



Greater London Authority

Urban Greening Factor for London

Research Report



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Summary

The population of London continues to grow. This, combined with an increased density of development in many areas, is likely to increase pressure on London's greenspace and natural environment. The review of the London Plan presents an opportunity to consider new policies to address these challenges, including the development of new policies or policy tools that promote the greening of buildings and the built environment (urban greening). This will ensure that, where possible, redevelopment and regeneration across the city results in a greener rather than a greyer built environment.

The Green Space Factor (GSF) is a planning policy tool that originated in Berlin and has been adopted and adapted in a number of other cities in Europe and North America to encourage urban greening. GSF schemes work by assigning a factor of between 0 and 1 for various surface cover types, with sealed surfaces given 0 and the most natural cover, 1. To calculate a GSF for a site, the factor for a particular surface cover is multiplied by its area. This is repeated for each surface cover type. The multiplied sums are added together and then divided by the overall site area to give an overall GSF score for a site of between 0 and 1. A planning authority can set a minimum target (typically 0.3, although this varies according to the type of development and class of land use). This can provide certainty to developers as to what is expected from new developments in terms of urban greening. It can also identify planning proposals with insufficient quantity and functionality of greening in order to encourage improvements to a proposal. It can also be useful in determining the scale and benefit of subsequent improvements to plans.

A GSF is usually applied to development proposals on previously developed land which has little or no existing natural surfaces. GSF schemes are not an alternative to planning policies that are intended to ensure the protection of a sufficient quantity of existing parks, natural habitats and other green open spaces, however GSF can be used as a tool to show how development may change a site or as a way of comparing proposals for a site.

This report is based on a review of the experiences of several cities operating or experimenting with the GSF, including Berlin, Malmö, Seattle, Washington DC, Helsinki and Southampton, and the results of a stakeholder consultation event held at City Hall on the 5th May 2017. Its purpose is to understand the benefits and issues associated with operating GSF schemes and to make recommendations as to the applicability of such a tool in London and its scope.

In general, experience of operating GSF schemes in other cities has been positive and most stakeholders in London have welcomed this initiative, however some concerns have been expressed about the limitations of the GSF approach, including the relationship with sustainability assessment schemes such as BREEAM, the mechanism for scoring, and the setting of targets, particularly in relation to high-rise development.

This report, which has been prepared by The Ecology Consultancy, in collaboration with The Green Infrastructure Consultancy and Temple proposes a GSF framework for London – to be called the Urban Greening Factor (UGF). It is recommended that the Mayor endorses the use of a UGF and encourages local planning authorities to implement schemes based on the principles and methodology outlined in this report. It is likely that the use of the UGF would be especially useful in those areas that are likely to be subject to higher density development, including districts within the Central Activity Zone, town centres, the Opportunity Areas and areas identified for high-density housing. The UGF could be promoted through a statement of support in the London Plan.

1 Introduction and purpose

- 1.1 The population of London is growing and current land use policy favours increased density to address the need for more housing and associated facilities. Dense and compact development supports efficient public transport systems and reduced energy demand. However, a denser, more highly populated city, will result in significant additional pressures on London's existing green spaces and natural environment. Denser development, unless sympathetically designed, can also exacerbate problems such as the urban heat island effect and storm-water flooding.
- 1.2 There is growing awareness of, and an associated body of evidence for, the multiple benefits of green infrastructure, including measurable net positive impacts on physical health and mental wellbeing¹. It is also recognised that green infrastructure will play a critical role in increasing London's capacity to adapt to climate change. Consequently, new approaches to the design and management of green space are already being adopted. In parallel, new ways of providing additional greening within the built environment will have to be found to ensure London remains in step with trends emerging in other global cities. As well as traditional approaches such as planting trees in the public realm, London's built environment will need more green roofs, green walls, green streets, rain gardens and other features. In a denser city, these features should no longer be considered as adornments to the built-environment, but as an essential component of the urban fabric.
- 1.3 The review of the London Plan provides an opportunity to include new policies that can help to address these challenges. This report considers the possibility of including a Green Space Factor (GSF), a planning policy tool that has been adopted by other planning authorities to increase the quantity and functionality of green infrastructure in the built environment, by setting minimum standards for new development projects.

¹ Green infrastructure is the network of green spaces (as well as features such as street trees and green roofs) that is planned, designed and managed to enhance the benefits provided by our natural capital, including: promoting healthier living; lessening the impacts of climate change; improving air and water quality; encouraging walking and cycling; and enhancing biodiversity and ecological resilience.

