College University in order to assess the biodiversity of the yards in Flagghusen. The jury writes in their report that they found few yards with anything close to a biotope, and very few nests (Institutionen för hållbar stadsutveckling *et al*, *n.d*, p. 2). According to the jury, none of the yards fulfill the demands that were set up in *Det goda samtalet* (Institutionen för hållbar stadsutveckling *et al*, *n.d*, p. 2).

One of the problems in Flagghusen, is that the required BAF was set lower in Flagghusen than in Bo01, and this meant that some developers have been able to build yards with a lot of hardscape and no trees and still fulfilled the BAF by adding green roofs (Institutionen för hållbar stadsutveckling *et al*, *n.d*, p. 4). Another problem noted by the jury was that many of the building permit drawings do not match the reality; biotopes, big trees and nests that are visible in the

drawings are missing in reality (Institutionen för hållbar stadsutveckling *et al*, *n.d*, p. 4). A third problem noted by the jury was that plants had been planted in the wrong situation, which the jury writes shows that the plans have not been created by professionals (Institutionen för hållbar stadsutveckling *et al*, *n.d*, p. 4).
As a conclusion the jury writes “Flagghusen har inget på något sätt uppseendeväckande eller ens intressant grönt hållbarhetskoncept att inspireras av” (Flagghusen has no sensational or even interesting green sustainability concept to be inspired by) (Institutionen för hållbar stadsutveckling *et al*, *n.d*, p. 5). They finish up by saying that it will be interesting to see what can be changed for the next development area (Institutionen för hållbar stadsutveckling *et al*, *n.d*, p. 5).

Fullriggaren

Det goda samtalet was developed in the next area, Fullriggaren, into Miljöbyggprogram Syd (MBP SYD). This program is described in further extent in Chapter 3 - Certification Systems.
According to Anderberg (2015, p. 226) the use of MBP SYD in Fullriggaren and the next area Kappseglaren, led to these areas containing many examples of leading sustainable buildings, such as one of the first carbon-neutral apartment buildings and Sweden's largest collection of passive and low-energy houses. However, as with Flagghusen, there were some problems in the outdoor environment. An examination of the greenspace in Fullriggaren, conducted by Miljöförvaltningen (2014, p. 5), show that only one project in Fullriggaren has achieved the promised BAF. The report states several possible reasons for this; e.g. conscious choices by developers to not include elements such as fountains and nests, changes from permeable surfaces to impermeable and, to plant less vegetation than in the building permit documents (Miljöförvaltningen, 2014, p. 5).
Despite these disappointments, the report concludes that the yards of Fullriggaren are leading examples of sustainable urban development, and that there is a large amount of vegetation, local stormwater management and possibilities for biodiversity (Miljöförvaltningen, 2014, p. 7). The report states that the use of MBP SYD has enhanced the creation of good urban spaces for plants, animals and humans (Miljöförvaltningen, 2014, p. 7).

Kappseglaren

Kappseglaren is only partially realized, and few courtyards have been finished in spring 2016. Two of the courtyards that have been finalized have been part of the BiodiverCity project. BiodiverCity is a project in which stakeholders from municipalities, the region, universities, research institutes, developers, consultants and entrepreneurs are working together to design and test green solutions in the urban environment (BiodiverCity, *n.d.,* p. 1). The goal is to find ways to increase biodiversity, improve the potential for urban ecosystem services and to use the urban greenery to improve the wellbeing of the citizens (BiodiverCity, *n.d.,* p. 1). The work was conducted through cases, in six different focus areas; (1) Green roofs, (2) green walls, (3) mobile vegetation systems, (4) urban biotopes, (5) three-dimensional vegetation and, (5) street trees (BiodiverCity, *n.d.,* p. 1). Some of these cases are located in Kappseglaren, among them two of the yards in this study.

Selection of case studies for this study

For the case studies in this thesis, the objects need to have good documentation, and preferably previous evaluation. The residential yards of Västra Hamnen used different kinds of BAF, which means that the building permit document contain a lot of information about the outdoor environment. Västra Hamnen has also gotten attention from researchers and examinations have been made concerning the sustainability of the outdoor environment. This will provide the background information I need in order to select my case studies. Västra Hamnen also provides many similar projects to compare. Though the study could have been conducted in other areas, one prerequisite was that the sites had to be accessible for site visits, the location in Southern Sweden and the openness of the yards were therefore important factors.

I will apply parts of the three rating systems on six residential yards to examine how well they rate ecosystem services. Half of the case studies have been selected because of the excellent work of including ecosystem services in their designs, and half of them for failing to do so. This will allow me to see if the rating systems are able to distinguish between designs that include ecosystem services, and those that do not. The residential yards are all located in Västra Hamnen, and have been selected based on the results provided in studies conducted on the area (Institutionen för hållbar stadsutveckling *et al*, *n.d.*; Miljöförvaltningen, 2014; BiodiverCity, *n.d.*), in discussion with Annika Kruuse from Malmö municipality, and site visits. The result of this is compiled in Appendix 1.

In the site visits I conducted an evaluation of the ecosystem services in each yard. In order to examine if the case studies included ecosystem services, the indicators that were found in Chapter 2 for each ecosystem service has been used.
For food production the indicators are trees and shrubs with edible berries and fruit and, areas for agriculture.
For aesthetic value the indicators are features that elevate the experience of the outdoor environment, e.g. borders, seating, space creating elements, decorative plants and water features.
For habitat services the indicators are habitats, biotopes and nests. Fruit and berries can also be important in some cases.
For air filtering in vegetation the indicators are a high amount of vegetation in general and, big trees and shrubs.
For stormwater management the indicators are permeable ground material, green roofs and, green and blue stormwater management features.

My case studies include the following three examples where ecosystems and their services have been allowed to dominate the design:

- Klippern 3 - Kappseglaren
- Koggen 1 - Kappseglaren
- Kommendörkaptenen 3 - Flagghusen

The following three are case studies where ecosystem services have not had a big impact on the design, and instead hardscape or short-cut turf dominates the yards:

- Briggen 4 - Fullriggaren
- Flaggskepparen 1 - Flagghusen
- Kommendörkaptenen 10 - Flagghusen

Briggen 4

In a study of the biodiversity of the yards in Fullriggaren, Briggen 4 showed results that were among the lowest of all the yards in the three areas (Miljöförvaltningen, 2014, p. 5). In the building permit documents, Briggen 4 had an ambition level A and a score of 0.55. According to the study of Miljöförvaltningen (2014, p. 5) the built design was missing two of the three requirements of A level, and had a score of 0.33 instead of the expected 0.55.

Figure 4. Briggen 4, Johanna Spjuth, 2016.

At a site visit it became obvious that many of the features present in the building permit documents had not been implemented in real life, including a pond, a large pergola and a grove biotope. The yard now provides a vast and open impression, with a large portion of the yard covered in more or less impermeable surfaces and a large turf area.

Flaggskepparen 1

Flaggskepparen 1 was developed by Wikeborg & Sander Fastighetsutveckling AB and is now owned by BRF Vindöga (Dalman *et. al.*, 2010, p. 16).
In Dalman *et. al.* (2010, p. 16) the developer states that the required BAF of the yard is fulfilled, despite the fact that it is placed on a garage. The developer made most of the yard private, for the bottom floor apartments, and there are plantings with a soil depth of 800mm and areas to sit for all the residents (Dalman *et. al.*, 2010, p. 16). Low and high walls create paths and makes the yard varied and green (Dalman *et. al.*, 2010, p. 16).

Figure 5. Flaggskepparen 1, Johanna Spjuth, 2016.

The yard of Flaggskepparen 1 is small and winding between the buildings. All vegetation areas are raised, which implies that the stormwater management is not dealt with using green solutions. A large portion of the yard is devoted to private areas for the bottom floor apartments, but in many cases these private areas are now hardscape as well. Overall, my impression of the

site during the visit was dominated by hardscape, as most of the yard is covered with concrete slabs.

Klippern 3

Klippern 3 is located in Kappseglaren, it was developed by Hauschild+Siegel, and is now owned by condominium association Ohoj. This was a project in BiodiverCity where Hauschild+Siegel has worked on different ways to retain and accommodate stormwater while creating aesthetic and functional housing (BiodiverCity, *n.d.,* p. 15). For this study, Klippern 3 will provide a good example of how to work with stormwater management.
As a BiodiverCity project, it was thoroughly described in reports by BiodiverCity (*n.d.*) and the architects, Hauschild+Siegel (*n.d.*). Their description is summarized here:
Facing the street two layers of climbing plants has been planted, one directly on the wall, and one on wires (Hauschild+Siegel, *n.d.*, p. 12). The climbing plants, together with other plants have been planted beneath ground level and covered with bars (Hauschild+Siegel, *n.d.*, p. 17). This creates a moist biotope and will contribute to retaining and accommodating stormwater and will add aesthetic and educational aspects to the housing (BiodiverCity, *n.d.,* p. 15). At the same time as the surface is a vegetation bed, the bars also allows the space to be entrance, bike parking and seating area (Hauschild+Siegel, *n.d.*, p. 17).
In the courtyard, the stormwater from the building and the ground will be collected at low points where it infiltrates the ground (Hauschild+Siegel, *n.d.*, p. 9). This will reduce the pressure on the regular stormwater system and temporary water will be an asset for insects and other animals (Hauschild+Siegel, *n.d.*, p. 9).
On the terraces there are planters to allow for the apartment owners to cultivate (Hauschild+Siegel, *n.d.*, p. 3). The plants will add to biodiversity and also help retain stormwater (Hauschild+Siegel, *n.d.*, p. 3). There are green roofs on top of the main house, and on the utility house. These have a varying soil depth to allow for a variation of plants, which consists of herbs, sedum and meadow plants (Hauschild+Siegel, *n.d.*, p. 15). Areas of sand and old logs are provided to create nests for bees and other insects (Hauschild+Siegel, *n.d.*, p. 15).

Figure 6. Klippern 3, Johanna Spjuth, 2016.

My site visit confirmed the description of Klippern 3, and all the elements described were present. Though small changes in the layout of the yard had been made, the overall features and systems were there, the vegetation had a prominent role in the yard and the moist areas

collecting stormwater seemed to be working well. For my thesis, Klippern 3 will provide an example of a site that has integrated stormwater management in the design.

Koggen 1

Koggen 1 is located in Kappseglaren and owned by developer MKB. As Klippern 3, Koggen 1 was part of BiodiverCity. The idea was to create a forest biotope that would be sustainable in the long term, and contribute to increase biodiversity in the area (BiodiverCity, *n.d.,* p. 14).
The courtyard of Koggen 1 is small and almost completely shaded (BiodiverCity, *n.d.,* p. 14). MKB describes their challenge as creating a yard that contains many functions, and at the same time is exciting and welcoming to their customers (MKB, *n.d.a*, p. 1). The solution was a rock garden with inspiration from a beech forest (MKB, *n.d.a*, p. 1). The plants consist of big trees that provide a canopy and a groundcover of shadow-tolerant species of bright which brightens up the yard from spring to fall (MKB, *n.d.a*, p. 1). The roofs are planted with plants from beach-front meadows (MKB, *n.d.b*, p. 1). These roofs are visible from the apartments and the idea was to add floral splendor and to remind of the sea, which is close but not visible (MKB, *n.d.b*, p. 1).

Figure 7. Koggen 1, Johanna Spjuth, 2016.

At the site visit at Koggen 1, vegetation dominated the impression and the feeling was of a forest, with trees and a varied groundcover. There is no area of turf, but at each entrance there are bike parking and entrance areas of concrete bricks. There are visible efforts to create habitats, with nests and dead wood laid out. In my project, Koggen 1 will provide a good example of how to work with habitat services and air filtration in vegetation.

Kommendörkaptenen 3

Kommendörkaptenen 3 is located in Flagghusen and was developed by the condominium association Urbana Villor, who also own and reside in the house. Kommendörkaptenen 3 was described by one of the architects, Cord Siegel (as quoted in Hall, 2011, p. 12) as bungalows that are stacked on top of each other, with nature built into the housing.
The jury of the competition for urban biotopes in Flagghusen (Institutionen för hållbar stadsutveckling *et. al.*, *n.d*, p. 2) describes the yard as green, with many trees, shrubs and perennials, a vegetable garden and a greenhouse. They also mention a beach biotope on the roof of the house, and balconies with 30 cm soil (Institutionen för hållbar stadsutveckling *et. al.*, *n.d*, p. 2). The jury mentions the soil on roof and balconies as innovative and of great importance to urban ecology (Institutionen för hållbar stadsutveckling *et. al.*, *n.d*, p. 2). Though

the jury did not award a winner of the competition they gave out six honorary awards, one of them to Kommendörkaptenen 3 (Institutionen för hållbar stadsutveckling *et. al.*, *n.d*, p. 2).
This yard has also been described by Hall (2011, p. 12) as the most remarkable yard, and by Dalman *et. al.* (2010, p. 16) as a yard that creates a maximum amount of green. Kommendörkaptenen 3 has won Naturvårdsverkets "Guldklimp" (Dalman *et. al.*, 2010, p. 16), and the Kasper Salin prize, the most prestigious architectural prize in Sweden (Hall, 2011, p. 12).

