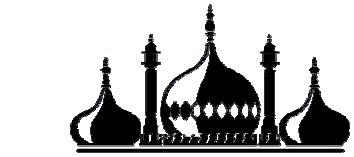


A Green Network for Brighton & Hove
Final Report

June 2009

Sussex Wildlife Trust
Sussex Environment Partnership
Brighton & Hove City Council

Contents

1.0 Summary

1.1 This report describes a methodology developed by Sussex Wildlife Trust, the Sussex Environment Partnership, Geospec and Brighton & Hove Council to define a green network for Brighton and Hove. It is a background document to the Brighton & Hove Local Development Framework and it is anticipated that its findings will inform development of a Site Allocations Development Plan Document.

1.2 For the purposes of this report, green networks are defined as interlinked, natural green spaces forming a continuous, natural network through the urban area and into surrounding countryside.

1.3 Green networks facilitate a strategic approach to natural green space planning and management and offer wider benefits to biodiversity and people in urban areas. These include defining potential sustainable transport corridors, aesthetic enhancement of the city and ecosystem services such as air purification, storm water drainage and reduced atmospheric CO_2.

1.4 The study was divided into four tasks:

1) Define the primary function(s) of the network;
2) Define a baseline of natural green space within the network;
3) Assess the baseline of natural green space against the primary functions to identify additional areas requiring creation and enhancement within the network and
4) Peer review and wider consultation

1.5 Stage 1 identified three primary functions of the network:

- A people-orientated function, taking account of accessibility to natural green space by adapting Natural England's published standards for the provision of accessible natural green space in urban areas.

- A species-orientated function, using generic species with pre-defined abilities to disperse through the urban environment.

- An ecological services function. This approach was frustrated by a lack of information on methods of quantifying the ecological services of green spaces in the UK and could not be used for network development.

1.6 Baseline data collated in stage 2 included the 2005 Brighton & Hove open space audit; the Brighton & Hove biodiversity audit 2007/8 and projected changes in population within core development areas around the city.

1.7 Stage 3 involved two approaches:

- Creating buffers around each natural green space, modified in width to take account of the population density of adjacent areas, so that the total area of the buffer encompassed 1,000 people per two hectares of space.

- Plotting dispersal areas for generic species with pre-defined abilities to disperse through the urban environment.

1.8 The resulting areas were combined and interpreted using local knowledge to produce a final green network map for the urban area. In the rural hinterland, the Priority Targeting Maps for the South Downs, developed by Natural England, were used to define the green network.

1.9 The methodology and maps were tested by peer review at local level without significant changes being made. At the time of writing, further review and consultation is planned.

2.0 Introduction

Green Networks: A definition

2.1 In this report an urban green network comprises natural green spaces which interconnect through the urban area and into the urban fringe and wider countryside. Such a network comprises protected wildlife sites and nature reserves and other areas of natural greenspace. These might include 'green roofs', 'pocket parks', natural landscaping in new development, as well as natural green areas in publically accessible open spaces such as parks, public gardens and school grounds. In this report, the term 'natural green space' conforms with the definition adopted by Natural England[1] and therefore excludes areas of habitat which are not publically accessible.

2.2 Connecting natural green spaces through the urban area has a number of benefits. For some species, it can improve their ability to move between sites and therefore promotes nature conservation objectives[2]. Green networks also further a strategic approach to natural green space provision, where individual spaces are treated as part of a single, city-wide natural

[1] See 'Providing Accessible Natural Greenspace in Towns and Cities. A Practical Guide to Assessing the Resource and Implementing Local Standards for Provision' English Nature (undated).

[2] Dawson D. 1994. Are habitat corridors conduits for animals and plants in a fragmented landscape? A review of the scientific evidence. *English Nature Research Report No 94.*

infrastructure, offering key benefits including biodiversity conservation and 'ecological services' (e.g. storm water control and air pollution amelioration). This strategic approach allows areas for change to be identified and promotes economies of scale. Green networks can also be integrated with other functions, such as footpath and cycle networks and other types of open space, to deliver multiple benefits efficiently. This approach can promote sustainable travel and recreation, and have important benefits for healthy lifestyles and community development.

The Brighton & Hove Green Network

2.3 The Brighton and Hove green network has been developed as a partnership project between the Sussex Wildlife Trust and Brighton & Hove Council. The project has included the development of a standard methodology for defining green networks, applicable to any urban area.