- 1.4 Although the existing London Plan has a number of policies that promote the provision of green infrastructure within new developments (including Policy 5.10 - Urban Greening; and Policy 5.11 - Green Roofs), it has been suggested that these policies may need to be complemented by a GSF scheme in order to assist developers and planners to determine the appropriate level of urban greening required to address particular local issues such as surface water flooding, lack of local green space or biodiversity conservation. We suggest that this should be known as the Urban Greening Factor (UGF), because this would emphasise that its purpose is to increase the amount of greening in and around buildings rather than protecting existing green space. The protection of green space is provided for by other land-use planning policies. The UGF would provide a method to evaluate proposals against minimum thresholds for the extent and functionality of urban greening, without the need to be too prescriptive about the range of interventions to be included in projects. This would provide developers with flexibility when determining the design and layout of development proposals.
- 1.5 This report describes how existing GSF schemes work and reviews how these schemes have been operated in some other cities (see Appendix 1). It also explores how a UGF might be applied in London.
- 1.6 Part of the process of preparing for this report was a stakeholder consultation workshop, which was held at City Hall on the 5th May 2017. There was a high level of support for the initiative, however, there were some participants who had concerns about how it would be applied in certain circumstances (see Appendix 3 for a summary of the event).

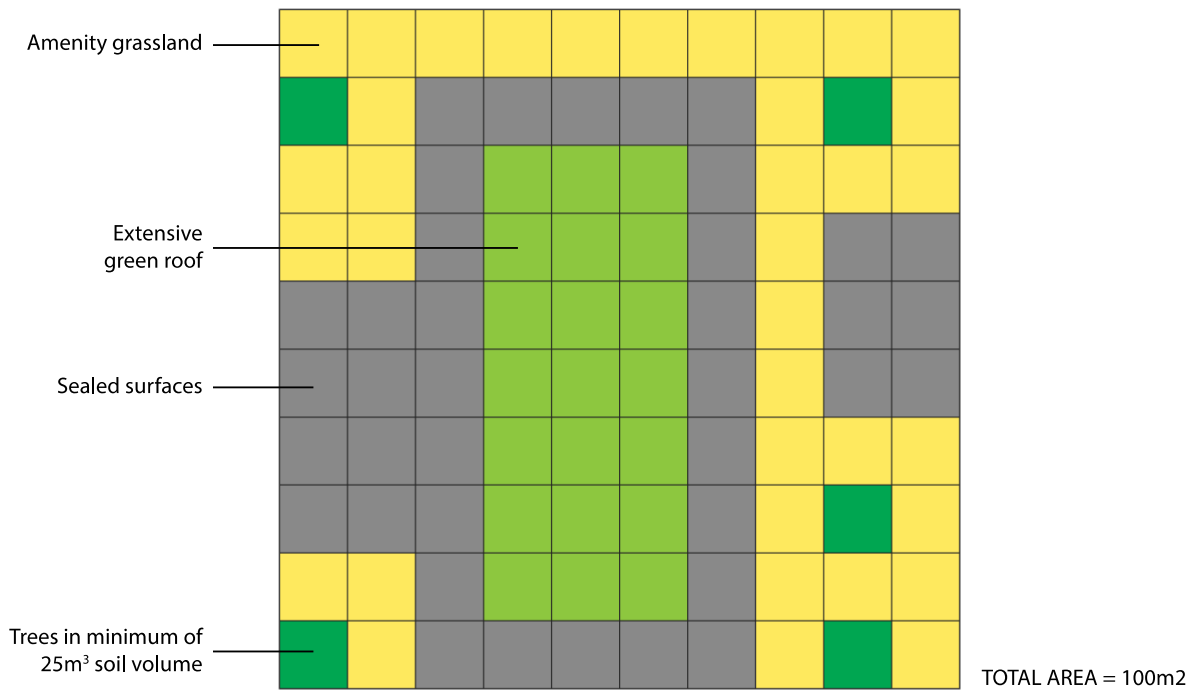
2 How it works

- 2.1 Green Space Factor schemes are applied in a number of cities around the world (see Appendix 1 for examples). All schemes allocate a factor to various types of surface cover included in planning proposals. The factors are a simplified measure of the various benefits (ecosystem services)² provided by soils, vegetation and water and are usually assigned on the basis of potential for rainwater infiltration. This is because the water-holding capacity of surface cover and associated soil is a good proxy for their ‘naturalness’ and their ability to provide the range of benefits associated with more natural systems including benefits in relation to health, climate change adaptation, air quality improvement and biodiversity conservation. Factors between 0 and 1 (in increments of 0.1) are allocated to each surface cover type, with impermeable surfaces such as concrete and asphalt assigned a factor of 0 and the most natural surface cover such as open water or trees on deeper soils, given a factor of 1.
- 2.2 In calculating an overall GSF for any given proposed development it is necessary to measure the overall area of the redevelopment or regeneration site and then to determine, map and measure the area of various surface cover types proposed as part of the new development (Figure 1 below). Typical surface covers defined by cities operating GSF schemes, include sealed surfaces, permeable paving, amenity grassland, trees and shrubs, extensive green roofs, roof gardens and green walls etc. A factor (a weighting for the naturalness and functionality) is then assigned to each surface cover type. To calculate the overall GSF score the factor for each surface cover within a site is multiplied by its area. This generates a series of figures which are then added together. This new total is then divided by the site overall site area to give a GSF score (as set out in Figure 2 below). This score can then be compared with a target set by the planning authority.





² For a full description of the ecosystem services see the UK National Ecosystem Assessment <http://uknea.unep-wcmc.org/>

Figure 1: Diagram of simplified theoretical development site to demonstrate how the GSF works (modified from a diagram in Southampton City Council’s GSF Guidance notes)³.