Figure 8. Kommendörkaptenen 3, Johanna Spjuth, 2016.

At the site visit, Kommendörkaptenen 3 provides a green impression, and that of a lush garden. There is a large greenhouse, several small trees, a beach biotope on the top floor and the most striking feature is the green balconies that line the front of every floor. In this study, Kommendörkaptenen 3 will provide a good case study for cultivation and aesthetic values.

Kommendörkaptenen 10

According to the information given by the developer to Dalman *et. al.* (2010, p. 13), the yard has a BAF of 0,475. This is interesting since the information provided on the building permit documents states a BAF of 0.58.
The developer also mentions this yard as a site with biotopes, and trees and shrubs that provides berries, fruit or nectar (Dalman *et. al.*, 2010, p. 13). Stormwater is delayed through BAF and the yard is open so animals can pass through (Dalman *et. al.*, 2010, p. 13).

Figure 9. Kommendörkaptenen 10, Johanna Spjuth, 2016.

At the site visit, some differences compared to the building permit documents were noted; most obvious was the decision to change a gravel surface to concrete bricks and to reduce the number of trees from three to one.

5. CASE STUDY RESULTS

Overview

After applying the selected parts of the rating systems to the six case studies some interesting results have been found.
All three systems rated the three “good” examples high and the three “bad” examples low. The three “good” yards got very similar results in the rating of SITES, while in BAF the difference between the ratings of the three “good” yards were larger than the difference between the lowest of the “good” examples and the highest of the “bad” examples. CEEQUAL provided the biggest difference between the “good” and the “bad” yards, which might be due to the fact that this is the system that distributes the most points for each question, which means that there is a large difference between receiving point and not receiving points.
BAF had an emphasis on shrubs and trees, whereas SITES provided a wide array of ways to measure the sustainability of outdoor environments. Though CEEQUAL provided interesting questions, the system was only able to measure three out of the five ecosystem services.
Figure 10 below provides an overview of the points each yard received in the ratings of ecosystem services in each rating system. For detailed ratings, see Appendix 2.

Case Study Object	Biotope area factor	Food production	Aesthetic values	Habtat for animals	Filtering in vegetation	Stormwater management	CEEQUAL	Food production	Aesthetic values	Habtat for animals	Filtering in vegetation	Stormwater management	Sustainable SITES		Food prerequisit	Food production	Aesthetic values	Number of aesthetic values	Habtat for animals	Filtering in vegetation	Stormwater prerequisit	Stormwater management
Briggen 4	0,66	0,00	0,10	0,05	0,09	0,42	64,00	N/A	43	5	N/A	16	5	N	Y	0	0	4of5	4	1	N	4
Flaggskepparen 1	0,13	0,00	0,04	0,02	0,01	0,06	20,00	N/A	20	0	N/A	0	1	N	Y	0	0	2of5	0	1	N	0
Klippern 3	1,98	0,13	0,30	0,76	0,11	0,68	145,00	N/A	59	32	N/A	54	14	Y	Y	3	2	5of5	6	3	Y	5
Koggen 1	1,52	0,01	0,44	0,39	0,16	0,52	175,00	N/A	68	53	N/A	54	15	N	Y	0	0	3of5	12	3	N	4
Kommendörkaptenen 10	0,22	0,00	0,05	0,00	0,06	0,11	65,00	N/A	39	10	N/A	16	6	N	Y	0	0	3of5	3	3	N	0
Kommendörkaptenen 3	3,17	0,17	0,81	0,14	1,18	0,87	153,00	N/A	63	58	N/A	32	13	Y	Y	3	2	5of5	3	5	Y	5

Figure 10. The rating of the case study objects in the three rating system.

The rating of the yards

Briggen 4

Briggen 4 was selected as one of the “bad” residential yards; however, using the rating in BAF it received a high rating. In CEEQUAL and SITES it is in the middle of the “bad” examples, though it was close behind Kommendörkaptenen 10 (the best of the “bad” examples) in both systems.
In the rating using BAF, Briggen 4 received a high rating in the ecosystem service stormwater management, where it received the same amount of points as Koggen 1 (one of the “good” examples). The reason for this is that Briggen 4 has a large yard, containing a large proportion of turf and reinforced turf and, a large part of the stormwater run-off is managed on site. Though Briggen 4 received an intermediate rating for stormwater management using SITES and CEEQUAL, the rating was not as high as using BAF. This is due to the run-off being retained in a turf area, which does not follow the guidelines in the SuDS manual (Woods Ballard *et. al.*,

2015). In the building permit plans this turf area was a pond, which would have passed the requirements of CEEQUAL and SITES.
Briggen 4 received one of the lowest values of habitat services in the rating of CEEQUAL, due to the fact that the yard contains no birdhouses and no habitats. In SITES Briggen 4 got the third best result in habitat services, due to the fact that the yard has a large proportion of native plants.
For air filtering in vegetation Briggen 4 receives a low rating in both BAF and SITES, mainly due to the low amount of shrubs and trees. Even though there is a large amount of greenspace, a big proportion of this consists of turf, which results in a low rating in SITES. Briggen 4 has a high rating in aesthetic value in SITES, but fails the mark in CEEQUAL, since the yard is not built in accordance with the design which had been made by a landscape architect.

Flaggskepparen 1

Flaggskepparen 1 got consistently low ratings, with the lowest score in every ecosystem service except one. The design of this yard is largely based on hardscape with a few raised planters. There are no sustainable drainage systems, all the run-off is managed in traditional drainage systems. Flaggskepparen 1 did receive 20 points in CEEQUAL for aesthetic value, since the planters and the seating are well executed and there is a clear design idea for the yard. This is one of the few scores that was not dependent on vegetation or stormwater, which also reflects that this yard is functional with a strong design idea, but does not enhance ecosystem services.

Klippern 3

Klippern 3 was selected to be a good example of stormwater management. For CEEQUAL and SITES it received the highest possible rating in this category, and it is one of two yards that passes the requirement of SITES; to accommodate all stormwater on site. Whereas CEEQUAL and SITES rate the proportion of run-off that is managed within the site, BAF rates the permeability of the ground. Therefore Klippern 3 received a lower score using BAF, since the permeable hardscape of the site (which is wooden boards that releases the water into the ground beneath), was rated 0.3 points/m^2, the same as permeable asphalt would have received.
Klippern 3 also received overall high ratings for food production, the second highest after Kommendörkaptenen 3. The reason for this is the cultivation planters that are located on the balconies. Though the areas are not as large as they are in Kommendörkaptenen 3, they are still large enough to receive points in SITES, where the cultivation has to amount to 10% of the vegetated area in order to receive points.
Klippern 3 also receives a high score on aesthetic values. In SITES it is one of two yards that receive the maximum 2 points, which is interesting considering the small size of the yard. In CEEQUAL it misses some points, since the design of the yard is not done in a way that speaks to the local traditions.
Klippern 3 fails to receive the habitat services points of SITES, since both the roof biotope and the moist biotope are too small to meet the size requirement. In BAF, Klippern 3 is rewarded for the large amount of edible plants and for the biotopes, and receives a high score in habitat services. Klippern 3 has no bird houses, which is reflects in the rating of CEEQUAL, but has not significantly affected the rating in BAF.
For air filtering the score is good, but not as good as the other “good” projects, mainly due to a lack of large trees.

Koggen 1

Koggen 1 is a yard built to imitate a forest, and was selected as a good example of habitat services and air filtering. Interestingly it only received the highest score in habitat services in the rating using SITES. In the habitat services rating using SITES, Koggen 1 was rewarded for a focus on native plants and that the forest biotope has been designed to cover the entire yard, which makes this the only yard which passes the size requirement of SITES. In the evaluation of habitat services using the rating of BAF Koggen 1 is far behind Klippern 3, which can be explained by the fact that BAF has a big focus on edible plants. In CEEQUAL, Klippern 3 receives a lower rating, since a part of that rating is based on the proportion of the lot that is covered in vegetation and Koggen 1 has a small yard and a big house, and therefore the proportion of the yard that is covered in vegetation is relatively small.
For air filtering Koggen 1 did receive a good rating in both the ratings done using BAF and SITES, and received the second best overall result, after Kommendörkaptenen 3.
Koggen 1 received high ratings in all three rating systems in stormwater management. However, Koggen 1 does not pass the requirement of SITES to manage all stormwater on site, since a parking on the side of the yard had the run-off direction toward the street.
In aesthetic value, Koggen 1 received no points in SITES, since the yard does not contain enough seating and sheltering elements. In BAF Koggen 1 got a good rating, due to a large amount of flowering shrubs and pergolas. In CEEQUAL Koggen 1 received the highest possible rating. The reason for this being the high value CEEQUAL places on the design being influenced by the local character. Koggen 1 was one of the few yards that had used brick in the houses, which is a traditional building material of the region, and the forest biotope which was inspired by Scanian beech forests.

Kommendörkaptenen 3

Kommendörkaptenen 3 was selected to be a good example of the inclusion of food production in a residential yard. It received the highest points in this ecosystem service using the rating of BAF, and a shared top result in the rating using SITES.
Kommendörkaptenen 3 got the highest score in air filtering in both BAF and SITES, which is due to the large amount of trees planted in the yard of Kommendörkaptenen 3, and the large amount of vegetation that has been made possible by the cultivation balconies. These balconies also gave Kommendörkaptenen 3 a high rating in stormwater management using BAF, where the calculation is based on ground material. In CEEQUAL and SITES the stormwater management is calculated as the proportion of stormwater which is managed on site, and this gave Kommendörkaptenen 3 a result which was more similar to the other “good” examples. In CEEQUAL however, Kommendörkaptenen 3 did not receive points for using Sustainable Drainage System as described by the SuDS Manual (Woods Ballard *et. al.*, 2015). That Kommendörkaptenen 3 still accommodates all stormwater on site means that SuDS would not have been necessary in this case. This would not have been an issue in the original system, since CEEQUAL only prescribes that the project need to provide proof that the possibility has been considered and implemented if suitable. Kommendörkaptenen 3 does not need to use SuDS in order to accommodate the run-off on site, and would therefore have been excluded from the question.
The large vegetation areas and a bird house gave Kommendörkaptenen 3 the highest points in habitat services using CEEQUAL, in the BAF rating the points were in the middle of the “good” examples, but in SITES Kommendörkaptenen 3 got the second lowest rating of all the yards.

For habitat services SITES measures the amount of native plants and a large amount of the plants in Kommendörkaptenen 3 are exotic species.
For aesthetic value Kommendörkaptenen 3 received the highest rating in the BAF rating, the second highest in the CEEQUAL rating and a shared best result in the SITES rating. In the BAF rating the high result was mostly due to the large amount of flowering trees and the terraces, in the CEEQUAL rating Kommendörkaptenen 3 was only two points from maximum, and in the SITES rating it was one of the few projects which fulfilled all the requirements.

Kommendörkaptenen 10

This was one of the yards that deviates from the building permit plans, it lacked vegetation and the permeable ground material in the plans had been switched to impermeable material. In the CEEQUAL and SITES ratings this was the “bad” example that received the highest score, in the BAF rating it was in the middle of the “bad” yards.
In the BAF rating Kommendörkaptenen 10 received many points in stormwater management for the green roofs on the main buildings. However, the shift from gravel to concrete bricks dragged down the rating. In the CEEQUAL rating Kommendörkaptenen 10 was the best of the “bad” yards in stormwater management due to the large turf area in the middle, and the green roofs. In the SITES rating however, it did not receive any points, since all water isn’t managed on site and the water is not retained using SuDS.
In aesthetic value Kommendörkaptenen 10 received a few points in the BAF rating for the flowering shrubs of the site, and in the CEEQUAL rating it received high points, though it missed some points due to details which were not designed to fit into the site, e.g. a big ventilation shaft and the pergola construction with a corrugated metal roof.
Kommendörkaptenen 10 received ratings in the mid-level for habitat services. Though the yard contains no bird houses or biotopes, it has a large amount of shrubs and native plant material, which showed in the scores overall. For food production and air filtering, the yard got no points in the BAF rating and only a few points for air filtering in the SITES rating.

The rating of ecosystem services

Food production

Only two of the yards in the study included areas for cultivation, Klippern 3 and Kommendörkaptenen 3. These were the only yards that received points for food production in the SITES rating, and only one other yard that got points for food production in the BAF rating. This ecosystem service was not at all measured in the rating of CEEQUAL. In the SITES rating there was both a prerequisite (which all the yards passed) and a credit that demanded that 10% of all vegetation was devoted for cultivation, in order to get points. None of the yards fulfilled a second requirement, which demanded a way to distribute the farmed products. The rating using BAF had a focus on edible shrubs and trees, which provided 0.8 points per bush or 5 points per tree, while cultivation areas got 0.5 points per m^2.

Aesthetic values

The most important factors in the BAF rating in order to receive high points on aesthetic value were water features and flowering trees. However, none of the yards had water features.

