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GRaBS Expert Paper 6

the green space factor and the green points system

By Annika Kruuse

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GRaBS

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Foreword

New developments are being planned and delivered all over Europe, and many of them include robust climate change mitigation measures (such as zero- or low-carbon dwellings, renewable energy, reduced car use, and so on).

However, new developments which also include specific adaptation measures for both green and blue (water) infrastructure and management are not so well established. But things are changing. In this, the sixth in the series of GRaBS Expert Papers, Annika Kruuse from the City of Malmö outlines the success of partnership working between the private, public and voluntary sectors to produce new developments that have a positive adaptive capacity. The partnership works because the developer has some choice of delivery, the municipality can meet its targets, and the community benefits from improved green infrastructure and a reduction in the impact of extreme heat and excessive rainfall.

This Expert Paper explains the process and the impact of the Green Space Factor and Green Points system, and is written with transferability in mind, to enable other municipalities to create new developments which integrate green infrastructure from the start. GRaBS project partners have already had the opportunity to do this, and systems have already been developed for use in North West England, the London Borough of Sutton and Southampton City Council.

Diane Smith
GRaBS Project Manager & European and Corporate Affairs Manager
TCPA

1 Introduction

There is a growing understanding that green and blue infrastructure provides a range of services which can make us more resilient and better adapted to climate change.[1] It helps us to cope with some of the extreme weather that we already experience, and which may become more common in the future. For example, it can help us to cope with heatwaves by providing evaporative cooling and shade and by letting cooler air flow into urban areas; it can also help us to cope with heavy rain by capturing rainwater, providing temporary or permanent areas in which to store water, and by allowing it to pass into the soil rather than running off the surface and potentially overwhelming drainage systems. Using green and blue infrastructure to help us adapt to climate change is recognised as a desirable 'win-win' approach because it also delivers multiple social, economic and environmental benefits.[2]

As a result there is increasing interest in tools that can be used to help ensure that adequate green and blue infrastructure is incorporated into new developments. Malmö in Sweden is often cited as an example of a city in which green infrastructure planning tools have been successfully used in new developments. This Expert Paper reports on the development of a suite of green infrastructure planning tools in the new Malmö city district of Västra Hamnen (Western Harbour). The planning of the Western Harbour area began in the late 1990s, when climate change was not a core issue – even in Sweden – and climate adaptation even less so. This Expert Paper focuses two green infrastructure tools developed since then: the Green Space Factor (an innovative way of calculating green space requirements for new development); and the Green Points System (a checklist of green and blue infrastructure options for developers to use to achieve a minimum level of green/blue space) compensation habitat for birds, biotopes in parks and the layout of an open stormwater system.

2 Bo01 – sustainable city of tomorrow

An international housing exposition, called Bo01, and also referred to as 'The Sustainable City of Tomorrow', was held in Malmö in 2001. It consisted of two parts: a temporary exhibition area of buildings surrounded by gardens and art forms; and a new housing district of 500 dwellings, mostly apartments.

The new housing district was the first development in the former industrial area of the Western Harbour and was an important step in Malmö's journey from industrial city in deep economic crisis to a modern, sustainable city with a knowledge-based economy. This change was driven partly by a visioning process led by the city administration during the 1990s. Additional outcomes of this process included the Öresund Bridge, connecting Malmö and Copenhagen, and the University of Malmö, established in 1999 in former industrial buildings in the Western Harbour.

The land of the Western Harbour has been claimed from the sea. The landfilling process started in the 1840s and continued into the late 1980s. The Kockums shipyard built its first steamship in 1873 and for the next 100 years was more or less synonymous with the Western Harbour. In the late 1980s, after the collapse of the Swedish shipbuilding industry, a modern car factory was built in Western Harbour, which made cars for a very short period of time before closing down. The last landfill was made with sea-sand to create a car testing lane. However, previous filling materials had been of varying quality, and thorough soil reclamation was the first action required when developing Bo01.