1. Measure site area, measure various surface cover types



2. Table showing areas of each cover type and factor assigned to each:

		Factor	Area (m ²)
	Extensive green roof	0.7	21
	Sealed surfaces	0.0	38
	Amenity grassland	0.4	36
	Trees in minimum of 25m ³ soil volume	0.8	5
			100

3. Calculation of the overall score for the site

$$\frac{(\text{■} \times 21) + (\text{■} \times 38) + (\text{■} \times 36) + (\text{■} \times 5)}{100}$$

Score = 0.33

³ <https://www.southampton.gov.uk/policies/Green-Space-Factor-guidance-notes-2015.pdf>

Figure 2: Formula for calculating the overall GSF score

$$\frac{(\text{Factor A} \times \text{Area}) + (\text{Factor B} \times \text{Area}) + (\text{Factor C} \times \text{Area}) + (\text{Factor D} \times \text{Area}) \text{ etc.}}{\text{Total Site Area}}$$

- 2.3 Depending on how a scheme is operated by the planning authority, failure to meet the target can result in rejection of a planning application, or an indication that a proposal needs to be amended, to include more, urban greening overall, and/or elements with a higher factor (and thereby higher functionality). Cities usually set a minimum target score that must be met, or they may incorporate ‘bonus points’ into their tool which relate to the delivery of a specific function or outcome (e.g. storm water management or increased public access).
- 2.4 GSF schemes are usually applied to high-density zones or districts where large-scale urban regeneration and renewal is planned, where rapid development is expected, or where particular problems (including, for example, biodiversity losses, surface water flooding or deficiency of accessible green space) could be exacerbated by inappropriate development.
- 2.5 It is important to recognise that GSF schemes are tools to help translate urban greening policy objectives into practice. They should be used in combination with the full suite of policies that relate to amenity, green infrastructure and biodiversity and are usually applied in concert with combinations of green infrastructure and biodiversity strategies, district plans, neighbourhood plans, landscape plans, masterplans and design codes. They should not be used a substitute for policies that protect a sufficient quantity of parks, natural habitats and other green and open spaces. Nor should they usually be applied to development proposals for greenfield sites; the existing notional ‘score’ of an undeveloped site will almost always be higher than any GSF target score. The GSF technique can be used, however, to show how changes in cover might occur as the result of development on greenfield sites or sites that already have a substantial green infrastructure component.
- 2.6 As most GSF schemes include a factor for green walls, this could, in theory, result in projects achieving a GSF score of more than 1 because the surface area of building façades may be substantially more than the development footprint. However, this is only likely to occur rarely and does not undermine the usefulness of the GSF approach.

3 Benefits

3.1 In cities where they have been adopted, GSF schemes have been shown to increase the amount of green space within developments as well as its utility, particularly with respect to surface water drainage (see Appendix 1). Depending on how they are operated, GSF schemes also have the effect of encouraging more developers to take specialist advice to ensure that their proposals are able to satisfy the planning authority's requirements. With most GSF schemes the purpose is easily explained and understood and the calculation of the overall score is a relatively straightforward and inexpensive process. GSF schemes allow flexibility with respect to plot layout and landscape design and are not prescriptive.

3.2 The benefits of a GSF include the following:

- It is a means to increase the inclusion of multifunctional green infrastructure features in development in the absence of other existing mechanisms;
- urban greening is encouraged on restricted sites in densely developed areas;
- it is a simple mechanism, easily understood by non-specialists;
- it facilitates conversations between developers and planners;
- it empowers local authorities, who do not always have the capacity or specialist knowledge, to successfully argue the case for more greening; and
- over-time, authorities can adjust factors and targets to reflect local conditions and priorities, e.g. to encourage interventions that reduce flood risk or increase biodiversity.

4 Potential Drawbacks

- 4.1 GSF schemes may be characterised as an unnecessary additional administrative burden. This has been a criticism of the application of a GSF in some cities in the United States, where the attainment of a particular score is a pre-requisite of the permitting process, where only approved experts can submit and score proposals, and where post-construction monitoring is compulsory.
- 4.2 It has also been suggested that fragile or high-input landscape features (like intensive green walls for example) could be included in plans for the purpose of meeting a GSF target, with these features subsequently failing if not properly installed or maintained. However, this criticism applies to all aspects of building design and construction and should be addressed by ensuring that any proposed urban greening intervention is supported by appropriate specification and maintenance plans, rather than omitting any particular type of surface cover from the GSF assessment.
- 4.3 Although the scoring schemes for GSFs are relatively simple, with an overall score ranging between 0 and 1, the factor assigned to any particular surface cover type may vary from one planning authority to another. The assignment of a particular factor to a particular surface cover type can (and should) be subject to local determination. There is the potential for low quality features (for example green roofs with inadequate substrate depth) to be proposed in order to meet the GSF target score. These difficulties can be overcome by providing clear definitions and accurate descriptions of the various types of surface cover and for the GSF scheme to differentiate between high quality features that provide multiple functions and lower quality features that may provide fewer or more limited functions. For example, a higher factor can be given to a tree planted with a minimum of 25 cubic metres of rooting medium with a lower factor assigned to a tree planted with a just 10 cubic metres of rooting medium. Both scenarios will result in a development with trees but only the former is likely to result in a development with trees that will thrive over the long term and provide the full range of benefits associated with an extensive and healthy tree canopy.