Kommendörkaptenen 3, which received the highest rating for aesthetic value in BAF, had a common roof terrace, which was also rated highly in BAF. Experiential shrubs, which were present in most of the yards, only provided 0.4 points for each solitary bush.
In the SITES rating aesthetic value was measured by the accessibility of vegetation, and vegetation elements. Many of the yards had some of the required elements but only two yards had all the elements and managed to receive points.
In the CEEQUAL rating of aesthetic value the rating differed from the other two rating systems in that it was focused on the design and style of the yard, rather than vegetation which would provide aesthetic values in itself. This also meant that some of the yards that contained less vegetation, such as Briggen 4, could still get a good rating for aesthetic value in CEEQUAL. Therefore it is relevant to question if this is a measurement of an ecosystem service.

Habitat services

The three rating systems rate habitat services in very different ways. BAF and CEEQUAL rate bird houses very high, something which is not rated in SITES. BAF rates edible shrubs and trees high. Both BAF and SITES promote the creation of biotopes, something which is placed under aesthetic value in CEEQUAL.
In SITES the focus of the habitat service is to use native plants, with one credit for use of native species, and another for creating biotopes which occur naturally in the area. For biotopes there is a minimum area requirement, which made all the yards except Koggen 1 fail to receive points. Native plants were the focus of Koggen 1 and Klippern 3, but not in the other yards.
It is also interesting to note that CEEQUAL measured creating vegetation under habitat services, rather than air filtering as BAF and SITES does.

Air filtering in vegetation

Since CEEQUAL considers the addition of vegetation to be part of habitat services, CEEQUAL does not rate air filtering in vegetation separately.
The system used in SITES for rating air filtering in vegetation reminds of a simple version of BAF, though it is adapted to different parts of the world and compares the vegetation after construction to the vegetation before construction. The yards received similar results in the rating of SITES, probably due to the fact that all the yards are built on land that had no vegetation before the construction. The high amount of trees in Kommendörkaptenen 3 did give that yard a higher rating than the other yards in the rating using both SITES and BAF.

Stormwater management

The majority of the points for stormwater management in BAF were provided based on ground material, where each ground material gets a score based on permeability. In CEEQUAL and SITES this is not the focus; instead they require proof from the stakeholders of the amount of stormwater that is managed on site (SITES require that all stormwater is managed on site). CEEQUAL and SITES also provide points if the stormwater management is constructed in a beautiful way (in the case of SITES), or follows the guidelines of the SuDS Manual (Woods Ballard ***et. al.***, 2015, in the case of CEEQUAL). In BAF a site can receive points if the stormwater which is deposited on impermeable surfaces is retained on site, however, these points are only 0.2-0.1 per m^2.

6. DISCUSSION

The relevance of food production

Both Klippern 3 and Kommendörkaptenen 3 were built with the design idea to create houses for families with the feeling of a bungalow but in an urban, compact way (Hauschild+siegel, *n.d.*; Hall, 2011, p. 12). The other researched residential units have a more traditional layout with apartments, and it is possible that the developers has had their focus on passing the BAF minimum requirement and creating homes that would sell quickly. In this case food production appears to have been considered unimportant as a selling point. It is also relevant to point out that in Flaggskepparen 1, where every bottom floor apartment got their own outdoor space, only one of them had chosen to devote part of this space for cultivation, most had made their lot into a hardscape patio. This contradicts the research of FOR, which shows that 88% of all Swedish households grow edible plants in some fashion (Björkman, 2012, p. 26). According to FORs research, gardening is the second most common outdoor recreational activity (Björkman, 2012, p. 16). Delshammar writes that urban agriculture is part of the Swedish culture and often carries an important social function (Delshammar, 2011, pp. 9, 18). Locally grown food is also important in order to reduce transportation to cities, an important part of creating more sustainable urban areas (Delshammar, p. 9, 22). These factors show that promoting food production should be important both for the developers and in the rating systems.

SITES is the rating system that most strongly focuses on food production, with a prerequisite for not building on farmland, and the project has to devote a full 10% of vegetated area for food production in order to receive points. SITES however seem to have its focus on big scale projects and companies, since the second requirement is that the food needs to be distributed to the community in some way. That the food is harvested and consumed by residents is not brought up as an example. If the project that pursues a certification is a large-scale company, it is paramount that the food is distributed in order for the service of this ecosystem not to be wasted. However, the distribution requirement is a problem if SITES is used on a housing project. It might not be strange that SITES has its focus on large scale projects for companies that want to brand themselves as sustainable, many individuals would not go through with an expensive certification process in order to certify their own home. However, there is the possibility that a housing project such as the ones in Västra Hamnen would pursue a rating, which would make it necessary to look over this phrasing.

BAF also measures the ecosystem service food production, but has a large focus on shrubs and trees with edible fruits and berries, which got a rating of 0,8 per bush or 5 per tree, while cultivation areas got a rating of 0,5 per m2. Since the trees and shrubs are also measured in air filtering and biodiversity, this means that planting an apple tree will receive a lot more points than providing land for cultivation. This shows that BAF values trees extremely high, since trees produce many ecosystem services. However, for the ecosystem service food production, the weighting between the fruit tree and the cultivation area might seem unfair, since the cultivation area can create a bigger variation of food. Of course this might also reflect the same sentiment that SITES does, that developers and planners are afraid to plan for cultivation areas that will then be unutilized. In the case of trees and shrubs with edible berries and fruit, they will always provide the ecosystem service, and if the fruit and berries are not consumed by humans, they will instead provide food for the local fauna.

CEEQUAL does not rate food production. Though CEEQUAL is now adapted for use in urban environment, the original focus is on construction projects, and in the construction of a bridge,

food production is less relevant than it would have been in a housing project. In order for food production to be a relevant ecosystem service to include, the people that would farm needs to live close by.

Three ways to measure aesthetic values

One of the interesting problems of measuring and valuing ecosystem services, is how to create a numerical value that can reflect the complex impressions and benefits that a green environment will provide humans. This is especially true for cultural ecosystem services, such as aesthetic values. Hermann *et. al.* (2011, p. 15) write that the indicators used to map cultural services are inadequate to describe them fully. Therefore it is especially interesting to examine how the three rating systems have chosen to measure the ecosystem service aesthetic value.

Probably due to the complexity of cultural ecosystem services, the three systems have very different ways to measure aesthetic value. BAF has its focus on individual features, such as water features and flowering trees. In SITES the aesthetic value is measured by how well the yard provide secluded places in a good micro climate to sit down and relax in and, the visual and physical connection to vegetation. The method that BAF and SITES use to measure aesthetic values relates well to the description of Naturvårdsverket (2012, p. 135), which states that the ecosystem service aesthetic value is dependent on vegetation, clean water, and the climate regulating and noise absorbing qualities of nature. While BAF is more focused on enhancing the vegetation which will hopefully provide the ecosystem service, SITES is focused on vegetation features that will enhance the ecosystem benefit (the benefit to human health and well-being). While BAF focuses on creating more vegetation, SITES focuses on the qualities the vegetation needs to have in order to provide aesthetic services.

While BAF and SITES relies on the vegetation or garden features to create the aesthetic values, CEEQUAL has a large focus on the design intent and the built features. This is good in the context of a construction project, where it is important that the design is considered and also adapted to the local context. In a construction project, this question will ensure that the project has a design intent, is beautifully executed and will fit into the surroundings. However, the rating of aesthetic services in CEEQUAL is not directly dependent on the ecosystem service aesthetic value, the one that is produced by vegetation. This becomes obvious in my case study, where some of the yards that provided less vegetation, such as Briggen 4, still got a good score for aesthetic services in CEEQUAL.

CEEQUAL does provide several questions for aesthetic values, and there are also parts where CEEQUAL has made changes in order to make the system adapted to urban areas. One example of this is that the style and size of the new development should be adapted to the surroundings. In my case study this reflected well in the design of Koggen 1, which had been influenced by the local context both in building and plant material. In that context the question worked well, and was able to detect design intent. However, in the case of Klippern 3, which has an innovative design, the question in CEEQUAL rated this design lower, since it did not relate as well to the surroundings. The problem with rating design in this way is that a good design solution will not be the same for any two places, and is not always in line with the surroundings.

What is a habitat?

For habitat services BAF and CEEQUAL rates bird houses highly, something which is not at all rated in SITES. BAF rates biologically accessible water as very important for wild animals, and also provides points for diversity in groundcover and shrubs with edible berries. While BAF relies on the vegetation features to create habitat, CEEQUAL demands that habitats are created according to the recommendation of an ecologist.
Bolund and Hunhammar (1999, p. 299) write that the size of the vegetation area is very important for the preservation of fauna. This is something which is rated both in CEEQUAL and SITES, but not in BAF. In CEEQUAL the amount of vegetation is rated in a similar but not as detailed, way as SITES and BAF does for the ecosystem service air filtering. While CEEQUAL promotes a larger amount of vegetation, SITES has a minimum requirement of 185.81 m^2 in order for a yard to receive points for a biotope. This proved difficult for the yards to achieve; only Koggen 1 had a continuous biotope large enough to pass this requirement. Though it is difficult to achieve this in a small yard, size is important when creating habitat.

Rating habitat based on nativeness

The large vegetation areas and a bird house gave Kommendörkaptenen 3 high ratings in habitat services in the rating of CEEQUAL and BAF, but in the rating of SITES Kommendörkaptenen 3 got the second lowest score of all the yards. For habitat services SITES measures native plants, which can be seen in the rating of Kommendörkaptenen 3, which got a low score since a large amount of the plants in the yard are exotic species except on the roof terrace on the top of the house.
Kommendörkaptenen 10 also received some points for habitat services. Though the yard contain no bird houses or biotopes, it still has a large proportion of Swedish plant material, which showed in the scores overall. The two yards that received high ratings for habitat services in the rating of SITES were Koggen 1 and Klippern 3, both of which had a large amount of native plants due to their participation in the BiodiverCity project. Both in BAF and in SITES native plants are considered important for habitat services. It is an interesting difference compared to CEEQUAL, which also provides points for creating native biotopes, but instead of considering this a habitat service, CEEQUAL considers this an aesthetic service.

The view that BAF and SITES is promoting by attributing habitat services to native plant material is one that assumes native plants are more efficient in supporting native animal biodiversity. This is a view that is commonly supported in the U.S., a survey among landscape architecture firms conducted by Calkins (2005, p. 33) shows that almost 80% of respondents use native plants often. This concept has been criticized by researchers such as Kendle & Rose (1999) and Hitchmough (2011). Hitchmough (2011, p. 381) writes that research has shown that urban gardens dominated by exotic species support extremely rich communities of native invertebrates, and that there is no evidence that gardens with more native plants support more native invertebrate biodiversity. Kendle & Rose (1999, p. 24-25) also support this by providing the example of Buddleja Davidii, which has proved to be a great success among butterflies in Great Britain. This is also true in Sweden, where Buddleja Davidii has received the name “Fjärilsbuddleja” (Butterfly Buddleia).
Kendle & Rose (1999, pp. 20-21) brings up a second problem with the term native, that it is difficult to give a precise definition concerning what counts as a native plant. One example where it becomes difficult to define a plant is Mahonia aquifolium, which is frequently used in the

yards in Flagghusen. According to “the virtual flora” (Den virtuella floran, 2004), Mahonia originates from northern America, but has naturalized in mid- and southern Sweden. In my case study there was a need to make a decision whether or not Mahonia is to be considered native, but neither BAF nor SITES provided a clear enough answer to this. BAF provides no definitions at all, and SITES definition of a native plant is one that is native to the ecoregion, or naturally occur within 321,97 kilometers of the site (SITES, 2015, p. 313), but no definition of what is considered as “naturally occurring” plants is provided. Since the plant is naturalized in Sweden I have considered it as native. Ambiguities such as this can cause a problem, if there are different ways to interpret a credit, this can make the rating seem arbitrary.

The difference between CEEQUAL, which considers nativeness an aesthetic feature, and SITES, which considers nativeness as paramount to habitat services can be attributed to cultural differences. According to Hitchmough (2011, p. 381) the notion of nativeness as habitat is most strongly held in the part of the world that has most recently been colonized by Europeans. An important reason for this dispersion is the view in colonized countries that the landscape pre-colonization was completely “natural”, i.e. not affected by humans (Hitchmough, 2011, p. 381)
Another aspect where the view of natives is different between countries is when it comes to smaller countries such as Britain, the Netherlands and Sweden, the amount of native species tend to be relatively small and therefore not contain as many species that are considered attractive enough to become part of the cultivated flora (Hitchmough, 2011, p. 382). For larger countries such as the U.S. and China the contribution of native species to the cultivated flora tend to be much larger, and therefore exotic plants, according to Hitchmough (2011, p. 382), does not have the same importance in creating richness and beauty in designed landscapes.