2.4 The green network was conceived to incorporate a number of functions including :

- maintenance of biodiversity and the creation of new habitats (a spatial expression of Biodiversity Action Plan targets);
- facilitation of Climate Change adaptation
- identification of a potential sustainable transport (footpath and cycleway) network;
- aesthetic enhancement of the city;
- delivery of ecosystem function benefits such as air purification, storm water drainage and reduced atmospheric CO_2.

2.5 The aim of the Brighton and Hove green network project has been to define a continuous green network through the city which can be implemented through the Local Development Framework to 2026. The green network is also intended to be complementary to the objectives of the council's Open Space Strategy and Biosphere Reserve aspirations.

3.0 Planning Policy Background

Planning Policy Statement 9

3.1 Planning Policy Statement 9 paragraph 12 states that local authorities should aim to maintain networks of natural habitats which link sites of biodiversity importance and provide routes or stepping stones for the migration, dispersal and genetic exchange of species. Such networks should be protected from development, and, where possible, strengthened by or integrated within it. This may be done as part of a wider strategy for the protection and extension of open space and access routes.

South-East Plan

3.2 Policy NRM4 of the draft South East Plan seeks to avoid a net loss of biodiversity, and to achieve a net biodiversity gain across the region by "establishing accessible green networks and open green space in urban areas to create habitats of importance to local communities".

4.0 The Brighton and Hove Green Network Project

Overview and Scope

4.1 Work began on the development of a green network for Brighton and Hove in spring 2007. A Geographical Information System (GIS) based approach was adopted, to be supported by local knowledge, peer review and wider consultation. GIS manipulation was carried out by GeoSpec, a specialist GIS consultancy based at the University of Brighton. Existing data sets were combined to define and predict the location and dimensions of the network, taking account of published guidance and examples of similar work elsewhere in the UK.

4.2 The study was divided into four tasks:

1. Define the primary function(s) of the network;
2. Define a baseline of natural green space within the network;
3. Assess the baseline of natural green space against the primary functions to identify additional areas requiring creation and enhancement within the network and
4. Peer review and wider consultation.

4.3 The identification of the network has involved a cumulative process of development, assessment, testing and review, followed by further development. At the time of writing, further changes to the network are anticipated as additional information is received and incorporated.

4.4 Four core components of the network were defined during the design of the project. These were adapted from similar work elsewhere in the UK and Europe:

- **Core areas** – areas of national, regional and city-wide nature conservation importance (including Special Areas of Conservation, Sites of Special Scientific Interest, Local Nature Reserves and Sites of Nature Conservation Importance).

- **Ecological development areas** – areas not currently part of core areas but with the potential to be so. These areas include other sites of biodiversity value and land with potential for achieving Biodiversity Action Plan habitat creation targets.

- **Connection zones** – areas linking core areas and ecological development areas where urban greening and habitat creation is a priority. These zones might incorporate sections of urban roads, housing and industrial estates where biodiversity enhancements could be undertaken, e.g. tree planting; green verge creation, widening and planting; traffic control and creation of 'home zones' and incentives to enhance private gardens. Connection zones might also include spaces or parts of spaces with other primary uses such as public parks and school grounds.

- **Buffer zones** – areas used to protect core areas from adverse external influences. These areas might include sports pitches and other leisure uses where biodiversity is incidental.

4.5 Novel ways of addressing gaps in the identified network were fully considered, including the use of green roofs and green walls, urban landscaping and street trees and verges, particularly in areas of high density development.

4.6 The final network may be used to inform development decisions and green space maintenance operations by identifying areas of importance for biodiversity, including areas for enhancement to achieve habitat creation targets. The study did not identify areas for the recreation of individual habitat types, which would need to be addressed as part of a local Biodiversity Action Plan.

4.7 Private gardens, rail land and other privately owned and inaccessible green spaces were normally not included in the network because of the limited tools available for the delivery of accessible natural green space. Exceptionally, inaccessible space was included if it was considered to be strategically important to completing the network and ways of improving accessibility were considered to be feasible.