- 4.4 GSF schemes may be confused with certification or benchmarking methods designed to measure the sustainability or performance of developments. BREEAM, for example, which assesses the sustainability of building and infrastructure projects, includes five assessment categories, which consider landscape and ecology⁴. These are: site selection; ecological value of sites and protection of ecological features; mitigating ecological impact; enhancing site ecology and long-term impact on ecology. In addition, the BREEAM Communities scheme measures and certifies the sustainability of large-scale development plans⁵. In contrast with the GSF calculation process, these BREEAM assessments require detailed baseline surveys, calculations and reports, which must be evaluated by suitably qualified persons and which may have substantial costs. Although BREEAM is a valuable way of measuring environmental performance and encouraging designers to strive for excellence, it does not perform the same function as a GSF scheme and could not be used as an alternative or replacement. BREEAM schemes have not been devised as tools for planning authorities and could not be readily applied to the task of improving green infrastructure provision across entire planning zones or neighbourhoods.
- 4.5 Following discussion with stakeholders, the potential drawbacks (depending on how a GSF scheme is constituted and implemented) have been identified as follows:
- given that a GSF determines only the quantum of broadly described surface covers, the design qualities of each treatment cannot readily be assessed;
 - there is a risk of a GSF being too rigidly interpreted, with schemes meeting, but not exceeding, minimum targets;
 - devising a proposal that meets a GSF scheme might be seen as an alternative to getting expert advice on how to integrate green infrastructure in a meaningful way; and
 - plot-based (two dimensional) calculations could result in insufficient urban greening being provided on and around very tall buildings with a small ground-level curtilage.
- 4.6 Due to these potential challenges, planning authorities need to be clear that a GSF is an assessment tool and should not be the sole method of determining how urban greening is provided as part of a development. Planning and assessment tools should support good design. If adopted, a GSF would need to be promoted as a tool to complement and help deliver policies and standards on parks, open space, and nature conservation.

⁴ <http://www.breeam.com/>

⁵ <http://www.breeam.com/communities>

5 Recommendation – An Urban Greening Factor for London

- 5.1 Most cities apply a GSF to city centres, districts or neighbourhoods where there is a risk of sealed surfaces predominating. It is suggested that London follows this approach, with local planning authorities encouraged to require developers to use a GSF where there is likely to be an intensification of development on previously developed land and in areas subject to regeneration and renewal. This is in order to ensure that, wherever possible, new development contributes towards creating neighbourhoods that have an overall increase in green cover.
- 5.2 We propose that such an approach is described as an Urban Greening Factor (UGF) to emphasise that this initiative is about provision of functional green infrastructure at the building plot level rather than new public green space, which should be promoted through other planning policies, if needed. The Mayor could recommend that the UGF is used to inform projects in the Central Activity Zone, or projects in locations where large-scale urban renewal is planned (e.g. Opportunity Areas, Intensification Areas and Housing Zones). The UGF could also be used in a voluntary way to evaluate any development in any location, especially where there is a concern that cumulative development, over time, is resulting in an overall loss of green cover in the locality.
- 5.3 To illustrate how a UGF might be applied to developments in London, case-studies are provided in Appendix 2. These have informed our proposals below for:
- a generic city-wide methodology for determining a UGF score which provides a model against which local authorities can create bespoke approaches relevant to local circumstances; and
 - a generic set of factors that provide a benchmark for different development typologies.

- 5.4 The proposed city-wide methodology for determining a GIF score is presented in Table 1 below. It assigns a factor to a range of surface cover types that are likely to be included within development proposals in London. It briefly describes the surface cover type and provides references that provide additional technical description of the surface cover type. The table covers most eventualities, however, if a surface cover type is encountered which is not listed, it is suggested that it is assigned the same factor as the category in the table that is most functionally similar. Factors are similar to those used in other cities, with 0 assigned to sealed, hard surfaces and 1 assigned to the most natural and or permeable features.
- 5.5 All developments (in areas targeted in strategic plans) should deliver additional urban greening, however targets may need to be differentiated depending on the development type and location. The project examples in Appendix 2 indicate that an overall minimum target score of 0.3 will be suitable for most proposed developments on previously developed land in London. However, each local planning authority may consider adjusting this figure, based on local needs and particular development typologies. In particular, developments that are predominantly residential may justify the application of a higher target score of 0.5, particularly if the development is resulting in additional pressure on already limited green space. Adjustments to the 0.3 target should be supported by the testing of design options that are appropriate to the location, its context and the Needs Assessment supporting the local development plan.