1 See, for example, S.E. Gill, J.F. Handley, A.R. Ennos and S. Pauleit: 'Adapting cities for climate change: the role of the green infrastructure'. *Built Environment*, 2007, 33 (1), 115-33. See also *Climate Change Adaptation by Design*. TCPA, 2007. **http://www.tcpa.org.uk/pages/climate-change-adaptation-by-design.html**

2 See, for example, *Planning for Climate Change – Guidance and Model Policies for Local Authorities*. Planning and Climate Change Coalition. TCPA, 2010. **http://www.tcpa.org.uk/pages/planning-for-climate-change-guide.html**

The Bo01 district layout differs from that of most modern cities; there are no straight streets or long lines of vision. The intention behind the design was to trigger the visitor's curiosity and make them want to find out what lies round the next corner. The plan director for Bo01, the Swedish architect Klas Tham, studied a range of attractive cities, many of them medieval, with a location similar to the Western Harbour – i.e. on an east-facing coast exposed to mainly western winds. He decided to design a modern version of narrow medieval alleys. The aim was to protect the area from wind, achieved by placing the higher buildings along the seafront, with lower buildings behind them thus sheltered from the prevailing winds. The masterplan set out an outline of the buildings, courtyards, streets and squares and stipulated what height they could be, and the development as built demonstrates extensive architectural variation, with several different developers involved with each small block.

Major efforts were made to produce a district that reflected the Bo01 expo's 'Sustainable City of Tomorrow' theme. Most importantly, the area is supplied with 100% locally produced renewable energy, with electricity generated from wind, heat from the sun and from sea water, which is seasonally stored in underground aquifers. The area's waste system features two technical methods for collecting organic waste: waste mills in some buildings, and vacuum waste collectors in others. Organic waste is stored in underground tanks, from which it is collected and transported to a biogas plant, where it is upgraded to biogas and biomanure. Other waste types, such as paper, plastic and glass, are collected in separate buildings in a way that was advanced at the time of introduction but is now standard for new developments in Malmö. There are public transport links with frequent services and cycle lanes. Together with car sharing pools, these contribute to sustainable mobility, even though many families in the area still have two cars. The environmental schemes as well as aesthetics are described in the *Quality Program Bo01*,[3] a document co-created by the city and the expo company, with representatives from the developers giving their views throughout the process.

3 green and blue Bo01

The public space of Bo01 consists of four main parts: the seaside walk, the internal alleys and squares, the canal side walk and the three parks. The Quality Program set out ambitious instructions for the aesthetic quality as well as the biodiversity of the public space, not least the parks. The stormwater management system within the streets, squares and private courtyards also makes an important contribution to the character of the public space. The landscape architect responsible for the green and blue aspects of Bo01 realised that the housing blocks' courtyards needed special schemes to prevent them becoming grey and visually boring surfaces. The objective of creating new, high-quality green space incurred a breakthrough when the City Council agreed to use a 'Green Space Factor' and a 'Green Points System' to achieve a minimum level of greenery, and special green and blue qualities for the courtyards.

As a result of the geographical position of Malmö – built on former agricultural land with no hills, forests or other natural obstacles to dense development – there is little green land available for recreation in Malmö compared to other Swedish cities, and a discussion about creating new biologically and recreationally valuable land had been proceeding in Malmö. The time was therefore ripe to apply green planning instruments and this took place more than ten years before such measures were considered in any other Swedish city. The most important goals when implementing the green planning instruments were: to present an attractive, healthy environment for people; to promote biodiversity; and to minimise stormwater run-off.

Again, owing to Malmo's geographical location on flat, former agricultural land, many parts of the city lack natural channels for stormwater. This doesn't affect the city districts closer to the sea, but in large areas elsewhere small creeks receive more stormwater than they have capacity for, leading to problems with flooding and erosion. These circumstances have

3 *Quality Program Bo01*. City of Malmö, 1999.
http://www.malmo.se/download/18.4a2cec6a10d0ba37c0b800012615/kvalprog_bo01_dn_eng.pdf

inspired an interest in local stormwater management by Malmo's water and waste water company. The Bo01 expo created a perfect opportunity to implement a large open stormwater system within a dense housing district (see more details below). Today, Malmo is one of Sweden's leading cities in dealing with this issue.