Instead of focusing on whether or not a plant is native, Hitchmough argues that we should focus on the properties of the plants and whether or not they are sustainable (Hitchmough, 2011, p. 380). According to Hitchmough (2011, p. 380) there are five key attributes that define a sustainable plant; (1) It is well fitted in the landscape and able to maintain its population, (2) it is able to survive in the long term with low inputs of resources, water and maintenance time, (3) it supports as much native animal biodiversity as possible, (4) it is attractive and meaningful to local people and, (5) where appropriate it reflects and reinforces the character of a particular place. Though native plants can usually be assumed to be more robust, the same is true for species drawn from similar climates in other parts of the world (Hitchmough, 2011, p. 381). The climate is changing fast and will affect the plants possible to cultivate, as seen in the predictions that London in 2050 will have a climate like present day Bordeaux (Hitchmough, 2011, p. 381). Hitchmough therefore concludes that the best way to ensure a sustainable resource consumption is to work with the way plantings are designed, established and managed, rather than where the plants originate from (Hitchmough, 2011, p. 381).

This discussion leads me to doubt if nativeness is a good way to rate habitat services. Maybe CEEQUAL is more correct in placing local biotopes as an aesthetic value. Kendle & Rose (1999, p. 28) writes that this concept of promoting a regionally appropriate vegetation has an importance in defining the landscape character of an area. However, Kendle and Rose (1999, p. 28) also write that this does not mean that natives are always the most appropriate, instead they go on to praise “the unique communities of natives and naturalized aliens that add so much richness to the environments we live in” and write; “How much truer this is for the rich and eclectic cultural and historical mix reelected by urban civilization”. The collection of natives can

be a reflection and provide an important connection to the local landscape character of the region. At the same time the urban biotopes with their unique mix of natives and exotic plants provide an important landscape character of their own.

Vegetation for air filtering

Since CEEQUAL considers the addition of vegetation to be part of habitat services, CEEQUAL does not rate the air filtering qualities of vegetation separately. CEEQUAL does include questions aimed at mitigating air pollution during the construction phase and in the choice of material, e.g. 8.4 designing to minimize the energy consumption and carbon dioxide emissions during maintenance and 9.4 minimizing the transportation of the staff (CEEQUAL, 2013, pp. 113, 142). However, a landscape project has a big potential to not only mitigate the production of air pollution, but also to help filtering pollutants from the surroundings. When comparing CEEQUAL to SITES in this case, SITES does cover a broader range of sustainability aspects. In addition to providing a way to measure the addition of vegetation that will provide air filtering capacities, SITES also has credits focused on reducing the air pollution, such as credit 7.7 protect air quality during construction (SITES, 2015, p. 257).
The system used in SITES reminds of a simplified version of BAF, though it is adapted to be used in different parts of the world, and also rates the vegetation compared to the vegetation before construction. The high quantity of trees in Kommendörkaptenen 3 gave that yard a considerably higher score than the other yards in both the rating of BAF and the rating of SITES. Since the filtering capacity of vegetation is higher for trees than it is for shrubs or grass (Bolund & Hunhammar, 1999, p. 295), this would imply that both BAF and SITES provide good indicators for how good a site is at providing the ecosystem service filtering in vegetation. Though SITES is a more holistic and complex system than BAF, the BDI measurement of SITES is simple. While BAF rates shrubs and trees differently depending on the function, the SITES rating is based only on the kind of vegetation, or, in the case of grass, how it is managed. This makes SITES BDI less complex than BAF and could provide inspiration for how to make BAF easier to use. However, the result of BAF is more varied and can measure a wide variety of qualities in the vegetation. In SITES the result is dependent on the comparison of the vegetation before and after redesign. This made the result of the study more even, since all the case study objects are located in an industrial area that had no vegetation before the development started.

Permeability and stormwater management

The certification systems and BAF provided different ways to measure the ecosystem service stormwater management. While BAF measures the permeability of the groundcover, CEEQUAL and SITES instead require proof of the amount of stormwater that is managed on site. Many researchers have pointed to the importance of permeable ground cover in order to lower the flow peaks and total amount of water which needs to be accommodated by the stormwater infrastructure (Naturvårdsverket, 2012, p. 134; Bolund & Hunhammar, 1999, p. 297). Therefore it is obvious that permeable groundcover is a feature which is very relevant for the ecosystem service stormwater management. In the BAF rating, vegetation on the ground get a rating of 2, and water surfaces 1. A green roof receives a score of 0.1, despite the fact that green roofs has been shown to accommodate an average of 50% of stormwater (Gregoire & Clausen, 2011, p. 964). Hardscape with permeability receives 0.3 points, though these surfaces, if constructed in

the correct way, can accommodate up to 100% of stormwater (Brattebo & Booth, 2003, p. 4375; Münchow & Schramm, 1998, p. 184). BAF does provide extra points if the hardscape runoff is detained in water or moist areas, though even in this case the surface will receive a low rating. This makes it obvious that the weighting of BAF is constructed to lead developers to choose certain design solutions over other. That vegetation areas are highly rated indicates a desire to force the developers to include more vegetation - which would also provide many other ecosystem services besides stormwater management.
Despite the good intentions of the rating of BAF this does provide some strange results, e.g. Kommendörkaptenen 3 received 0.87 points in the BAF rating due to the stacked cultivation balconies, despite the fact that they will do little to accommodate the stormwater on the site, as they are under roofs. The rating of BAF is also strange when comparing Kommendörkaptenen 3 with Klippern 3, while both yards accommodate all stormwater on site, one got a rating of 0.87 and the other got 0.68.
In the rating of CEEQUAL and SITES the stormwater management is instead calculated in the proportion of stormwater which is managed on site and these ratings therefore provided more even results. In my study, CEEQUAL failed to give Kommendörkaptenen 3 the maximum points despite the fact that it manages all stormwater on site. This is due to Kommendörkaptenen 3 not having a Sustainable Drainage System, as described by the SuDS Manual (Woods Ballard *et. al.*, 2015). As explained in Chapter 5, this would not have been an issue in a real project, where the project only need to provide proof that the possibility of incorporating SuDS has been considered and implemented if suitable.
In SITES all projects has to accommodate all stormwater on site, and a project will only get extra points stormwater management if they manage stormwater from outside of the project boundary. Only two yards passed the basic requirement. Besides the accommodation of stormwater, the projects also receive points if the stormwater management is beautifully designed. Koggen 1 and Briggen 4 received the same score here, 4 points, despite Koggen 1 accommodating 95% of all stormwater, and Briggen 4 only just passing the 50% limit. The difference in applying the rating on a finished project is visible here, if Koggen 1 had been designed with the SITES rating in mind, the landscape architects would have been able to review the requirements beforehand and adjust the design to accommodate 100% of stormwater on site.

The credibility of the rating systems

In a rating system it is important that the clients can trust that the rating means that a project is sustainable. For the BAF rating, the largest problem appears to be that there is no mechanism that enforces the requirements. Because of the lack of enforcement, the designs are often changed by the developers after they have received the building permit. Even if a project passed the BAF requirements at the building permit phase, it does not mean a project has followed the guidelines of BAF. This undermines the credibility of BAF, as there is no way to ensure that a BAF rated project is sustainable.

For the two certification systems the results are more credible, since the certification is awarded when the project is finished and there are proof that the requirements are fulfilled. One important difference between CEEQUAL and SITES is that in the rating of CEEQUAL questions does not have to be addressed if they are not applicable in a project, while in SITES all credits has to be addressed. When the stakeholders can chose which questions to work with there is a

risk of undermining the credibility of CEEQUAL. Green *et. al.* (2014, p. 22) have questioned if a CEEQUAL-certified project includes a good treatment of ecosystem services and Wangel *et. al.* (2016, p. 201) argue that the possibility to leave out questions allows for a project to be certified on the highest level of CEEQUAL without actually being sustainable.
In SITES it is not possible to exclude credits, even if they are not applicable in a project. Nielsen, a landscape architect who worked on a SITES certified project, had this problem, their project could only achieve a "silver" rating in the SITES certification, due to the local conditions of their site (Green, 2013). At the same time as it is important that the certification is credible, it also needs to be adaptable to local conditions. The possibility to leave out questions makes CEEQUAL more adaptable as it can be adjusted to fit the local conditions (Kyrkou & Karthaus, 2011, p. 205; Wangel *et. al.*, 2016, p. 201). Kyrkou & Karthaus (2011, p. 205) writes that the sustainability challenges differ between each project and the certification systems need to be adaptable to this. However, Alminana said (as quoted in Green, 2013) that "if you are only focused on points, you are missing the point", implying that the goal of certifying with SITES should not be to receive the highest rating, but instead to get a framework for including sustainable thinking in the project. Wangel *et. al.* (2016, p. 200) argues that it is important to be able to understand what the rating of a certified project means. In this aspect SITES works better, since all projects are matched to the same criteria.

Another aspect which might influence the credibility of CEEQUAL and SITES is inflation of the certification. Ek and Brinkhoff (2013, p. 18) points out that CEEQUAL has awarded 67% of all rated projects in 2011 with the highest rating, "excellent". If it is too easy to get a good score in a certification system, it will eventually lose its ability to promote cutting-edge sustainable outdoor environments. As a contrast to the ratings of CEEQUAL, in SITES only 30 of the 160 projects that registered for certification between 2010 and 2014 achieved the certification (Steiner, 2014, p. 306). This study showed that the requirements of SITES was high, and many projects failed to get credits, e.g. Koggen 1 on stormwater management and Klippern 3 on habitat services. That it is more difficult to achieve a high rating in SITES might give SITES-certified projects a higher credibility and status than CEEQUAL-certified projects.

Weighting of points

The weighting of credits in a rating system is important to create a system that advocates all ecosystem services to an adequate degree. Both SITES and CEEQUAL mention their weighting in their manuals. In CEEQUAL (2013, p. 2-3) it is explained that the weighting of the Swedish manual is the same as for the British manual, but that a weighting exercise for Scandinavia will be conducted in 2013. SITES (2015, p. xiii) writes that the points are divided between the credits depending on the potential of the credit to meet their main goals. Though neither CEEQUAL nor SITES explain the way their weighting is executed, this study shows that the points are fairly evenly divided between the ecosystems services in both CEEQUAL and SITES. Aesthetic services are slightly more heavily weighted in CEEQUAL, and in SITES habitat services and stormwater management receives slightly higher ratings than the other ecosystem services examined. Naturvårdsverket (2012, p. 131) writes that in urban areas the cultural ecosystem services are usually stronger while the need for regulating services is increasing, as climate change is ongoing (Naturvårdsverket, 2012, p. 131). This would imply that the weighting of SITES is more in accordance with the need for ecosystem services in urban areas, while CEEQUAL focuses on cultural services, which are already strong in urban areas. Ek and

Brinkhoff (2013, p. 16) write that CEEQUAL has been careful to create a good weighting of the points, but does not provide a good measurement of all three parts of sustainability. According to Ek and Brinkhoff, CEEQUAL should include more of the social issues, such as construction workers working environment, and a financial part (Ek & Brinkhoff, 2013, p. 18).
In BAF the points are divided into three categories; climate regulation, social values and biodiversity (Stockholms Stad, 2012, p. 13). A project using BAF has to achieve at least 60% of the factors in each of these areas (Stockholms Stad, 2012, p. 13). In my study of BAF, stormwater management was the ecosystem service which provided the highest score in the rating of BAF, while in habitat services and food production not even the best examples received high ratings. The results also show a heavy weighting on shrubs and trees in the rating of BAF. The reason for this is the double counting where some factors, e.g. shrubs and trees, get points in many of the ecosystem services, which gives them a high score in total. The problem with this is that the points gained for planting of bushes with edible berries is higher than the points gained for creating of a habitat.

Subjective assessments in the rating systems

In my research some assessments had to be based on personal judgements, e.g. whether a plant is native to the region, or if a kind of berry is edible. In many cases shrubs and trees were given points, though it can be questioned whether a plant should be considered edible just because it is possible to eat. For example, many yards had used Mahonia. According to Westerstål (2009, p. 88) the berries of Mahonia are edible and possible to make jam of, though Svensson (*n.d.*) writes that there are restrictions as to how much of this jam one should eat. In these cases I have still considered Mahonia as an edible plant.
This means that my research includes a personal assessment, when I decide whether a plant is considered edible. However, in this case the methodology of the research is based on the methodology of the system, in this case BAF. In BAF there are no set lists, or exact lines drawn. This means that in a project the stakeholders make a subjective assessment. Since it is in the interest of the developer to get a high rating, they are likely to call a groundcover “diverse” or a perennial border a “butterfly restaurant”, though that does not mean that the groundcover or the perennial border provide that ecosystem and its services.
In this case the certification systems are more set in their definitions, since documentation is required as proof. The project is then examined by an external institution, meaning that the results are less likely to be biased. However, even in this case the results are examined by a person who will also have to make subjective decision during the assessment. In CEEQUAL the project is first assessed by an assessor and then verified by a verifier, the two persons involved will ensure less subjectivity. However, the assessor is a person at the company and the verifier only comes in and looks at parts of the certification documents. Ek and Brinkhoff (2013, p. 17) writes that the verifier has a short time to judge the project afterwards, which means that not all the proof is gone through. The idea though is that the requirements are set up in a way which makes it very difficult to “cheat”, requirements include things such as “a plan made by an educated ecologist” or similar. This would allow for the specialists who will be involved to add their expertize.