Table 1: Proposed surface cover type descriptions and factors

Surface Cover Type	Factor
Semi-natural vegetation (e.g. woodland, flower-rich grassland) created on site.	1
Wetland or open water (semi-natural; not chlorinated) created on site.	1
Intensive green roof or vegetation over structure. Vegetated sections only. Substrate minimum settled depth of 150mm – see livingroofs.org for descriptions ⁶ .	0.8
Standard trees planted in natural soils or with a minimum of 25 cubic metres soil volume per tree (preferably with load-bearing substrates and connected pits) – see Trees in Hard Landscapes for overview ⁷ .	0.8
Extensive green roof with substrate of minimum settled depth of 80mm (or 60mm beneath vegetation blanket) – meets the requirements of GRO Code (2014).	0.7
Flower-rich perennial planting – see Centre for Designed Ecology for case-studies ⁸ .	0.7
Rain gardens and other vegetated sustainable drainage elements – See CIRIA for case-studies ⁹ .	0.7
Hedges (line of mature shrubs one or two shrubs wide) – see RHS for guidance ¹⁰ .	0.6
Standard trees planted in individual pits with less than 25 cubic metres soil volume.-	0.6
Green wall –modular system or climbers rooted in soil – see NBS Guide to Façade Greening for overview ¹¹ .	.0.6
Groundcover planting – see RHS Groundcover Plants for overview ¹² .	0.5
Amenity grassland (species-poor regularly mown lawn).	0.4
Extensive green roof of sedum mat without substrate or other systems that do not meet GRO Code (2014) ¹³ .	0.3
Water features (chlorinated) or unplanted detention basins.	0.2
Permeable paving - see CIRIA for overview ¹⁴ .	0.1
Sealed surfaces (e.g. concrete, asphalt, waterproofing, stone).	0

⁶ <https://livingroofs.org/intensive-green-roofs/>

⁷ <http://www.tdag.org.uk/trees-in-hard-landscapes.html>

⁸ <https://cfde.co.uk/front-page/about/case-studies/>

⁹ <http://www.susdrain.org/case-studies/>

¹⁰ <https://www.rhs.org.uk/advice/profile?pid=351>

¹¹ <https://www.thenbs.com/knowledge/the-nbs-guide-to-facade-greening-part-two>

¹² <https://www.rhs.org.uk/advice>

¹³ <https://livingroofs.org/code-practice-green-roof-organisation/>

¹⁴ <http://www.susdrain.org/resources/ciria-guidance.html>

6 Conclusions and Recommendations

- 6.1 Accounts of GSF schemes in other cities are positive¹⁵. These provide simple, flexible and cost-effective ways of assessing the quantity and functionality of urban greening in development proposals and have been shown to increase the quantum of urban greening within development. The provision of sufficient green infrastructure in the built environment is important if growth in London is going to be able to contribute to continuing efforts to reduce noise, air and water pollution, to enable adaptation to climate change, and to create greener neighbourhoods that improve the health of Londoners and provide additional habitat for wildlife. Failure to include adequate urban greening could exacerbate the inequalities between those already living in greener neighbourhoods and those living at higher density with less access to gardens or public greenspace.
- 6.2 This report proposes that the Mayor endorses the use of a GSF in London - to be called the London UGF - and encourages local planning authorities to implement their own schemes. The UGF can be promoted through a statement of support in the London Plan. The benefit of this approach is that it will provide the flexibility for local authorities to tailor the UGF to their own needs or priorities.

¹⁵ <http://www.grabs-eu.org/downloads/EP6%20FINAL.pdf>

Appendix 1: Examples of existing schemes

CONTEXT

Beginning with Berlin in the 1990s, GSF schemes have spread to other German cities (including Hamburg) and then overseas, including Sweden (Malmö), Finland (Helsinki), the United States (including Seattle and Washington DC) and Canada (Toronto). Southampton was the first UK authority to develop a GSF scheme. A partnership led by the Red Rose Forest, developed a GI Toolkit, based on a GSF approach, for England's North-West region in 2008¹⁶. The following paragraphs summarise the experience of selected cities in operating GSF schemes.

Berlin

The City of Berlin has operated a GSF scheme, known as the Biotop Flächenfaktor or Biotope Area Factor (BAF) since 1994¹⁷. Berlin was the first city to formally adopt a GSF, having explored the approach in the Western Sector during the 1980s. The BAF is applied, in combination with Landscape Plans, in a number of inner-city neighbourhoods. Landscape Plans address spatial issues and opportunities and the BAF ensures that adequate green space is provided within each development parcel. BAF targets are adjusted according to land use, with sites with educational use, for example, requiring the highest scores. Minimum scores for sites within neighbourhoods covered by the scheme vary between 0.3 and 0.6. Problems with surface water flooding and an overall lack of green space were the catalysts for the BAF initiative, and surface cover types are assigned scores (between 0 for impermeable surfaces and 1 for vegetated surfaces completely connected with the soil below) based on their ability to infiltrate, store and evaporate water. The BAF is viewed positively by city planners, architects and developers, who have praised its simplicity and flexibility, however, it is recognised that it cannot be used to assess the environmental impact of a scheme¹⁸.