3.1 Public space

The public space within Bo01 is of very high quality, aided by a range of surface materials, public art, meeting places and other features, all set out in the Quality Program and designed by external landscape architects (having secured the work through a competitive process). The different parts each have a different character; the area along the sea front is almost completely devoid of vegetation, but is designed for people to walk alongside the sea or sit on the long wooden staircase construction that runs along the seafront. The interior is designed a bit like a maze, with no straight streets or lines of vision but narrow curved alleys and small squares. There are vegetated ponds in the small squares and along some of the alleys, retaining and cleaning the stormwater as well as contributing to the aesthetics of the area.

The two new parks have been designed by well-known landscape architects. One of the new parks and an old, reconstructed park possess meadows, woodlands, sea shore and marine biotopes. The third park, along the seafront, was designed to serve people rather than to enhance biodiversity. The parks are not connected to the stormwater system, thereby missing the opportunity to achieve a closed local water system. The stormwater ponds of the streets and squares retain and clean much of the water, but to achieve a closed local water management system more space would have been required.

3.2 Open stormwater management

Stormwater from all the different surfaces within Bo01 is managed in an open system, consisting of narrow concrete canals and ponds with or without vegetation (sometimes referred to as a Sustainable Drainage System). The stormwater system was not set out in the district plan, but in the more specific public space plan. The whole system relies on a thorough planning

Fig. 1 Vegetated ponds form an important part of the stormwater system at Bo01, Western Harbour, Malmö

of heights of the whole area, and every courtyard lies above the stormwater system in the public space. Every courtyard has its own stormwater pond. The courtyard and roof run-off flows into the narrow canals integrated into streets, alleys and squares. There is a ridge which travels along the centre of Bo01. The stormwater to one side of the ridge is led through vegetated ponds, (see. Fig. 1), to the larger salt water canal bordering Bo01; some of the water is re-circulated to the top of the ridge where it goes back into the system through small fountains made of solid stone. The reason for the water circulation is mainly aesthetic, although it has been argued that it is also beneficial for the vegetation of the ponds. The water to the other side of the ridge goes to the sea, passing a vegetated pond in only one or two places.

The system is not regarded as technically crucial for managing the stormwater at the site – pipes taking the water directly to the sea and salt water canal would have been sufficient. However, the main purpose of including the open stormwater system was its high aesthetic value, as well as to pilot a system of this character within a dense housing district. As a result, similar approaches are now being used in other new developments in the city, but not in the further development of the Western Harbour.

3.3 Green Space Factor

The aim of using the Green Space Factor was to secure a certain amount of green cover in every building lot, and to minimise the degree of sealed or paved surfaces in the development. It is applied to the

whole building lot, taking into account both the building areas and the open space. The courtyards are mainly private although it is possible to pass through some of them if you are a visitor. The developers had to describe in their detailed plans how they would achieve the requested Green Space Factor of 0.5. The plan was then checked by landscape architects at the city planning office, and the developers were asked to improve it if necessary. The system was adapted from Germany, where it is used in Berlin[4] and Hamburg among other cities. It has also been used in Seattle and, through the GRaBS project, some of the UK partners have been looking to adapt it for their own situations (see Case Study 1, on page 8).

The approach essentially assigns factors to different surface types, which are then multiplied by the area of each within the courtyard and summed; the total is divided by the courtyard area to give the overall Green Space Factor, which must reach a specified target level. The minimum level of the Green Space Factor to be reached in Bo01 was set at 0.5.

The Green Space Factor (GSF) is calculated as:

$$GSF = \frac{(\text{area A} \times \text{factor A}) + (\text{area B} \times \text{factor B}) + (\text{area C} \times \text{factor C}) + \text{etc.})}{\text{total courtyard area}}$$

The factors assigned to the different surface types vary from 1 for vegetation which is in contact with ground water (i.e. where there is no underground parking beneath) and open water, to 0 for sealed areas. High factors are also assigned to green roofs, large trees, and wall areas covered with climbing plants. The complete list of the factors used today is given in Box 1, on page 6.