Planning tool versus certification system

As mentioned in the introduction, the Swedish laws were changed in 2015 and now prevents municipalities from adding demands on developers (Plan- och bygglagen, 2010, 8 Kap. 4 a §). This new laws makes it especially important to compare BAF, as a frequently used planning tool, with certification systems. Certification systems could become the new way to ensure a high quality of the outdoor environment in urban areas. This possibility was mentioned both by Ek & Brinkhoff (2013, p. 2), and Lund municipality (Wiklund, 2015, p. 3).
BAF as a planning tool has been used because it is easy to understand and measure, even for stakeholders that are not used to working with green environments (Emanuelsson & Persson, 2014, p. 18). BAF is focused on the amount of plants and the ground cover, and assumes that this will provide ecosystem services. SITES and CEEQUAL on the other hand are more focused on the results, and demand proof that the yards will provide certain ecosystem services (e.g. stormwater management). SITES and CEEQUAL also takes on a broader scope of questions, ranging from how the construction is carried out, to choice of material and maintenance plans. Of course, the certification systems therefore demand a lot of extra work from the stakeholders and will consume both time and money. The question in the case of certification is therefore often; Is the result worth the cost?
My study of five ecosystem services provided the finding that almost all of BAF was covered in these five ecosystems, whereas for SITES and CEEQUAL these five ecosystem services only covered a small part of the entire rating system. This implies that SITES and CEEQUAL provides a better overall picture, at the same time as it is also interesting to note that BAF does cover all of these five ecosystems in a simple system, while CEEQUAL only covered three ecosystem services.

While the certifications can be expensive and time consuming to use, CEEQUAL mentions the possibility to use the CEEQUAL manual as a checklist in projects, either for the client to set a certain standard and to ensure the sustainability throughout the project (in the way MBP SYD is used now), or for the developers as a support in decision-making (CEEQUAL, 2014, p. 10). This is an interesting option for companies that wish to have a framework on how to include sustainability in their projects. The companies could follow the guidelines of SITES or CEEQUAL, without actually certifying. In this case, the availability of the system is important. Where SITES is available for download on their website, CEEQUAL is only available for educated assessors. While having someone at the company who's an educated assessor might be a an advantage for a company that wants to use the manual as a guide in their projects, the accessibility of SITES would be an asset in this case since it is thereby possible to distribute the system more widely within the company.

Design for sustainable outdoor environments

The case study objects were designed with the guidelines of MBP SYD. The results of using MBP SYD in the residential yards in Västra Hamnen has been questioned in later studies on the area (Institutionen för hållbar stadsutveckling *et al*, *n.d.*; Miljöförvaltningen, 2014). This brings up the question; *How would the design of Västra Hamnen have been different if one of the three rating systems examined in this thesis had been used instead of MBP SYD*?
While BAF for Årstafältet is similar to MBP SYD in the basics of the system, BAF has a more holistic view of sustainability. While MBP SYD has a strong focus on biodiversity, BAF for

Årstafältet includes points for aesthetic features, e.g. fountains and floral splendor. If BAF for Årstafältet had been used in Västra Hamnen, the design would most likely have been more diverse, and possibly have included more features and plantings. However, BAF for Årstafältet shares a major problem with MBP SYD, that there are no repercussions if a project does not fulfill the promises made in the building permit documents. In Västra Hamnen, the design of the yards had been altered after the development was approved in the building permit phase (Miljöförvaltningen, 2014, p. 5; Institutionen för hållbar stadsutveckling *et al*, *n.d*, p. 4). This problem would most likely have persisted even if a different kind of BAF had been used.

The rating systems have the advantage that they certify the projects after they have been built, and therefore the finished projects are more likely to be built in a sustainable way. CEEQUAL and SITES have a different way to measure sustainability, with a focus on performance, rather than on individual features. While both kinds of BAF promote permeable material, e.g. reinforced grass, CEEQUAL and SITES focuses on retaining the water on site. Therefore the certification systems would possibly create yards with more hardscape, but also more green solutions, such as rain gardens. The same difference is appears for other ecosystem services as well, while BAF focuses on the quantity of trees and shrubs, the certification systems provide points for a certain type of vegetation. In this case it is not as clear which system provides the most vegetation, though BAF promotes a high amount of vegetation, SITES also has their Biomass Density Index which promotes the inclusion of vegetation in a project. In this case CEEQUAL does not provide the same focus on additional vegetation and is it therefore possible that using CEEQUAL would not have provided the same amount of vegetation in the yards as the other two ratings would. CEEQUAL focuses on choice of material and the local context, and therefore the design and layout of the yards could be expected to have been different.
SITES has a focus on native plant material, which would have had a strong effect on the vegetation of the yards, with more Swedish plants present. SITES also includes agriculture and credits aimed at creating restorative areas in the outdoor environment, which would likely have influenced the design of the vegetation in the yards.

7. CONCLUDING

Conclusion

Though all three systems managed to show the difference between the yards that had included ecosystem services in the design and the yards that had not focused as much on ecosystem services, there are important differences between the three systems and the way they rate ecosystem services.

What differences are there in the way CEEQUAL, Sustainable Sites Initiative and Biotope Area Factor (as used in Årstafältet) rate ecosystem services?

BAF as used in Årstafältet included many parts of ecosystem services and was able to rate all five ecosystem services of this study. While the certification systems are expensive and time consuming to use, BAF provides a simple way to put a numerical value on ecosystem services. However, the planning tool has several problems, including the lack of methods to enforce its requirements and the points awarded for features rather than results. There is a risk that BAF does not actually provide more sustainable outdoor environments.

As a certification that was originally designed for construction work, it was especially interesting to see if CEEQUAL would be able to rate residential yards in urban areas. This study showed that the questions of CEEQUAL were relevant in an urban landscape project, and that CEEQUAL provided a rating that reflected the difference between the yards that had included ecosystem services in the design and the yards that had not. Another important aspect of CEEQUAL is that the manual is available in Swedish which makes the system easy to use in the Swedish context. The questions of CEEQUAL showed that the system had included ecosystem services in the rating. However, CEEQUAL only covered three of the five ecosystem services examined in this study. Another issue in CEEQUAL is that a project can leave out questions, which can create a credibility issue at the same time as it makes the system more flexible.

SITES has ecosystem services as the foundation of the system, which showed in the credits, which were aimed at enhancing ecosystem services. The focus of SITES is on landscape architecture with credits focused on the design of the green space. In general, SITES had high standards that left projects without points more often than the other systems, which implies that SITES forces projects to work towards more sustainable solutions. Some questions, such as habitat services, are aimed at the U.S. context however, and if SITES is to be used in Sweden, a larger examination would be needed to see how the system would fit into the Swedish context.

Which of the systems CEEQUAL, Sustainable Sites Initiative and Biotope Area Factor (as used in Årstafältet) can be expected to lead to the most sustainable outdoor design?

Since BAF fails to provide a system for enforcing the requirement, the sustainability of a project which has used BAF cannot be guaranteed.

CEEQUAL provides a holistic approach to ecosystem services, it is flexible and can be used in many different kinds of project, e.g. housing areas, bridges and streetscape, and also provides a manual in Swedish. In CEEQUAL questions can be left out, which at the same time as it makes the system more flexible, also makes it easier to achieve a good rating even in a project with low sustainability standards.

SITES is aimed at promoting ecosystem services and does so by providing a wide range of guidelines. SITES covers all the five ecosystem services in credits that are focused on results. Where BAF is focused on specific plants and features, SITES will look at structures and the outcome. However, SITES is less flexible than CEEQUAL, there is no way to adjust the system to local circumstances. In habitat services SITES focuses on native plants, which is not necessarily a good way to create habitat services. The requirements of SITES are overall higher than those of the other two rating systems, and it delivered less points than the other systems. This implies that SITES sets higher standards, and therefore projects certified with SITES could be assumed to have a more sustainable outcome. Among the three rating systems examined in this study, SITES is the one that will likely lead to the most sustainable outdoor designs.

Literature and method

The literature on the three rating systems were scarce and in the case of SITES the literature was from sources that were not independent. This shows that there is a great need to expand the research on SITES, CEEQUAL and BAF.

In this case studies the plans which were used were the ones made available to the public in the form of building permit plans and documents. The first step was to conduct site visits and note differences compared to the plans. In order to examine the credits of the rating systems, plant identification was necessary and also an estimation of how the run-off was managed.
Limitations with this method include the human factor. Sometimes I was not able to identify certain plants, or wasn't sure how the run-off was managed. In these cases I had to make subjective assessments. In order to make this assessment less subjective I chose a strategy that I applied to all similar cases. E.g. with stormwater all drains were assumed to deposit away from the site, rather than into vegetation beds. Green roofs located higher up that were inaccessible; in those cases the information provided in the building permit documents was assumed to be correct. In the cases where nothing else was noted, the green roofs were assumed to be 30 mm thick.

The method used in the case study worked well with the goal of the thesis. The study was able to show many differences between the three rating systems. It was also a good method because it gave me as a researcher an in-depth understanding for how the rating systems would work in a real project.

Further research

The method used in this research could be extended to include a larger scope of ecosystems services, and also to test a larger extent of the certification systems.

It would be interesting to compare the two certification systems, CEEQUAL and SITES more closely. There is not much research done on these systems, and no comparisons of the two. A comparison of CEEQUAL and SITES would make it possible to examine the full systems, which was not possible in this limited study of five ecosystem services. While most of BAF was covered in this study, CEEQUAL and SITES are certifications that take on a broad range of sustainability issues that need to be examined further.

Biotope Area Factor has been used in many different versions in Sweden and internationally. More studies are needed on the different kinds of BAF that exists and the advantages and disadvantages of these different systems.
The future of using BAF in Sweden is uncertain with the new laws working against the use of BAF. However, if we are to continue using BAF in SWEDEN, this study has shown some of the issues of BAF. Further research is needed on how BAF could be developed, possibly with inspiration from certification systems, such as CEEQUAL and SITES. If BAF will not be possible to use in the future, one solution is to develop a Swedish certification system for outdoor environments. This could be inspired by systems such as CEEQUAL or SITES but should be less complex and easier to use.

In this thesis I have focused on ecosystem services and ecological sustainability. Both CEEQUAL and SITES provides credits for social sustainability, which is an important part of sustainability and something which would be interesting to explore in further research.

In my research I have only touched on the subject of how ecosystem services should be weighed against each other. This is a research subject that is under much debate and this research could be expanded in further studies of rating systems. One interesting question is: *How have CEEQUAL, SITES and Biotope Area Factor weighed different ecosystem services?* The values assigned to each ecosystem service in the different rating systems could be used to show the perceived value of ecosystem services.

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Area	Lot	BAF	Actual BAF	Notes from litterature	Site visit: Short description. Color = overall impression	Notes
Kappseglaren	Koggen 1	0,6		BiodiverCity project	Lots of vegetation, visible nests, dead wood, seatings	Use as good example
	Klippern 3	0,64		BiodiverCity project	Lots of vegetation, raingardens, climbing plants	Use as good example
Fullriggaren	Briggen 1 + 2	A: 0,45	0,31: 3 of 5	No climbing plants or herb garden. Added plantingboxes.	Sculptural elements, geometrical hardscape, varied vegetation	Counted together
	Briggen 3	A: 0,56	0,39. 3 of 5		Hardscape and grass, some trees	
	Briggen 4	A: 0,55	0,33. 3 of 5		Hardscape and grass	Use as bad example
	Fullriggaren 2	B: 0,48	0,43: 2 of 3		Grass areas, naturalistic planting, green visible roofs, seating	
	Fullriggaren 3	A: 0,55	0,42. 3 of 5	Nice, has a wild feel and will contribute to biodiversity.	Naturalistic planting, nests, dead wood, green visible roofs, seating	
	Fullriggaren 4	B: 0,49	0,40, 2 of 3		Closed	
	Fullriggaren 5	A: 0,55	0,40: 2 of 5	Has not added trees on plan.	Grass, hedges, playground	
	Skonaren 1	C: 0,48	0,41: 2 of 2	Fullfilled promises	Grass, hardscape, few shrubs or trees	
	Skonaren 2	B: 0,51	0,41: 2 of 3		Closed	
	Skonaren 3	A: 0,50	0,51: 5 of 5	Fullfilled promises, reinforced turf used well	Hardscape, grass, raised planters, large bike parking	
	Slupen 1	A: 0,50	0,42: 1 of 5	Plants poor condition.	Seating, plantings, grass, hardscape	
	Slupen 2	B: 0,60	0,56: 2 of 3	Good stormwater management	Plantings, lots of grass.	
	Slupen 3	A: 0,64	0,47: 3 of 5	Reiforced turf used well	Small, reinfroced turf.	
	Slupen 4	B: 0,61	0,53: 2 of 3		Seating, plantings, grass, hardscape	
	Slupen 5	A: 0,51	0,31: 4 of 5	Good stormwater management, nests and green walls.	Closed	
Flagghusen	Flaggskepparen 1	0,45			Mostly hardscape, raised planters and seatings	Use as bad example
	Flaggskepparen 2	0,54			Lots of hardscape, turf, big trees, pergola, nests	
	Flaggskepparen 4	0,43		Beach habitat, nice details.	Turf, trees, hardscape, very small	
	Flaggskepparen 5	0,48			Raised yard, raised planters with shrubs, seating areas	
	Flaggskepparen 6	0,48			Closed	
	Flaggskepparen 7	0,49		Pond and climbing plants	2/3rds armorerat gräs, pond with moving water.	
	Kommendörkaptenen 1	0,51			Large areas of turf and stone slabs, seatings, bike parking	
	Kommendörkaptenen 10	0,58			Large areas of stone slabs. Biotopes & trees missing.	Use as bad example
	Kommendörkaptenen 2	0,45			Raised yard, raised planters with shrubs and trees	
	Kommendörkaptenen 3	0,79		Beach biotop, cultivation balconies.	Greenhouse, cultivation, green balconies	Use as good example
	Kommendörkaptenen 4	0,45			Large. Lots of turf, round plantings.	
	Kommendörkaptenen 5	0,51		Grove biotope.	Closed	
	Kommendörkaptenen 6	0,51			Reinforced concrete with plantings.	
	Kommendörkaptenen 7	0,49			Playground, raised planters, trees, vegetation	
	Kommendörkaptenen 8	0,48			Turf, seating, evergreen shrubs, bike parking	
	Kommendörkaptenen 9	0,58		Water, swedish plant material.	Turf, big trees with ivy. Water feature	Now registered as part of Kom. 6