5.0 Method

Stage 1: Defining the Primary Functions

5.1 Discussions between the funding partners and Geospec identified three primary functions of the green network which were initially used to guide its development. In all three cases, the over-riding criterion was to identify the most appropriate routes to connect natural green spaces within the urban area, urban fringe and downland:

- **A people-orientated function**. Natural England has published standards for the provision of accessible natural green space in urban areas (known as 'ANGSt'). For example, under the standards everyone is expected to live within 300 metres of an area of accessible natural green space. These standards were applied to the Brighton and Hove project to define 'zones of influence' of natural green space. It was assumed that these zones represent the areas with greatest potential for connectivity between spaces from a people-orientated viewpoint. It is important to recognise that the study did not attempt to address areas of deficiency in natural green space and it was assumed this work would be addressed through a wider open space strategy.

- **A species-orientated function**. GIS programming was used to define generic species with pre-defined abilities to disperse through the urban environment from existing areas of natural habitat. These species were used to define 'dispersal zones' around each site. This methodology, originally developed by the Forestry Commission, identified areas with greatest potential for connectivity between spaces from a species-orientated viewpoint.

- **An ecological services function**. The original objective of the project was to use quantified ecological services to guide the development of the network. However this approach was hampered by a lack of information in the UK on methods of quantifying the ecological services of green spaces. This strand of the methodology was eventually abandoned pending the development of tools, applicable to the UK, for quantifying the ecological services of natural green spaces.

Stage 2: The Baseline Data

5.2 The following data was used to develop the green network:

1. The 2005 Brighton & Hove open space audit. The audit identified all public open spaces in the city, including grass verges where they were assessed to form a green corridor or were of a size to enable alternative open space uses.

2. The Brighton & Hove biodiversity audit 2007/8. The audit identified all areas of natural habitat in the urban area and surrounding downland, detectable by remote sensing techniques (in practice, 25m^2 or greater).

3. Projected changes in population within core development areas around the city (defined by the council's Planning Strategy and Projects Team).

4. Outside the urban area, the Natural England ANGSt and the Forestry Commission species dispersal maps were not appropriate for defining the network. Instead, habitat creation maps developed for the South Downs Habitat Potential Mapping project were used. These maps identify the best locations for creating chalk grassland on the open downland. The maps were used to guide the size and location of the network to connect the urban sections of the green network with the city's administrative boundary.

5. Ordnance Survey's Address Point dataset was used to define population density across the city.

Stage 3: Assessing the open space baseline against the primary functions of the network: People-orientated function

5.3 The people-orientated function of the network was developed as follows. Throughout the software used was ESRI's ArcMap 9.1.:

5.4 Natural England's ANG standards state that in order to benefit from natural green space in the urban area, no-one should be further than 300m (in a straight line) from their nearest natural green space. This is taken as the average distance people are normally willing to walk to reach such spaces. A separate Natural England standard states that such space should be provided at a ratio of at least 2 ha per thousand people. The green network project assumed that land identified by applying these ANGSt criteria is the most suitable for connecting natural green spaces from a people-orientated viewpoint, because it would be the most likely to be used to walk between spaces.

5.5 To reflect the first part of the ANG standard, all areas of natural habitat within Brighton & Hove (identified from the Biodiversity Audit) were assumed for the purposes of the project to be 'accessible natural green space'. These areas were buffered by a radius of 300m. To integrate the effect of 'population pressure' on these buffer areas (the 2 ha per thousand people ANG standard), it was recognised that the distribution of both property addresses and green space in Brighton and Hove is irregular. Assuming that people use their nearest patch of green space, there is therefore a variation in the pressure of population (and usage) on each patch of green space. Some patches in densely populated parts of the city will be very heavily used, while green space in sparsely populated parts will be little used.

5.6 The population pressure on each patch of green space in the city was calculated to address the 2 ha per thousand people ANG standard. The number of addresses within 300m of each patch of green space was calculated and a modified buffer was then modelled for each green space patch to reflect the variable population pressure; patches in densely populated parts of

the city were assigned small buffers, patches in sparsely populated areas were assigned a larger buffer up to a maximum of 300m. The actual buffer value for each green space was calculated using the following formula[3]:

$$\left[\frac{(\text{Area in hectares}/\text{Population Pressure})}{(2/1000)}\right] * 300$$

5.7 This formula gives the population pressure per unit area on each green space patch, normalised by the ideal amount of green space provision (2ha per 1000 people) and multiplied by the ANGSt buffer size. For example, a patch of green space of 2ha in size with 1000 people within a 300m buffer will have a modified buffer value of 300m – in keeping with the ANGSt guidelines. Conversely, green space of 1ha surrounded by 1000 people within a 300m buffer will have a modified buffer value of 150m, reflecting the greater pressure of population on this green space.