3.4 Green Points

The Green Space Factor results in a certain amount of green cover in the building lot. It also starts to reward surface cover types which tend to be of a higher functionality than others by assigning them a higher factor, and it is possible to layer the different surface cover types to achieve a higher Green Space Factor (for example an area of grass covered by trees results in a higher Green Space Factor than an area of grass with no tree cover). That said, it does not really fully encompass the quality of the green cover. For example, using this approach a mown and manicured lawn is of equal value to a more natural meadow which supports greater biodiversity; an extensive green roof with a thin growing substrate for vegetation is of equal value to an intensive green roof with a thicker substrate which supports increased biodiversity and can help to intercept more rainwater, thereby reducing the amount of stormwater run-off.

To overcome this issue, in the courtyards of the Western Harbour, Green Points were added to the Green Space Factor to achieve certain additional qualities. Developers were given a list of 35 Green Points and were required to choose 10 of them. As for the Green Space Factor, the chosen 10 Green Points were described in the detail plans. Among the points, some aimed to aid biodiversity such as the inclusion of bat boxes and wild flowers in the courtyards, whilst others were included to improve the architectural qualities of the yard or help with stormwater management. A full list of 35 Green Points, from which developers selected 10, is shown in Box 1, on page 6.

Some of the yards have semi-natural biotopes as a result of the Green Points (see Figs 2 and 3, on page 7), while the one with the highest Green Space Factor reached its result with lawns and large areas of green roofs (see Fig. 4, on page 7).

A large area of land was unused and standing empty following the closure of the car factory in the early 1990s. As a result, sea birds had started to nest there, some species of which were on the EU species directive. When Bo01 was built, Malmo used a possibility in Swedish law to build a compensation habitat for sea birds in another part of the harbour, close to the wind power mill serving Bo01 with electricity. It was the first time a Swedish city used this possibility in the law.

4 For details of the Berlin Biotope Area Factor, see **http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/bff/index_en.shtml**

Box 1
Green Points

1 A bird box for every apartment
2 A biotope for specified insects in the courtyard (water striders and other aquatic insects in the pond)
3 Bat boxes in the courtyard
4 No surfaces in the courtyard are sealed, and all surfaces are permeable to water
5 All non-paved surfaces within the courtyard have sufficient soil depth and quality for growing vegetables
6 The courtyard includes a rustic garden with different sections
7 All walls, where possible, are covered with climbing plants
8 There is 1 square metre of pond area for every 5 square metres of hard-surface area in the courtyard
9 The vegetation in the courtyard is selected to be nectar rich and provide a variety of food for butterflies (a so-called 'butterfly restaurant')
10 No more than five trees or shrubs of the same species
11 The biotopes within the courtyard are all designed to be moist
12 The biotopes within the courtyard are all designed to be dry
13 The biotopes within the courtyard are all designed to be semi-natural
14 All stormwater flows for at least 10 metres on the surface of the ground before it is diverted into pipes
15 The courtyard is green, but there are no mown lawns
16 All rainwater from buildings and hard surfaces in the courtyard is collected and used for irrigation
17 All plants have some household use
18 There are frog habitats within the courtyard as well as space for frogs to hibernate
19 In the courtyard, there is at least 5 square metres of conservatory or greenhouse for each apartment
20 There is food for birds throughout the year within the courtyard
21 There are at least two different old-crop varieties of fruits and berries for every 100 square metres of courtyard
22 The facades of the buildings have swallow nesting facilities
23 The whole courtyard is used for the cultivation of vegetables, fruit and berries
24 The developers liaise with ecological experts
25 Greywater is treated in the courtyard and re-used
26 All biodegradable household and garden waste is composted
27 Only recycled construction materials are used in the courtyard
28 Each apartment has at least 2 square metres of built-in growing plots or flower boxes on the balcony
29 At least half the courtyard area consists of water
30 The courtyard has a certain colour (and texture) as the theme
31 All the trees and bushes in the courtyard bear fruit and berries
32 The courtyard has trimmed and shaped plants as its theme
33 A section of the courtyard is left for natural succession (that is, to naturally grow and regenerate)
34 There should be at least 50 flowering Swedish wild herbs within the courtyard
35 All the buildings have green roofs