APPENDIX 2: CASE STUDY RESULTS

BRIGGEN 4 - BAF

Food production			
Cultivation areas	0,5	0	0
Balconies, patios and greenhouses prepared for cultivation	0,5	0	0
Shrubs with edible berries, solitary	0,8	5	4
Shrubs with edible berries	0,2	0	0
Trees with edible fruits	5	0	0
Total:			**4**
Size			1275
BAF			**0,00**
Aesthetic values			
Visible green roof	0,05	43	2,15
Floral splendor	0,2	63,5	12,7
Shrubs, experiential, solitary	0,4	7	2,8
Shrubs, experiential	0,1	0	0
Shrubs, edible berries etc, solitary	4	5	20
Shrubs, edible berries etc	1	0	0
Trees, experiential	12,5	0	0
Fruit/flowering trees	25	1	25
Pergolas	0,3	19	5,7
Birdhouses	1	0	0
Open water	1	0	0
Biologically accessible waters	1	0	0
Fountains etc, water sound	7,5	0	0
Common roof terrace	0,2	0	0
Greenspace facing street	3	21	63
Trees facing street	50	0	0
Total:			**131,35**
Size			1275
BAF			**0,10**
Habitat for animals			
Diversity in groundcover	0,7	0	0
Native plant selection	0,5	100,5	50,25
Diversity of green sedum roofs	0,1	0	0
Butterfly restaurants	1	2	2
Shrubs with berries, solitary	1,6	5	8
Shrubs with berries	0,4	0	0
Houses for birds and more	2,5	0	0
Biologically accessible permanent water	4	0	0
Moist areas with temporary water	2	0	0
Total:			60,25
Size			1275
BAF			**0,05**
Filtering in vegetation			
Shrubs, solitary	0,8	7	5,6
Shrubs	0,2	13	2,6
Trees, trunk bigger than 30cm	60	0	0
Trees, 20-30cm trunk	37,5	1	37,5
Trees, 16-20cm trunk	25	1	25
Vegetation on walls	0,5	77	38,5
Total:			**109,2**
Size			1275
BAF			**0,09**
Stormwater management			
Vegetation on ground, no substructure	2	225	450
Open ground, > 800mm plant bed	1,5	0	0
Open ground, 200-800mm plant bed	0,2	0	0
Green roof, >300mm plant bed	0,4	0	0
Green roof 50-300mm plant bed	0,1	52	5,2
Integrated plantings on balconies	0,3	0	0
Water surfaces	1	0	0
Hardscape with permeability	0,3	103	30,9
Hardscape with some permeability	0,2	46	9,2
Hardscape with joints	0,05	420	21
Impermeable surfaces	0	0	0
Moist areas with temporary water	2	0	0
Delaying stormwater from impermeable surfaces and hardscape with joints in water and moist areas	0,2	0	0
Delaying stormwater from impermeable surfaces and hardscape with joints in underground magazines	0,1	0	0
Impermeable surfaces and hardscape with joints dewaters into vegetation	0,1	134	13,4
Total:			**529,7**
Size			1275
BAF			**0,42**

BRIGGEN 4 - CEEQUAL

Food production			
No questions in CEEQUAL concerns food production.	N/A		N/A
Aesthetic values			
Does the project provide facilities which favor the user and are the details well excecuted?	20	20	20
Has the landscape and visual elements been designed by a qualified landscape expert in each phase of the project?	31	19	19
- design	19	19	
- build	12	0	
Has the design been adapted to the local character?	24	4	4
- the shape and level of the ground	4	4	
- material	4	0	
- style and details	4	0	
- scale	4	0	
- landscape or city pattern	4	0	
Points recieved:			**43**
Habitat for animals			
Has habitats been built?	22	0	0
Does the site include nesting boxes or chambers for birds?	21	0	0
Improvement of areas of high ecological value	6%	5	5
Up to 5% - 0 p, 5-25% - 5 p, 25-50% - 10 p, 50-75% - 15p, more than 75% - 21p.			
Points recieved:			**5**
Filtering in vegetation			
No questions in CEEQUAL are relevant.	N/A		N/A
Stormwater management			
Do the project use sustainable drainage systems?	22	0	0
How big percentage of the total stormwater surface run-off from the project is treated at the source through infiltration?	50%	16	16
Up to 30% -8 p, up to 60% - 16 p. Up to 90 % - 24 p. More than 90% - 32p.			
Points recieved:			**16**

BRIGGEN 4 - SITES

Food production			
10% of vegetated area is dedicated to food production	3	0%	0
There is a way to distribute or sell produced goods to the site users and the community.	1	0	0
Total:			**0**
Aesthetic values			
The site provide accessible, quite outdoor spaces, including :	2	4 of 5	0
Seating for 5% of site users		No	
Visual and physical access to vegetation		Yes	
Elements that reduce noise and mitigate negative distractions		Yes	
Elements that address microclimate and other site-specific conditions (sun, shade, wind)		Yes	
Provide unobstructed views of vegetation from 50% of common spaces (e.g. living areas and office spaces)		Yes	
Total:		**4 of 5**	**0**
Habitat for animals			
Conserve and use native plants	50%	4	4
20% - 3 p, 40% - 4 p. 60% - 6 p.			
Conserve and restore native plant communities	0%	0	0
20% - 3 p, 40% - 4 p. 60% - 6 p.			
Total:			**4**
Filtering in vegetation			
Determine biomass density index			
Trees with understory	6	17	102
Trees without understory	4	0	0
Shrubs	3	6	18
Perennials	2	62	124
Dessert plants	1,5	0	0
Annual plantings	1,5	2	3
Managed turf >3 inch	3	0	0
Managed turf <3 inch	2	124	248
Unmanaged grass layer >9 inch	2	0	0
Unmanaged grass layer <9 inch	1,5	0	0
Wetland (not open water)	6	0	0
Impervious cover and bare ground not shaded by vegetation	0		0
Additional: Green walls, pergolas, trellises etc.	1	71	71
Total:			566
Size:			1275
BDI estimated 10 years after construction of new design:			0,443921569
BDI before redesign:	0		0
BDI before compared to estimated BDI after 10 years:			**0**
Same = 1, 1 more = 3, 2 more = 5, 4 more = 6.	**Total:**		**1**
Stormwater management			
All percipitation is managed on site	PR.	No	
Beautiful stormwater features?	4-5 p	4	4
50% of them=4points. 100% = 5points.			
Total:		**No**	**4**

FLAGGSKEPPAREN 1- BAF

Food production			
Cultivation areas	0,5	6	3
Balconies, patios and greenhouses prepared for cultivation	0,5	0	0
Shrubs with edible berries, solitary	0,8	0	0
Shrubs with edible berries	0,2	0	0
Trees with edible fruits	5	0	0
Total:			**3**
Size			2432
BAF			**0,00**
Aesthetic values			
Visible green roof	0,05	0	0
Floral splendor	0,2	57	11,4
Shrubs, experiential, solitary	0,4	14	5,6
Shrubs, experiential	0,1	3	0,3
Shrubs, edible berries etc, solitary	4	0	0
Shrubs, edible berries etc	1	0	0
Trees, experiential	12,5	0	0
Fruit/flowering trees	25	0	0
Pergolas	0,3	2	0,6
Birdhouses	1	0	0
Open water	1	0	0
Biologically accessible waters	1	0	0
Fountains etc, water sound	7,5	0	0
Common roof terrace	0,2	0	0
Greenspace facing street	3	26,8	80,4
Trees facing street	50	0	0
Total:			**98,3**
Size			2432
BAF			**0,04**
Habitat for animals			
Diversity in groundcover	0,7	57	39,9
Native plant selection	0,5	0	0
Diversity of green sedum roofs	0,1	0	0
Butterfly restaurants	1	0	0
Shrubs with berries, solitary	1,6	0	0
Shrubs with berries	0,4	0	0
Houses for birds and more	2,5	0	0
Biologically accessible permanent water	4	0	0
Moist areas with temporary water	2	0	0
Total:			39,9
Size			2432
BAF			**0,02**
Filtering in vegetation			
Shrubs, solitary	0,8	14	11,2
Shrubs	0,2	20	4
Trees, trunk bigger than 30cm	60	0	0
Trees, 20-30cm trunk	37,5	0	0
Trees, 16-20cm trunk	25	0	0
Vegetation on walls	0,5	10	5
Total:			**20,2**
Size			2432
BAF			**0,01**
Stormwater management			
Vegetation on ground, no substructure	2	0	0
Open ground, > 800mm plant bed	1,5	0	0
Open ground, 200-800mm plant bed	0,2	80	16
Green roof, >300mm plant bed	0,4	0	0
Green roof 50-300mm plant bed	0,1	0	0
Integrated plantings on balconies	0,3	0	0
Water surfaces	1	0	0
Hardscape with permeability	0,3	0	0
Hardscape with some permeability	0,2	473	94,6
Hardscape with joints	0,05	506	25,3
Impermeable surfaces	0	1373	0
Moist areas with temporary water	2	0	0
Delaying stormwater from impermeable surfaces and hardscape with joints in water and moist areas	0,2	0	0
Delaying stormwater from impermeable surfaces and hardscape with joints in underground magazines	0,1	0	0
Impermeable surfaces and hardscape with joints dewaters into vegetation	0,1	0	0
Total:			**135,9**
Size			2432
BAF			**0,06**

FLAGGSKEPPAREN 1- CEEQUAL

Food production			
No questions in CEEQUAL concerns food production.	N/A		N/A
Aesthetic values			
Does the project provide facilities which favor the user and are the details well excecuted?	20	20	20
Has the landscape and visual elements been designed by a qualified landscape expert in each phase of the project?	31	0	0
- design	19	0	
- build	12	0	
Has the design been adapted to the local character?	24	0	0
- the shape and level of the ground	4	0	
- material	4	0	
- style and details	4	0	
- scale	4	0	
- landscape or city pattern	4	0	
Points recieved:			**20**
Habitat for animals			
Has habitats been built?	22	0	0
Does the site include nesting boxes or chambers for birds?	21	0	0
Improvement of areas of high ecological value	0%	0	0
Up to 5% - 0 p, 5-25% - 5 p, 25-50% - 10 p, 50-75% - 15p, more than 75% - 21p.			
Points recieved:			**0**
Filtering in vegetation			
No questions in CEEQUAL are relevant.	N/A		N/A
Stormwater management			
Do the project use sustainable drainage systems?	22	0	0
How big percentage of the total stormwater surface run-off from the project is treated at the source through infiltration?	0%	0	0
Up to 30% -8 p, up to 60% - 16 p. Up to 90 % - 24 p. More than 90% - 32p.			
Points recieved:			**0**

FLAGGSKEPPAREN 1- SITES

Food production			
10% of vegetated area is dedicated to food production	3	0	0
There is a way to distribute or sell produced goods to the site users and the community.	1	0	0
Total:			**0**
Aesthetic values			
The site provide accessible, quite outdoor spaces, including :	2	2 of 5	0
Seating for 5% of site users		Yes	
Visual and physical access to vegetation		Yes	
Elements that reduce noise and mitigate negative distractions		No	
Elements that address microclimate and other site-specific conditions (sun, shade, wind)		No	
Provide unobstructed views of vegetation from 50% of common spaces (e.g. living areas and office spaces)		No	
Total:		**2 of 5**	**0**
Habitat for animals			
Conserve and use native plants	0%	0	0
20% - 3 p, 40% - 4 p. 60% - 6 p.			
Conserve and restore native plant communities	0%	0	0
20% - 3p, 40% - 4p, 60% - 6p			
Total:			**0**
Filtering in vegetation			
Determine biomass density index			
Trees with understory	6	0	0
Trees without understory	4	0	0
Shrubs	3	35	105
Perennials	2	57	114
Dessert plants	1,5	0	0
Annual plantings	1,5	6	9
Managed turf >3 inch	3	0	0
Managed turf <3 inch	2	0	0
Unmanaged grass layer >9 inch	2	0	0
Unmanaged grass layer <9 inch	1,5	0	0
Wetland (not open water)	6	0	0
Impervious cover and bare ground not shaded by vegetation	0	0	0
Additional: Green walls, pergolas, trellises etc.	1	2	2
Total:			230
Size:			2432
BDI estimated 10 years after construction of new design:	0		0,09457237
BDI before redesign:			0
BDI before - estimated BDI after 10 years:			**0**
Same = 1, 1 more = 3, 2 more = 5, 4 more = 6.		**Total:**	**1**
Stormwater management			
All percipitation is managed on site	PR.	No	
Beautiful stormwater features?	4-5p	0%	0
50% of them=4points. 100% = 5points.			
Total:		**No**	**0**