5.8 As a final stage to developing the people-orientated function of the green network, the population pressure analyses were repeated using predicted populations for Brighton & Hove until 2026, with projected data for six 'core development areas'. Rectangular areas representing each of these were delineated by using British National Grid co-ordinates for two sets of diagonally opposite corners. The areas delineated were as shown in Table 2:

Table 2: Predicted Populations in Core Development Areas

Area	Bottom Left Corner (X,Y)	Top Right Corner (X,Y)	New residential units
Brighton Marina, Black Rock and Gas Works Site	533400, 103000	534800, 103550	2344
Brighton Station East, London Road and Preston Park West	530000, 105000	531400, 106800	800
Edward Street and Eastern Road	531850, 103830	532700, 104050	200
Lewes Road/ Academic Corridor	532600, 106800	534350, 108580	275
Shoreham Harbour	520900, 104000	527100, 104900	1200
Old Shoreham Road/ Hove Station Area	528400, 105250	529250, 105875	150

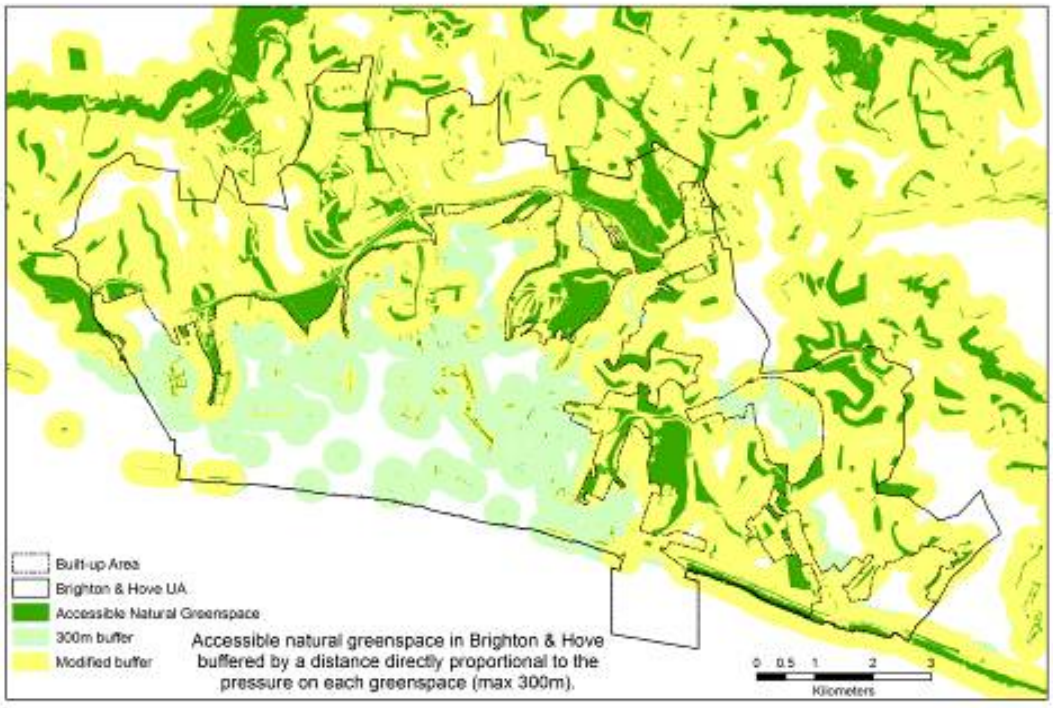
5.9 The actual co-ordinate pairs used were inexact, reflecting the ambiguous geographical delineation of the core development areas. To model the actual locations of the new residential units, random numbers were calculated within the limits of each rectangle – one

[3] Note, that in this calculation the population pressure is based in the assumption of 2.06 persons per residential address This is the population of Brighton & Hove at the 2001 Census divided by the number of addresses within the Ordnance Survey Address Point dataset. Therefore, each address point occurring within the 300m buffer of a green space patch was multiplied by 2.06 to give the population pressure.

co-ordinate pair for each unit up to the maximum for each area; 2,344 co-ordinate pairs for the Brighton Marina, Black Rock and Gas Works Site for example.