4 evaluation of the green ideas used at Bo01

Bo01 has become more popular with the citizens of Malmo than anyone anticipated. Many people walk, bike, sunbathe and swim along the sea shore. The park situated beside the coast line (always intended to serve residents rather than to enhance biodiversity) is crowded on summer days and evenings. After further consideration, the lawns were partly sown with meadow plants and managed as meadows for a short period of time. However, the large number of visitors soon made it clear that lawns were more suitable for that location.

Fig. 2 A storm water pond in a courtyard at Bo01, Western Harbour, Malmö – the pond is built as a semi-natural biotope with regional wetland plants; in the background is a green roof, with edge of a woodland on the right

A common problem with local authorities demanding special development qualities is the lack of recourses for evaluation. In the case of Bo01, a national environmental programme had financed an area ecologist, who was trusted with the evaluation of the green schemes of Bo01. When the outcomes were evaluated a year after the housing expo most developments had more or less achieved the Green Space Factor that had been sought. All developers had shown in their detailed plans how they would achieve a Green Space Factor of at least 0.5. In most cases where the actual Green Space Factor was lower than the planned one, climbing plants had died and not been replaced. In the case of the lowest achieved Green Space Factor, a change in the plan had been made. The lowest factor that was achieved at Bo01 was 0.24, but almost everyone had reached 0.5 or very

Fig. 3 A sea shore habitat with regional vegetation in a courtyard at Bo01, Western Harbour, Malmö

Fig. 4 The courtyard with the highest Green Space Factor (a score 0.84) at Bo01, Western Harbour, Malmö was achieved its rating mainly with mown lawns and sedum roofs

The Green Space Factor and the Green Points System

Case Study

Green Infrastructure Toolkit – adapting the Green Space Factor and the Green Points System for use in the North West of England

This toolkit was developed from Malmö's Green Space Factor and Green Points system to support the green infrastructure objective of the Northwest Regional Development Agency's Sustainability Policy for the Built Environment. Projects funded through the European Region Development Fund North West Operational Programme will need to follow this policy until 2013.

The requirement of the policy is to achieve a Green Infrastructure Score of 'Very Good' using the toolkit; and it is expected that green infrastructure is optimised in all developments in order to achieve the 11 economic benefits identified by the Natural Economy Northwest project. The toolkit, which is available online, helps developers to determine their Green Infrastructure Score and interventions to maximise benefits.

The Green Infrastructure Score approach was developed from Malmö's Green Space Factor. In the North West of England it has been adapted to apply to the whole of the development site, with different requirements depending on whether the site already has built structures on it or not. If the site already has built structures then the Green Infrastructure Score has to be determined for the site as it exists pre-development as well as for the planned development; to reach a score of 'Very Good' the planned score needs to be at least 0.2 higher than the pre-development score. If the site does not currently have built structures on it then the score for the planned development must reach at least 0.6 to be classed as 'Very Good'. Different requirements were set for the site depending on the existence of built structures to try to include restructuring projects as well as new developments. The thinking was that where there is an existing urban form it may be harder to reach a target of 0.6; so that a planned-development score that is higher than the pre-development score should mean the incorporation more green infrastructure into the development through the restructuring process (and hence it being better adapted to climate change). The terminology 'Very Good' was used to tie in with the existing BREEAM terminology used in the UK, which is used and understood by developers.