¹⁶ <http://www.greeninfrastructurenw.co.uk/html/index.php?page=projects&GreenInfrastructureValuationToolkit=true>

¹⁷ http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/bff/index_en.shtml

¹⁸ Darla Nickel, Wenke Schoenfelder, Dale Medearis, David P. Dolowitz, Melissa Keeley & William Shuster (2014) German experience in managing storm-water with green infrastructure, *Journal of Environmental Planning and Management*, 57:3, 403-423, DOI: 10.1080/09640568.2012.748652

Malmö

A GSF was trialled in 2001 in a new residential development in the post-industrial Western Harbour area of Malmö, Sweden. The original purpose of the GSF was to ensure that adequate green space was provided on every plot and that sealed surfaces were minimised. A GSF minimum score of 0.5 was set. The scheme was subsequently revised after the quality of some developments did not match the planning authority's expectations. The GSF scheme has also been supplemented by a Green Points System designed to improve the quality of landscape design and to encourage the inclusion of features that increase biodiversity. The GSF is now being applied to a wider area within Malmö as well as the neighbouring town of Lund¹⁹.

Seattle

Seattle in the State of Washington, adopted a GSF in 2006 and expanded the scheme in 2009. It was initially modelled on the Berlin BAF with modifications. The three priorities of Seattle's scheme have been: liveability; ecosystem services; and climate change adaptation. As with other schemes, Seattle's GSF has a catalogue of landscape elements, each with its own score, and a requirement for project proposals to meet a minimum overall score. Minimum scores vary according to zones, with residential zones requiring the highest scores and commercial and industrial areas lower scores. To qualify for certain scores, landscape features must comply with detailed standards set by the city. For example, bio-retention facilities must include adequate soil volumes²⁰. Increased structural diversity of planting (mixtures of trees, shrubs and perennials) is also encouraged. The Seattle scheme includes a provision for bonus credits for drought tolerance, irrigation with harvested rainwater, landscape features visible to passers-by and food cultivation. For a scheme to be awarded a GSF score, it must be submitted with a landscape plan and landscape management plan and be submitted by a landscape professional (who, for proposals above a certain size, must be a licensed landscape architect). A landscape professional must also verify that the landscape scheme has been installed in conformance with the approved plan. Since its GSF scheme was adopted, Seattle's Department of Planning and Development has noted higher quality and better-integrated landscape design, with increased use of permeable paving, green roofs, and green walls.

¹⁹ Annika Kruuse (2011) GRaBS Expert Paper 6 the green space factor and the green points system

²⁰ City of Seattle (2015) Director's Rule 30-2015: Standards for Landscaping, including Green Factor.

Washington DC

In Washington DC, the GSF is known as the Green Area Ratio (GAR). It was introduced in 2013 and revised in 2016 and is very similar to the Seattle scheme. It has been established by regulation and applies to all applications for building permits for new buildings and major renovations (with a few exemptions). The satisfactory implementation of a landscape scheme, that has met the minimum GAR score, must be demonstrated by a Certified Landscape Expert, before a certificate of occupation may be granted. The Washington DC scheme gives high scores for trees (measured by canopy size), intensive green roofs and the conservation of existing soil. Target scores vary according to planning zones, with differentiation between residential, mixed use and downtown (city-centre) areas²¹.

Helsinki

Helsinki, Finland, considered a GSF as part of its Climate-Proof City – Tools for Planning (ILKKA) project (2012-2014)²². The approach was to test the operation of a GSF tool and to use the tool as part of the evaluation of various landscape design options in two new development sites (Kuninkaantammi and Jätkäsaari). A unique scoring system was developed by a panel of local experts. Issues considered were ecology, functionality, amenity and maintenance, with the ecological and functional goals prioritised over amenity and maintenance. Minimum GSF scores were set for various land use classes, including residential (0.5), office (0.4), commercial (0.3) and industrial/logistics (0.2), with an expectation that higher targets would be met. These targets reflect the typical differences in the extent of greenspace provided within these development types in Helsinki. With the great diversity of neighbourhoods in London, it is likely that a similar range of GSF target scores would be required.

²¹ Washington DC zoning codes <http://handbook.dcoz.dc.gov/> and map <http://maps.dcoz.dc.gov/zr16/map.html#l=14&x=8565251.499999998&y=4709970.999999999&mms=18!26!21!24!22!19!4!8!1!2&dcb=0>

²² http://ilmastotyokalut.fi/files/2014/11/Developing_Helsinki_Green_Factor_Summary_13032014.pdf

Southampton

Using a GSF tool is a requirement for applications within Southampton's City Centre Action Plan (AP 12), which in 2015, required "all developments (and especially key sites) to assess the potential of the site for appropriate green infrastructure improvements by using the Council's Green Space Factor, and to improve the score for the site"²³. For other sites, not within the City Centre, the council encourages, but does not require, use of the GSF tool. Scores are assigned according to the rate of infiltration of rainwater for each landscape element²⁴. The scoring system takes into account existing land cover, encourages retention of existing features and requires an overall increase in score compared with the existing condition. Performance requirements for surface cover types are not prescribed (as they are in Washington DC, for example). A completed spreadsheet must be submitted as part of an application; however, there is no requirement for a suitably qualified professional to do this and no mechanism for verifying that a scheme has been implemented satisfactorily.