5.10 The 300m buffer areas around each natural green space, modified by population pressure, are shown on Map 1 (below). Map 1 therefore shows the draft network as defined by the people-orientated function alone:

Map 1: The green network by people-orientated function



Stage 3: Assessing the open space baseline against the primary functions of the network: Species-orientated function

5.11 To define the best location for the green network from a species-orientated viewpoint, expert opinion was used to define the potential movement of two hypothetical species through the urban fabric of Brighton and Hove. The two species used were a hypothetical reptile, with a maximum dispersal distance of 1km and a hypothetical grassland butterfly with a maximum dispersal distance of 3km. These generic species were designed to be able to move progressively less easily through increasingly urbanised habitats and urban features.

5.12 Each of the habitats identified by the biodiversity audit of Brighton and Hove was classified into one of seven groups (A to G), as shown in Table 2 below. The classification was based on the similarity of habitats from a species perspective. It was assumed that the species were not able to move through (or over) wholly urban features (such as buildings and roads), unless road verges were present. Similarly, private back gardens were not taken into account in the analysis because of the impracticalities of including them in a publically accessible green network.

Table 2: Groups of Habitats used to predict species movement

Integrated Habitat System* Code	Habitat	Group
AR	Open water	A
AS	Standing open water	A
CR	Arable	C
EM	Fen, marsh, swamp	F
GA	Acid grassland	E
GC	Calcareous grassland	E
GI	Improved grassland	C
GN	Neutral grassland	E
GU	Semi-improved grassland	C
HE	Heathland	F
LF	Boundary & linear features	?
LR	Littoral rock	B
LS	Littoral sediment	B
OT	Other tall herbs and ferns	E
OV	Unknown terrestrial vegetation	?
RE	Inland rock exposure	B
SC	Scrub	E
SR	Maritime cliffs & slopes	B
SS	Supralittoral sediment	B
TS	Scattered trees	G
UH	Unidentified habitat	?
URO	Built up area & gardens	D
WB	Broadleaf woodland	G
WC	Coniferous woodland	G

*The Integrated Habitat System was the habitat classification system used by the Biodiversity Audit 2008

5.13 Three different permeability scenarios were tested and a different permeability value was assigned to each habitat group under each scenario. In each case the higher the permeability value, the more difficult it was for a given species to move through that habitat. The actual amount of potential movement was a function of the maximum dispersal distance, divided by the ease of movement. The generic reptile (with a maximum dispersal distance of 1,000m) was therefore able to move 1,000m through a habitat with a permeability value of 1 (1000/1), whereas the same species could only move 15.62m through a habitat of permeability value equal to 64 (1000/64).

5.14 Permeability scenario 1 used a geometric progression ranging from 1 to 64 for the seven classes of habitat type. Scenario 2 used a logarithmic series ranging from 10 to 10,000,000 and scenario 3 used a rounded exponential series ranging from 3 (e^1) to 1,097 (e^7). The permeability values for each habitat group under each scenario are shown in Table 3 below.

Table 3: Habitat groups divided by three permeability scenarios

IHS Group	Scenario 1	Scenario 2	Scenario 3
A	64	10000000	1097
B	16	100000	148
C	8	10000	55
D	32	1000000	403
E	1	10	3
F	2	100	7
G	4	1000	20

5.15 The ArcMap version 9.1 cost distance function was used to calculate the potential movement of both the generic reptile and generic butterfly species. This used as a baseline all areas of natural habitat identified in the Brighton & Hove biodiversity audit as the hypothetical species source and the habitat data (reclassified into the seven classes described above) as the impedance to movement.

5.16 The resulting raster data layer shows the parts of the landscape accessible to the two hypothetical species – the potential green network. Due to problems with modelling the permeability of the habitat data for the rural area, only the potential network within the Brighton and Hove built-up area was calculated. On each of the two maps, the potential network is shown in a light green (see Maps 2 and 3, below).

5.17 As expected, the network is larger for the generic butterfly species than for the generic reptile because of the butterfly's larger potential dispersal distance. In addition, reflecting the difference in permeability ranges for each scenario, the network covered the largest area under scenario 1, whilst the smallest area was covered under scenario 2. Scenario 1 was rejected because its range is too defused to be useful for defining corridors of space. Scenario 1 was therefore chosen as providing the most useful results for developing the green network (shown on Maps 2 and 3 below).