The interventions suggested to maximise benefits were developed from Malmö's Green Points system, and their inclusion is to try to ensure that any green infrastructure that is put in place is as functional as it can be. There are 71 suggested interventions in total, which are grouped according to the 11 economic benefits identified by the Natural Economy Northwest project; this provides a common framework which is used in the North West of England when discussing the benefits that green infrastructure provides. The 11 benefits are: economic growth and investment, land and property values, labour productivity, tourism, products from the land, health and wellbeing, recreation and leisure, quality of place, land and biodiversity, flood alleviation and management, and climate change adaptation and mitigation.

The idea is that the developer refers to any existing Green Infrastructure Plans or Strategies for the area in order to determine which of the benefits they should be trying to achieve; they then filter the list of interventions accordingly and use this as a starting point to inform the design of the site and its green infrastructure.

Several local authorities in the North West of England have expressed an interest in incorporating such an approach into their planning policies and, through the GRaBS project, the London Borough of Sutton and Southampton City Council have been exploring this.

The Green Infrastructure Toolkit is available at **http://www.ginw.co.uk/resources/gi_toolkit.xls**

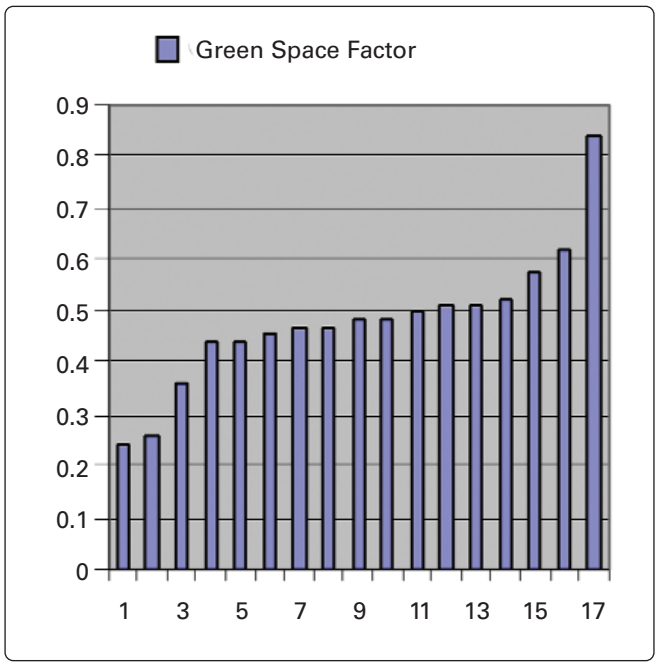

Fig. 5 There were 17 completed developments in the year 2002, when the courtyards of the multi-family houses were evaluated. The evaluation showed that most developers had reached, or almost reached, the requested Green Space Factor of 0.5; three were much lower (0.24-0.36) and one was much higher (0.84)

close to that (see Fig. 5). In two cases, landscape architects had been hired to compete for the best result, and interestingly reached Green Space Factors of 0.84 (Fig 5).

The residents of Bo01 were asked in a survey what they thought about the yards and parks and the stormwater system. Both the green and blue aspects were highly ranked.

A competition was arranged to find the courtyard most suitable for biodiversity while still offering a good environment for the residents. A jury (made up of representatives from the Swedish National Board of Housing, Building and Planning, the Swedish Agricultural University, the Swedish Biodiversity Centre, and the Swedish Nature Conservation Association) awarded first prize to a rather small courtyard where all the vegetation was arranged in biotopes; the stormwater pond was particularly impressive with 40 different species of wild and regional wetland plants. The landscape architect also intended the pond to be a site for childrens' exploration of biodiversity, and included vegetation that would benefit from moderate disturbance. The jury also gave special prizes to five other yards that either had interesting and aesthetic biotopes, a very high Green Space Factor or an intensive green roof. The jury was slightly disappointed with the results of the yards from a biodiversity perspective. Jurors concluded that much more could have been achieved through little effort at very low cost, but that an important first step in green and blue planning had been achieved that could be further developed in the future.