²³ Southampton City Centre City Centre Action Plan, Adopted Version 18 March 2015.

²⁴ <https://www.southampton.gov.uk/policies/Green-Space-Factor-tool.xls>

Appendix 2: Sample calculations for London projects

Part of Chobham Manor Phase 1 (Stratford)

Without green roofs



	Green Infrastructure Factor	Area(m²)
Standard trees	0.8	531
Amenity grassland	0.4	2,406
Sealed surfaces	0	4,273
		7,210

$$\frac{(0.8 \times 531) + (0.4 \times 2406) + (0 \times 2457)}{7210} = 0.19$$

With green roofs



	Green Infrastructure Factor	Area(m²)
Standard trees	0.8	531
Extensive green roof	0.7	1,816
Amenity grassland	0.4	2,406
Sealed surfaces	0	2,457
		7,210

$$\frac{(0.8 \times 531) + (0.7 \times 1816) + (0.4 \times 2406) + (0 \times 2457)}{7210} = 0.37$$

Cairo New Road (Croydon)

Existing factory site



	Green Infrastructure Factor	Area(m²)
Ornamental shrubs	0.5	12
Amenity grassland	0.4	435
Sealed surfaces	0	2,680
		3,127

$$\frac{(0.5 \times 12) + (0.4 \times 435) + (0 \times 2680)}{3127} = 0.06$$

Approved residential development

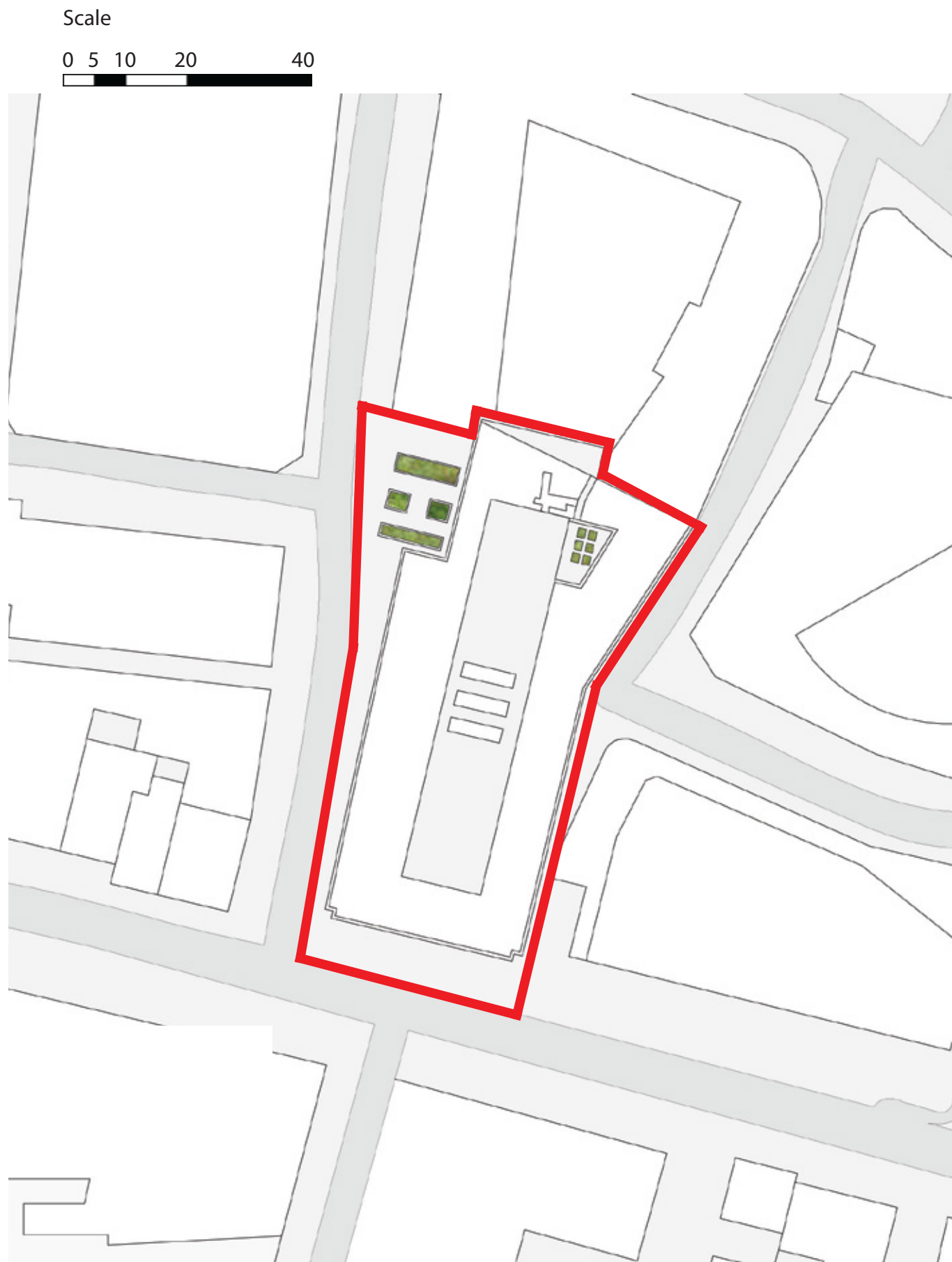


	Green Infrastructure Factor	Area(m²)
Standard trees	0.8	154
Extensive green roof	0.7	629
Ornamental shrubs	0.5	223
Amenity grassland	0.4	315
Sealed surfaces	0	1,806
		3,127