Map 2: Potential green network derived from the ease of movement of a generic reptile

Map 3: Potential green network derived from the ease of movement of a generic butterfly

Combining the people-orientated and species-orientated methodologies

5.18 To integrate the people-orientated and species-orientated green network methodologies, the three maps were overlaid (see Map 4). The 'final potential network' (see Map 5) was then defined as being a combination of:

- All areas of natural habitat identified by the biodiversity audit (taken for the purposes of this study as being 'accessible natural greenspace')
- All areas where either of the species permeability maps coincide with the ANG buffer map.

Map 4: People-orientated and species-orientated green networks combined

Map 5: The final potential network

5.19 Map 5 shows the 'final potential network' (dark green) overlaid over a base map of all green space in the city.

Modelling the green network on the open downland

5.20 Neither the people-orientated nor the species-orientated methods for defining the green network were found to be useful for modelling the network over land which is predominantly rural in character. To address the rural hinterland of Brighton and Hove, it was therefore decided to use the South Downs Habitat Potential Mapping (SDHPM) model, originally

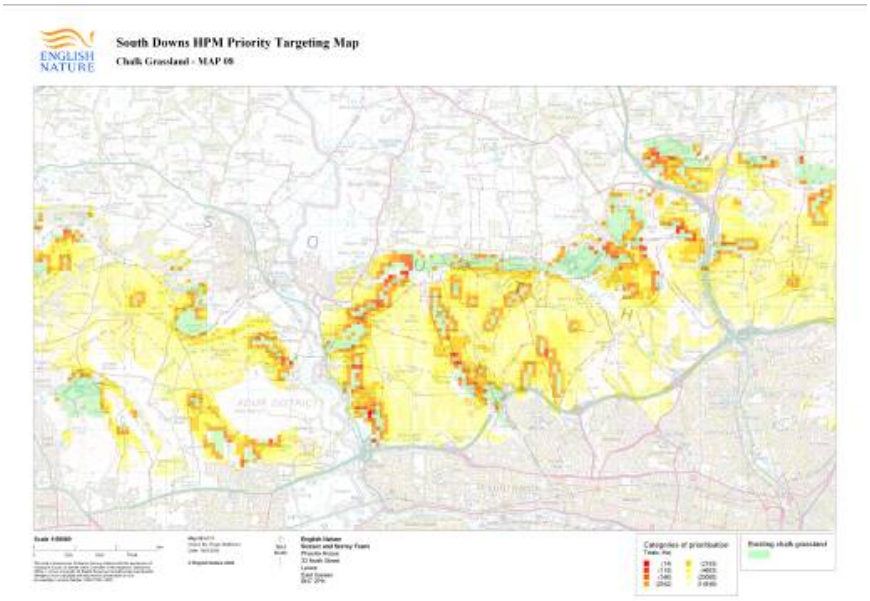
developed by Natural England, the Landscape Enhancement Initiative[4] and the Biogeography and Ecology Research Group (BERG) at Brighton University and Geodata from Southampton University. The SDHPM model identifies the most appropriate locations for re-creating species-rich chalk grassland across the South Downs.

5.21 The SDHPM model is based on a grid system where the whole of the South Downs is divided in to 100m x 100m (1 ha) grid squares, and attribute data attached to each grid square, for a range of both environmental parameters and spatial attributes. The modelling process then took place in two stages:

1. An analysis of the environmental parameters required for chalk grassland (rendzina soils, excluding clay caps, habitat categories that have re-creation potential).