Unfortunately, no baseline survey of biodiversity was made prior to the Bo01 development. However, bird surveys conducted during the years 2002-2005 found in total 12 nesting species in the 9 hectare housing area. Bat surveys showed that bats had occupied one of the several bat nesting boxes in the area. The rate of plant species colonisation had been high in three studied biotopes in one of the parks in the area, leading to a high biodiversity. But the biotopes were of woodland character and the colonising plants were weeds and did not help to accomplish the goals of the biotopes.

5 Development of the Green Space Factor and the Green Points System

5.1 Flagghusen

Although the environmental efforts of Bo01 were generally recognised as successful, the development received widespread criticism for its social achievements, mainly because the flats and houses were expensive to buy or rent – and there were only three buildings offering rented accommodation. In the next phase of development in the Western Harbour – 'Flagghusen' – the city administration intended to keep

building costs down as much as possible, with at least 60 percent of the units available for rented accommodation. However, the vision of the Western Harbour being a nationally leading example of sustainable development would not to be abandoned.

Environmental and architectural qualities of the Bo01 district were regulated by an extensive Quality Programme, produced by the Bo01 company in conjunction with the city administration and representatives from developers. For the Flagghusen phase, a different approach was adopted involving a process of 'Creative Dialogue' among stakeholders to reach achievable environmental goals at a realistic cost.[5] The city administrators and the developers reached an agreement to focus on four aspects of sustainability, including high quality architecture, social sustainability, economic sustainability and ecological sustainability. Environmental focal points included greenery and urban biodiversity – chosen partly because these are inexpensive to deliver at a high quality if considered early in the planning and building phases.

The Green Space Factor was applied less stringently compared to the Bo01 process – the overall goal of a minimum Factor of 0.5 was abandoned. Instead, the Green Space Factor became relative to the building rate. So, for example, if the building covered 60 per cent of the site, the Green Space Factor to be reached was only 0.4; whereas if the buildings covered 50% then the requested Green Space Factor was 0.5.

The Green Points were also further developed. They now all aimed at enhancing biodiversity, and there were no longer 35 to choose from, but a list of biotopes out of which at least one should be built, a number of animal housing or habitats of which three should be built and a request that plant species should be rich in nectar and or berries, seeds and nuts.

Again, a competition for the courtyard achieving best biodiversity was held with a similar jury to that of Bo01. It concluded that although the Green Points had focused even more on biodiversity compared Bo01, not a single developer had accomplished an acceptable result and they decided not to award any winner. It found some very interesting solutions though, most spectacularly the 'Urbana Villor' project,[6] that has a sandy biotope on the rooftop, large balconies with 300 millimetre substrate on the whole surface and a greenhouse as well as allotments for the inhabitants to use (see Figs 6 and 7). At the other end of the scale was a courtyard to a large extent built with permeable concrete blocks (see Fig. 8) and most of the greenery on the rooftops where it is not available for use by the inhabitants.

Box 2

Green Space Factor

Surface type	Factor
Vegetation on ground	1
Vegetation on trellis or facade	0.7
Green roofs	0.6
Vegetation on beams, soil depth between 200 millimetres and 800 millimetres	0.7
Vegetation on beams, soil depth more than 800 millimetres	0.9
Water surfaces	1
Collection and retention of stormwater	0.2
Draining of sealed surfaces to surrounding vegetation	0.2
Sealed areas	0
Paved areas with joints	0.2
Areas covered with gravel or sand	0.4
Tree, stem girth 16-20 centimetres (20 square metres for each tree)	20
Tree, stem girth 20-30 centimetres (15 square metres for each tree)	15
Tree, stem girth more than 30 centimetres (10 square metres for each tree)	10
Solitary bush higher than 3 metres (2 square metres for each bush)	2

5.2 A new green space factor

After the Flagghusen development was completed, there was general disappointment with the courtyards of Flagghusen in terms of its green spaces. Therefore

5 See *The Creative Dialogue concerning Flagghusen.* City of Malmö, **http://www.malmo.se/download/18.af27481124e354c8f1800015973/Flagghus+broschyr+ENG+tryckkvl.pdf**
6 See **http://www.hauschild-siegel.com/**

Fig. 6 Allotments and greenhouse in the 'Urbana Villor' project in Western Harbour, Malmö

in 2009 the Green Space Factor was further revised and strengthened. The minimum factor to achieve became 0.6 (compared to 0.5 for Bo01), and several of the individual factors were lowered. For example, the factor for green roofs was decreased from 0.8 to 0.6 (note that the factor for green roofs in Bo01 was set higher in order to try to encourage their uptake). The Green Space Factor as it looks today is shown in Box 2. It is used in the Western Harbour and in a couple of smaller new developments in Malmo.