$$\frac{(0.8 \times 3359) + (0.7 \times 2698) + (0.5 \times 695) + (0.4 \times 6462) + (0 \times 24557)}{3127} = 0.26$$

4 Wood Street (Cheapside) City of London

Without green roof



	Green Infrastructure Factor	Area(m²)
Ornamental shrubs	0.5	87
Sealed surfaces	0	3,701
		3,788

$$\frac{(0.5 \times 87) + (0 \times 1986)}{3788} = 0.01$$

With green roof (as built)



	Green Infrastructure Factor	Area(m²)
Extensive green roof	0.7	1,715
Ornamental shrubs	0.5	87
Sealed surfaces	0	1,986
		3,788

$$\frac{(0.7 \times 1715) + (0.5 \times 87) + (0 \times 1986)}{3788} = 0.33$$

Appendix 3: Summary of the stakeholder event

STAKEHOLDER EVENT

A stakeholder consultation workshop was held in City Hall on the 5 May 2017. Over 20 attended and included London local authority planners, property developers and landscape and ecology professionals. Following an introduction by Peter Massini (the Lead on Green Infrastructure for the Greater London Authority), there were presentations on how the Green Space Factor has operated internationally and in the UK (from Gary Grant of the Green Infrastructure Consultancy) and developer and local authority perspectives on implementing green infrastructure (from Louise Clarke, Group Sustainability Manager of the Berkeley Group Holdings plc and Andrew Ruck, Planning Policy Officer at the London Borough of Southwark). Attendees were asked to contribute their views on whether a GSF would be a suitable mechanism for delivering green infrastructure, the opportunities and challenges, how it might fit in a London context and where it should be applied (i.e. geographic scope). This was achieved via a general question and answer session followed by break-out group sessions.

The concept of a GSF for London was viewed positively by most of the attendees, in particular, by local authority planners who would need to implement it, but with some strong reservations expressed by some. A few were opposed to its introduction due to it not being ambitious enough. Others were concerned that a GSF scheme would not be able evaluate the quality of the green infrastructure. There were also concerns that a GSF would not take account of context or the need to deliver green infrastructure as part of a planned network.

Benefits identified included:

- a means to increase green infrastructure in development in the absence of other current mechanisms and a starting point which could be improved or refined in future (considering that there was insufficient green infrastructure being implemented especially in the inner-city boroughs);
- it would be used due to its simplicity and is something non-specialist planners at local authorities could understand;
- it helps facilitate the conversation between developers and planners;
- it would empower local authorities who do not always have tools / knowledge to successfully argue the case for more ambitious schemes; and
- boroughs could adjust GSF scores to reflect a local concern, e.g. sustainable drainage or a desire for green roofs.

Potential issues (depending on how any future GSF is implemented) included:

- given it only assesses 'quantity' and 'type' on one site, not the design and how the green infrastructure links with wider networks, many schemes could be approved that would be sub-optimal;
- the use of the term 'green infrastructure' in the title might be misleading because the tool might not assess whether or not a scheme is appropriate for a location and whether or not it can fulfil its intended function, e.g. acting as a wildlife corridor;
- there was a danger that it would be too rigidly applied and become a 'tick box' exercise, e.g. developers would always aim for the minimum target and never exceed this;
- It might be used as a replacement to getting expert advice on how to integrate green infrastructure in a meaningful way; and
- 2D calculations will lead to insufficient green infrastructure being introduced for very tall buildings with a small ground level footprint – in these instances a scheme that includes a 3D surface calculation might be more appropriate.

Due to these issues, some attendees felt a London GSF scheme would have to be carefully implemented. Explanations of the purpose and operation of a London GSF would be important. Communications would need to make it clear that it is not the only way to assess how green infrastructure is implemented into a development and it cannot be a replacement for good design of green infrastructure and the built environment. Also, the links with natural capital, health, and synergies with other assessment and benchmarking schemes need to be made clear. Alternative names to Green Space Factor might be better (alternative suggestions included 'Green Infrastructure Factor', 'Green Surface Factor' or 'Green Factor').

In terms of suitable locations for the application of GSF schemes, several attendees suggested that they should be applied to large sites or to neighbourhoods covered by AAPs. Others were concerned that by excluding smaller sites, opportunities to improve catchment management, especially in flood prone areas, could be missed.



Ecology Consultancy

The Ecology Consultancy is part of the Temple Group.

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