KLIPPERN 3 - BAF

Food production			
Cultivation areas	0,5	36	18
Balconies, patios and greenhouses prepared for cultivation	0,5	36	18
Shrubs with edible berries, solitary	0,8	11	8,8
Shrubs with edible berries	0,2	0	0
Trees with edible fruits	5	7	35
Total:			**79,8**
Size			606
BAF			**0,13**
Aesthetic values			
Visible green roof	0,05	35	1,75
Floral splendor	0,2	224,25	44,85
Shrubs, experiential, solitary	0,4	25	10
Shrubs, experiential	0,1	0	0
Shrubs, edible berries etc, solitary	4	18	72
Shrubs, edible berries etc	1	0	0
Trees, experiential	12,5	0	0
Fruit/flowering trees	25	0	0
Pergolas	0,3	0	0
Birdhouses	1	0	0
Open water	1	0	0
Biologically accessible waters	1	0	0
Fountains etc, water sound	7,5	0	0
Common roof terrace	0,2	0	0
Greenspace facing street	3	17	51
Trees facing street	50	0	0
Total:			**179,6**
Size			606
BAF			**0,30**
Habitat for animals			
Diversity in groundcover	0,7	224,25	156,98
Native plant selection	0,5	224,25	112,13
Diversity of green sedum roofs	0,1	151,25	15,125
Butterfly restaurants	1	0	0
Shrubs with berries, solitary	1,6	18	28,8
Shrubs with berries	0,4	0	0
Houses for birds and more	2,5	0	0
Biologically accessible permanent water	4	0	0
Moist areas with temporary water	2	73	146
Total:			459,03
Size			606
BAF			**0,76**
Filtering in vegetation			
Shrubs, solitary	0,8	25	20
Shrubs	0,2	0	0
Trees, trunk bigger than 30cm	60	0	0
Trees, 20-30cm trunk	37,5	0	0
Trees, 16-20cm trunk	25	0	0
Vegetation on walls	0,5	96	48
Total:			**68**
Size			606
BAF			**0,11**
Stormwater management			
Vegetation on ground, no substructure	2	0	0
Open ground, > 800mm plant bed	1,5	73	109,5
Open ground, 200-800mm plant bed	0,2	0	0
Green roof, >300mm plant bed	0,4	151	60,4
Green roof 50-300mm plant bed	0,1	0	0
Integrated plantings on balconies	0,3	36	10,8
Water surfaces	1	0	0
Hardscape with permeability	0,3	111,5	33,45
Hardscape with some permeability	0,2	30	6
Hardscape with joints	0,05	0	0
Impermeable surfaces	0	201	0
Moist areas with temporary water	2	73	146
Delaying stormwater from impermeable surfaces and hardscape with joints in water and moist areas	0,2	231	46,2
Delaying stormwater from impermeable surfaces and hardscape with joints in underground magazines	0,1	0	0
Impermeable surfaces and hardscape with joints dewaters into vegetation	0,1	0	0
Total:			**412,35**
Size			606
BAF			**0,68**

KLIPPERN 3 - CEEQUAL

Food production			
No questions in CEEQUAL concerns food production.	N/A		N/A
Aesthetic values			
Does the project provide facilities which favor the user and are the details well excecuted?	20	20	20
Has the landscape and visual elements been designed by a qualified landscape expert in each phase of the project?	31	31	31
- design	19	19	
- build	12	12	
Has the design been adapted to the local character?	24	8	8
- the shape and level of the ground	4	4	
- material	4	0	
- style and details	4	0	
- scale	4	0	
- landscape or city pattern	4	4	
Points recieved:			**59**
Habitat for animals			
Has habitats been built?	22	22	22
Does the site include nesting boxes or chambers for birds?	21	0	0
Improvement of areas of high ecological value	45%	10	10
Up to 5% - 0 p, 5-25% - 5 p, 25-50% - 10 p, 50-75% - 15p, more than 75% - 21p.			
Points recieved:			**32**
Filtering in vegetation			
No questions in CEEQUAL are relevant.	N/A		N/A
Stormwater management			
Do the project use sustainable drainage systems?	22	22	22
How big percentage of the total stormwater surface run-off from the project is treated at the source through infiltration?	100%	32	32
Up to 30% -8 p, up to 60% - 16 p. Up to 90 % - 24 p. More than 90% - 32p.			
Points recieved:			**54**

KLIPPERN 3 - SITES

Food production			
10% of vegetated area is dedicated to food production	3	33%	3
There is a way to distribute or sell produced goods to the site users and the community.	1	0	0
Total:			**3**
Aesthetic values			
The site provide accessible, quite outdoor spaces, including :	2	5 of 5	2
Seating for 5% of site users		Yes	
Visual and physical access to vegetation		Yes	
Elements that reduce noise and mitigate negative distractions		Yes	
Elements that address microclimate and other site-specific conditions (sun, shade, wind)		Yes	
Provide unobstructed views of vegetation from 50% of common spaces (e.g. living areas and office spaces)		Yes	
Total:		**5 of 5**	**2**
Habitat for animals			
Conserve and use native plants	80%	6	6
20% - 3 p, 40% - 4 p. 60% - 6 p.			
Conserve and restore native plant communities	0%	0	0
20% - 3 p, 40% - 4 p. 60% - 6 p.			
Total:			**6**
Filtering in vegetation			
Determine biomass density index			
Trees with understory	6	12	72
Trees without understory	4	0	0
Shrubs	3	61	183
Perennials	2	235	470
Dessert plants	1,5	0	0
Annual plantings	1,5	36	54
Managed turf >3 inch	3	0	0
Managed turf <3 inch	2	0	0
Unmanaged grass layer >9 inch	2	0	0
Unmanaged grass layer <9 inch	1,5	0	0
Wetland (not open water)	6	0	0
Impervious cover and bare ground not shaded by vegetation	0	0	0
Additional: Green walls, pergolas, trellises etc.	1	56	56
Total:			835
Size			606
BDI estimated 10 years after construction of new design:			1,3778878
BDI before redesign:	0		0
BDI before - estimated BDI after 10 years:			**1**
Same = 1, 1 more = 3, 2 more = 5, 4 more = 6.	**Total:**		**3**
Stormwater management			
All percipitation is managed on site	PR.	Yes	
Beautiful stormwater features?	4-5 p		5
50% of them=4points. 100% = 5points.			
Total:		**Yes**	**5**

KOGGEN 1 - BAF

Food production			
Cultivation areas	0,5	0	0
Balconies, patios and greenhouses prepared for cultivation	0,5	0	0
Shrubs with edible berries, solitary	0,8	13	10,4
Shrubs with edible berries	0,2	0	0
Trees with edible fruits	5	0	0
Total:			**10,4**
Size			1784
BAF			**0,01**
Aesthetic values			
Visible green roof	0,05	510	25,5
Floral splendor	0,2	808	161,6
Shrubs, experiential, solitary	0,4	19	7,6
Shrubs, experiential	0,1	0	0
Shrubs, edible berries etc, solitary	4	13	52
Shrubs, edible berries etc	1	0	0
Trees, experiential	12,5	6	75
Fruit/flowering trees	25	6	150
Pergolas	0,3	86	25,8
Birdhouses	1	4	4
Open water	1	0	0
Biologically accessible waters	1	0	0
Fountains etc, water sound	7,5	0	0
Common roof terrace	0,2	0	0
Greenspace facing street	3	97	291
Trees facing street	50	0	0
Total:			**792,5**
Size			1784
BAF			**0,44**
Habitat for animals			
Diversity in groundcover	0,7	298	208,6
Native plant selection	0,5	808	404
Diversity of green sedum roofs	0,1	510	51
Butterfly restaurants	1	0	0
Shrubs with berries, solitary	1,6	19	30,4
Shrubs with berries	0,4	0	0
Houses for birds and more	2,5	4	10
Biologically accessible permanent water	4	0	0
Moist areas with temporary water	2	0	0
Total:			704
Size			1784
BAF			**0,39**
Filtering in vegetation			
Shrubs, solitary	0,8	19	15,2
Shrubs	0,2	0	0
Trees, trunk bigger than 30cm	60	0	0
Trees, 20-30cm trunk	37,5	6	225
Trees, 16-20cm trunk	25	0	0
Vegetation on walls	0,5	86	43
Total:			**283,2**
Size			1784
BAF			**0,16**
Stormwater management			
Vegetation on ground, no substructure	2	298	596
Open ground, > 800mm plant bed	1,5		0
Open ground, 200-800mm plant bed	0,2		0
Green roof, >300mm plant bed	0,4	510	204
Green roof 50-300mm plant bed	0,1	0	0
Integrated plantings on balconies	0,3	0	0
Water surfaces	1	0	0
Hardscape with permeability	0,3	0	0
Hardscape with some permeability	0,2	228	45,6
Hardscape with joints	0,05	297	14,85
Impermeable surfaces	0	0	0
Moist areas with temporary water	2	0	0
Delaying stormwater from impermeable surfaces and hardscape with joints in water and moist areas	0,2	0	40
Delaying stormwater from impermeable surfaces and hardscape with joints in underground magazines	0,1	0	0
Impermeable surfaces and hardscape with joints dewaters into vegetation	0,1	200	20
Total:			**920,45**
Size			1784
BAF			**0,52**

KOGGEN 1 - CEEQUAL

Food production			
No questions in CEEQUAL concerns food production.	N/A		N/A
Aesthetic values			
Does the project provide facilities which favor the user and are the details well excecuted?	20	20	20
Has the landscape and visual elements been designed by a qualified landscape expert in each phase of the project?	31	31	31
- design	19	19	
- build	12	12	
Has the design been adapted to the local character?	24	17	17
- the shape and level of the ground	4	4	
- material	4	4	
- style and details	4	1	
- scale	4	4	
- landscape or city pattern	4	4	
Points recieved:			**68**
Habitat for animals			
Has habitats been built?	22	22	22
Does the site include nesting boxes or chambers for birds?	21	21	21
Improvement of areas of high ecological value	45%	10	10
Up to 5% - 0 p, 5-25% - 5 p, 25-50% - 10 p, 50-75% - 15p, more than 75% - 21p.			
Points recieved:			**53**
Filtering in vegetation			
No questions in CEEQUAL are relevant.	N/A		N/A
Stormwater management			
Do the project use sustainable drainage systems?	22	22	22
How big percentage of the total stormwater surface run-off from the project is treated at the source through infiltration?	95%	32	32
Up to 30% -8 p, up to 60% - 16 p. Up to 90 % - 24 p. More than 90% - 32p.			
Points recieved:			**54**

KOGGEN 1 - SITES

Food production			
10% of vegetated area is dedicated to food production	3	0%	0
There is a way to distribute or sell produced goods to the site users and the community.	1	0	0
Total:			**0**
Aesthetic values			
The site provide accessible, quite outdoor spaces, including :	2	3 of 5	0
Seating for 5% of site users		No	
Visual and physical access to vegetation		Yes	
Elements that reduce noise and mitigate negative distractions		No	
Elements that address microclimate and other site-specific conditions (sun, shade, wind)		Yes	
Provide unobstructed views of vegetation from 50% of common spaces (e.g. living areas and office spaces)		Yes	
Total:		**3 of 5**	**0**
Habitat for animals			
Conserve and use native plants	60%	6	6
20% - 3 p, 40% - 4 p. 60% - 6 p.			
Conserve and restore native plant communities	86%	6	6
20% - 3 p, 40% - 4 p. 60% - 6 p.			
Total:			**12**
Filtering in vegetation			
Determine biomass density index			
Trees with understory	6	96	576
Trees without understory	4	0	0
Shrubs	3	171	513
Perennials	2	298	596
Dessert plants	1,5	0	0
Annual plantings	1,5	0	0
Managed turf >3 inch	3	0	0
Managed turf <3 inch	2	0	0
Unmanaged grass layer >9 inch	2	0	0
Unmanaged grass layer <9 inch	1,5	0	0
Wetland (not open water)	6	0	0
Impervious cover and bare ground not shaded by vegetation	0	0	0
Additional: Green walls, pergolas, trellises etc.	1	86	86
Total:			1771
Area of Lot:			1784
BDI estimated 10 years after construction of new design:			0,992713
BDI before redesign:			0
BDI before (minus) estimated BDI after 10 years:			**1**
Same = 1, 1 more = 3, 2 more = 5, 4 more = 6.		**Total:**	**3**
Stormwater management			
All percipitation is managed on site	PR.	No	
Beautiful stormwater features?			
50% of them=4points. 100% = 5points.	4-5p.	95%	4
Total:		**No**	**4**