5.3 Environmental building programme

The City of Malmo and its smaller neighbour Lund, have developed an environmental building program that was adopted during 2009. It is used on land owned by the cities, and forms also a support for discussions with developers on private land. The program is modelled on the environmental program developed for Flagghusen in the Western Harbour, but has three levels: 'C' represents the minimum requirements which are only slightly above legal requirements, 'A' which is front-line technique, and 'B' is in between. The programme requires a green space factor of 0.5 for housing in level A, 0.45 in level B and 0.4 in level C. The green points are the same as in Flagghusen for level A, and a bit fewer in level B and C. The Green Space Factor in the building program is not similar to the one developed for Western Harbour, a fact that causes some confusion among developers and others. But in Western Harbour it is the stronger Green Space Factor of 0.6 that must be accomplished.

Fig. 7 In the 'Urbana Villor' project the large balconies have 300 millimetre substrate covering the whole balcony area. A system for tiles makes it possible to use as little or as much as one wishes for vegetation, but the roots have large volumes of substrate. The balconies are not attached to the wall, but to a free-standing structure to avoid humidity problems

Fig. 8 One of the courtyards at Flagghusen, Western Harbour, Malmö, is to a large extent built with permeable concrete blocks. The permeability helps in reaching the required Green Space Factor, but most people would agree that the courtyard has low aesthetic value

The environmental building program is being revised during 2011, and it is likely that in the future, the green section will contain a Green Space Factor that includes biodiversity as well as social qualities and stormwater management. No Green Points will be needed as they are to be included in the Green Space Factor. For instance meadows or other biotopes will get higher points than mown lawns; animal housing will give additional points and so on. Inspiration for this work comes from Stockholm, where a large, new development is being planned with very high environmental ambitions: Norra Djurgårdsstaden.[7]

6 Conclusions

The City of Malmö has now been developing, using and refining green planning tools such as the Green Space Factor and the Green Points System for more than ten years in the Western Harbour. This has been an ongoing process, during which time barriers such as the initial scepticism of planners and developers have been gradually eroded, and the tools themselves have evolved to better achieve their goals. For example, since being applied as a pilot in Bo01, the Green Space Factor has been gradually improved and is now part of an environmental building programme that is used in all new developments in two cities: Malmö and Lund.

From its initial use as a means to reach a certain amount of green cover it is now increasingly recognised as an instrument to encourage the incorporation of adequate and functional green infrastructure into new developments; which in turn is increasingly recognised for the wide range of benefits it can deliver. Not least, it could be of crucial importance in helping us to adapt to climate change, as green infrastructure provision can help to manage temperature extremes, reduce flood risk and help other species adapt to changed conditions.

The incorporation of tools such as the Green Space Factor and Green Points system into wider planning systems can help ensure that it is not just exemplar developments such as Bo01 that benefit from the provision of green infrastructure, but that it becomes the norm across all developments.

7 See **http://www.stockholm.se/Fristaende-webbplatser/Fackforvaltningssajter/Exploateringskontoret/Ovriga-byggprojekt-i-innerstaden/Hjorthagen-Vartahamnen-Frihamnen-Loudden/In-english1/**

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By Annika Kruuse
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Dr Annika Kruuse is Project Manager at the Institute for Sustainable Urban Development, City of Malmö.

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Town and Country Planning Association

17 Carlton House Terrace
London SW1Y 5AS
t: +44 (0)20 7930 8903
www.tcpa.org.uk