KOMMENDÖRKAPTENEN 3 - BAF

Food production			
Cultivation areas	0,5	15	7,5
Balconies, patios and greenhouses prepared for cultivation	0,5	155	77,5
Shrubs with edible berries, solitary	0,8	0	0
Shrubs with edible berries	0,2	0	0
Trees with edible fruits	5	4	20
Total:			**105**
Size			630
BAF			**0,17**
Aesthetic values			
Visible green roof	0,05	12	0,6
Floral splendor	0,2	90	18
Shrubs, experiential, solitary	0,4	0	0
Shrubs, experiential	0,1	0	0
Shrubs, edible berries etc, solitary	4	0	0
Shrubs, edible berries etc	1	0	0
Trees, experiential	12,5	8	100
Fruit/flowering trees	25	15	375
Pergolas	0,3	0	0
Birdhouses	1	1	1
Open water	1	0	0
Biologically accessible waters	1	0	0
Fountains etc, water sound	7,5	0	0
Common roof terrace	0,2	87	17,4
Greenspace facing street	3	0	0
Trees facing street	50	0	0
Total:			**512**
Size			630
BAF			**0,81**
Habitat for animals			
Diversity in groundcover	0,7	122	85,4
Native plant selection	0,5	0	0
Diversity of green sedum roofs	0,1	0	0
Butterfly restaurants	1	0	0
Shrubs with berries, solitary	1,6	0	0
Shrubs with berries	0,4	0	0
Houses for birds and more	2,5	1	2,5
Biologically accessible permanent water	4	0	0
Moist areas with temporary water	2	0	0
Total:			87,9
Size			630
BAF			**0,14**
Filtering in vegetation			
Shrubs, solitary	0,8	0	0
Shrubs	0,2	0	0
Trees, trunk bigger than 30cm	60	6	360
Trees, 20-30cm trunk	37,5	3	112,5
Trees, 16-20cm trunk	25	10	250
Vegetation on walls	0,5	45	22,5
Total:			**745**
Size			630
BAF			**1,18**
Stormwater management			
Vegetation on ground, no substructure	2	223	446
Open ground, > 800mm plant bed	1,5	0	0
Open ground, 200-800mm plant bed	0,2	0	0
Green roof, >300mm plant bed	0,4	0	0
Green roof 50-300mm plant bed	0,1	12	1,2
Integrated plantings on balconies	0,3	135	40,5
Water surfaces	1	0	0
Hardscape with permeability	0,3	0	0
Hardscape with some permeability	0,2	134	26,8
Hardscape with joints	0,05	172	8,6
Impermeable surfaces	0	0	0
Moist areas with temporary water	2	0	0
Delaying stormwater from impermeable surfaces and hardscape with joints in water and moist areas	0,2		0
Delaying stormwater from impermeable surfaces and hardscape with joints in underground magazines	0,1	0	0
Impermeable surfaces and hardscape with joints dewaters into vegetation	0,1	223	22,3
Total:			**545,4**
Size			630
BAF			**0,87**

KOMMENDÖRKAPTENEN 3 - CEEQUAL

Food production			
No questions in CEEQUAL concerns food production.	N/A		N/A
Aesthetic values			
Does the project provide facilities which favor the user and are the details well excecuted?	20	20	20
Has the landscape and visual elements been designed by a qualified landscape expert in each phase of the project?	31	31	31
- design	19	19	
- build	12	12	
Has the design been adapted to the local character?	24	12	12
- the shape and level of the ground	4	4	
- material	4	0	
- style and details	4	0	
- scale	4	4	
- landscape or city pattern	4	4	
Points recieved:			**63**
Habitat for animals			
Has habitats been built?	22	22	22
Does the site include nesting boxes or chambers for birds?	21	21	21
Improvement of areas of high value	57%	15	15
Up to 5% - 0 p, 5-25% - 5 p, 25-50% - 10 p, 50-75% - 15p, more than 75% - 21p.			
Points recieved:			**58**
Filtering in vegetation			
No questions in CEEQUAL are relevant.	N/A		N/A
Stormwater management			
Do the project use sustainable drainage systems?	22	0	0
How big percentage of the total stormwater surface run-off from the project is treated at the source through infiltration?	100%	32	32
Up to 30% -8 p, up to 60% - 16 p. Up to 90 % - 24 p. More than 90% - 32p.			
Points recieved:			**32**

KOMMENDÖRKAPTENEN 3 - SITES

Food production			
10% of vegetated area is dedicated to food production	3	40%	3
There is a way to distribute or sell produced goods to the site users and the community.	1	0	0
Total:			**3**
Aesthetic values			
The site provide accessible, quite outdoor spaces, including :	2	5 of 5	2
Seating for 5% of site users		Yes	
Visual and physical access to vegetation		Yes	
Elements that reduce noise and mitigate negative distractions		Yes	
Elements that address microclimate and other site-specific conditions (sun, shade, wind)		Yes	
Provide unobstructed views of vegetation from 50% of common spaces (e.g. living areas and office spaces)		Yes	
Total:		**5 of 5**	**2**
Habitat for animals			
Conserve and use native plants	20%	3	3
20% - 3 p, 40% - 4 p. 60% - 6 p.			
Conserve and restore native plant communities	0%	0	0
20% - 3 p, 40% - 4 p. 60% - 6 p.			
Total:			**3**
Filtering in vegetation			
Determine biomass density index			
Trees with understory	6	63	378
Trees without understory	4	0	0
Shrubs	3	13	39
Perennials	2	265	530
Dessert plants	1,5	0	0
Annual plantings	1,5	15	22,5
Managed turf >3 inch	3	0	0
Managed turf <3 inch	2	223	446
Unmanaged grass layer >9 inch	2	0	0
Unmanaged grass layer <9 inch	1,5	0	0
Wetland (not open water)	6	0	0
Impervious cover and bare ground not shaded by vegetation	0	0	0
Additional: Green walls, pergolas, trellises etc.	1	45	45
Total:			1460,5
Size			630
BDI estimated 10 years after construction of new design:			2,318253968
BDI before redesign:	0		0
BDI before - estimated BDI after 10 years:			**2**
Same = 1, 1 more = 3, 2 more = 5, 4 more = 6.		**Total:**	**5**
Stormwater management			
All percipitation is managed on site	PR.	Yes	
Beautiful stormwater features?			
50% of them=4points. 100% = 5points.	4-5p	100%	5
Total:		**Yes**	**5**

KOMMENDÖRKAPTENEN 10 - BAF

Food production			
Cultivation areas	0,5	0	0
Balconies, patios and greenhouses prepared for cultivation	0,5	0	0
Shrubs with edible berries, solitary	0,8	0	0
Shrubs with edible berries	0,2	5	1
Trees with edible fruits	5	0	0
Total:			**1**
Size			1121
BAF			**0,00**
Aesthetic values			
Visible green roof	0,05	0	0
Floral splendor	0,2	52	10,4
Shrubs, experiential, solitary	0,4	4	1,6
Shrubs, experiential	0,1	41,5	4,15
Shrubs, edible berries etc, solitary	4	0	0
Shrubs, edible berries etc	1	5	5
Trees, experiential	12,5	1	12,5
Fruit/flowering trees	25	1	25
Pergolas	0,3	0	0
Birdhouses	1	0	0
Open water	1	0	0
Biologically accessible waters	1	0	0
Fountains etc, water sound	7,5	0	0
Common roof terrace	0,2	0	0
Greenspace facing street	3	0	0
Trees facing street	50	0	0
Total:			**58,65**
Size			1121
BAF			**0,05**
Habitat for animals			
Diversity in groundcover	0,7	0	0
Native plant selection	0,5	0	0
Diversity of green sedum roofs	0,1	0	0
Butterfly restaurants	1	0	0
Shrubs with berries, solitary	1,6	0	0
Shrubs with berries	0,4	5	2
Houses for birds and more	2,5	0	0
Biologically accessible permanent water	4	0	0
Moist areas with temporary water	2	0	0
Total:			2
Size			1121
BAF			**0,00**
Filtering in vegetation			
Shrubs, solitary	0,8	2	1,6
Shrubs	0,2	46,5	9,3
Trees, trunk bigger than 30cm	60	0	0
Trees, 20-30cm trunk	37,5	0	0
Trees, 16-20cm trunk	25	1	25
Vegetation on walls	0,5	56	28
Total:			**63,9**
Size			1121
BAF			**0,06**
Stormwater management			
Vegetation on ground, no substructure	2	0	0
Open ground, > 800mm plant bed	1,5	6	9
Open ground, 200-800mm plant bed	0,2	188,5	37,7
Green roof, >300mm plant bed	0,4	0	0
Green roof 50-300mm plant bed	0,1	486	48,6
Integrated plantings on balconies	0,3	0	0
Water surfaces	1	0	0
Hardscape with permeability	0,3	0	0
Hardscape with some permeability	0,2	8,3	1,66
Hardscape with joints	0,05	533	26,65
Impermeable surfaces	0	0	0
Moist areas with temporary water	2	0	0
Delaying stormwater from impermeable surfaces and hardscape with joints in water and moist areas	0,2	0	0
Delaying stormwater from impermeable surfaces and hardscape with joints in underground magazines	0,1	0	0
Impermeable surfaces and hardscape with joints dewaters into vegetation	0,1	0	0
Total:			**123,61**
Size			1121
BAF			**0,11**

KOMMENDÖRKAPTENEN 10 - CEEQUAL

Food production			
No questions in CEEQUAL concerns food production.	N/A		N/A
Aesthetic values			
Does the project provide facilities which favor the user and are the details well excecuted?	20	0	0
qualified landscape expert in each phase of the project?	31	31	31
- design	19	19	
- build	12	12	
Has the design been adapted to the local character?	24	8	8
- the shape and level of the ground	4	4	
- material	4	0	
- style and details	4	0	
- scale	4	4	
- landscape or city pattern	4	0	
Points recieved:			**39**
Habitat for animals			
Has habitats been built?	22	0	0
Does the site include nesting boxes or chambers for birds?	21	0	0
Improvement of areas of high value	49%	10	10
Up to 5% - 0 p, 5-25% - 5 p, 25-50% - 10 p, 50-75% - 15p, more than 75% - 21p.			
Points recieved:			**10**
Filtering in vegetation			
No questions in CEEQUAL are relevant.	N/A		N/A
Stormwater management			
Do the project use sustainable drainage systems?	22	0	0
How big percentage of the total stormwater surface run-off from the project is treated at the source through infiltration?	33%	16	16
Up to 30% -8 p, up to 60% - 16 p. Up to 90 % - 24 p. More than 90% - 32p.			
Points recieved:			**16**

KOMMENDÖRKAPTENEN 10 - SITES

Food production			
10% of vegetated area is dedicated to food production	3	0%	0
There is a way to distribute or sell produced goods to the site users and the community.	1	0	0
Total:			**0**
Aesthetic values			
The site provide accessible, quite outdoor spaces, including :	2	3 of 5	0
Seating for 5% of site users		Yes	
Visual and physical access to vegetation		Yes	
Elements that reduce noise and mitigate negative distractions		No	
Elements that address microclimate and other site-specific conditions (sun, shade, wind)		No	
Provide unobstructed views of vegetation from 50% of common spaces (e.g. living areas and office spaces)		Yes	
Total:		**3 of 5**	**0**
Habitat for animals			
Conserve and use native plants	30%	3	3
20% - 3 p, 40% - 4 p. 60% - 6 p.			
Conserve and restore native plant communities	0%	0	0
20% - 3 p, 40% - 4 p. 60% - 6 p.			
Total:			**3**
Filtering in vegetation			
Determine biomass density index			
Trees with understory	6	16	96
Trees without understory	4	0	0
Shrubs	3	50	150
Perennials	2	52	104
Dessert plants	1,5	0	0
Annual plantings	1,5	0	0
Managed turf >3 inch	3	123	369
Managed turf <3 inch	2	0	0
Unmanaged grass layer >9 inch	2	0	0
Unmanaged grass layer <9 inch	1,5	0	0
Wetland (not open water)	6	0	0
Impervious cover and bare ground not shaded by vegetation	0	0	0
Additional: Green walls, pergolas, trellises etc.	1	56	56
Total:			775
Size			1121
BDI estimated 10 years after construction of new design:			0,691347
BDI before redesign:	0		0
BDI before - estimated BDI after 10 years:			**1**
Same = 1, 1 more = 3, 2 more = 5, 4 more = 6.	**Total:**		**3**
Stormwater management			
All percipitation is managed on site	PR.	No	
Beautiful stormwater features?			
50% of them=4points. 100% = 5points.	4-5p	0	0
Total:		**No**	**0**