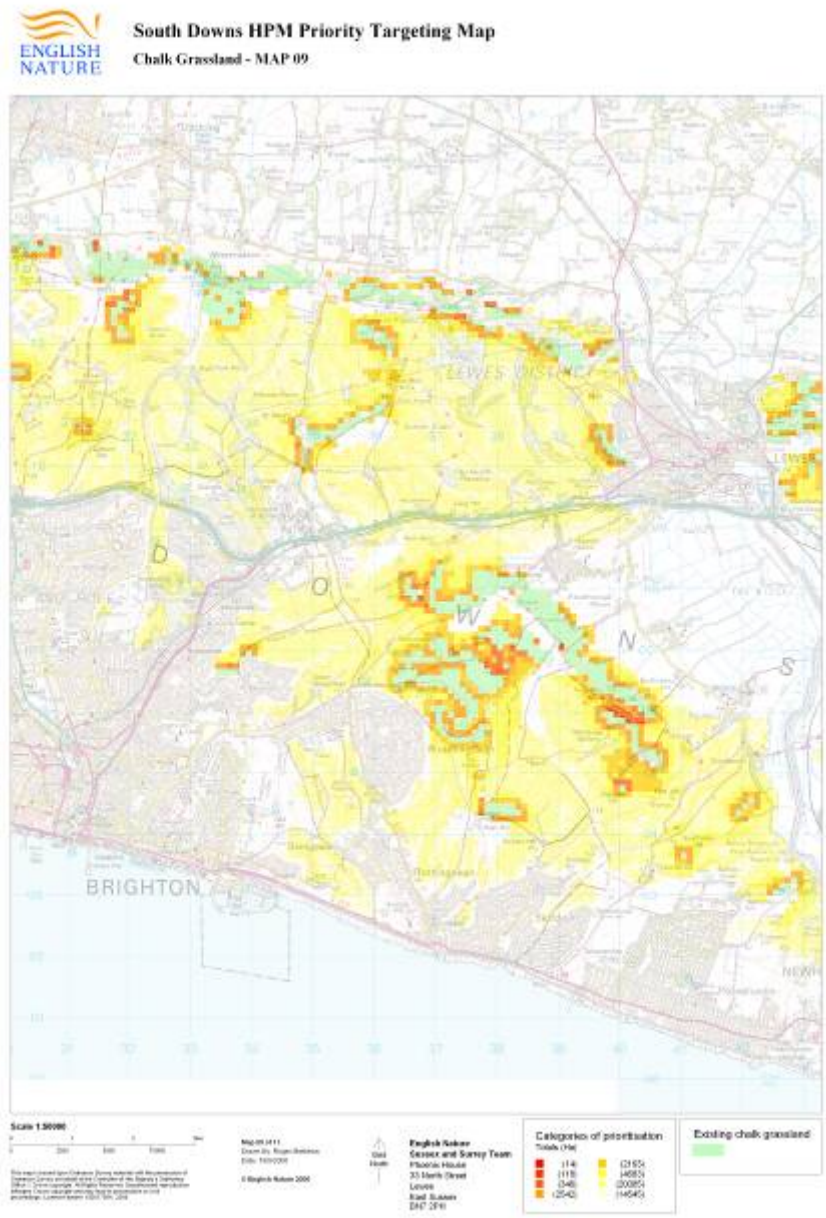
2. A spatial analysis of the data based on the distribution of the existing chalk grassland resource (eg linking, creating stepping stones, buffering etc) in order to identify priority targeting areas for re-creation.

5.22 The resulting Priority Targeting Maps for the South Downs thematically colour up all the grid squares identified as having chalk grassland re-creation potential, with those seen as being the highest priority, based on the spatial analysis (+ slope) appearing as the 'hottest' colours. The two maps covering the Brighton and Hove area are shown below (Maps 6 and 7):



Map 6: The SDHPM map for the west Brighton area

[4] The LEI includes the South Downs Joint Committee and the Rural Development Service



Map 7: The SDHPM map for the east Brighton and Hove area

Final Interpretation

5.23 Maps 5, 6 and 7 required interpretation to clearly delineate the draft green network and specifically of the precise boundaries of the ecological development areas, connection zones and buffer zones. Ecological development areas were defined by combining areas of natural green space outside protected nature conservation sites, plus additional areas of land that were known from local knowledge to have potential for habitat creation and/or enhancement (due to their location, land ownership or proximity to nature conservation features of value). Connection zones closely followed areas of connectivity defined by Map 5, taking into account a desire to establish natural green space links between important destinations such as recreational centres, transport hubs, universities and schools, to promote integration of the

network with public use. To achieve this, some interpretation was required, using aerial photography and local knowledge. The resulting draft green network maps are attached to this report.

6.0 Peer Review and Next Steps

6.1 At the time of writing peer review of the methodology and of the maps it produced is underway. Presentations of the methodology and detailed maps of the network were submitted for comment to the council's Wildlife Advisory Group in May 2008 and in September 2008 to a wider consultation, organised by the Sussex Biodiversity Record Centre, to identify Biodiversity Opportunity Areas for the South-East. No changes have been proposed to date to the methodology or to the maps as a result of these consultations.

6.2 During February and March 2009 the Brighton & Hove green network methodology and maps will be submitted to the South East England Biodiversity Forum for consideration with a view to the adoption of the methodology for use in urban areas throughout the South East Region. If agreed, the Brighton & Hove maps will also be included in the South East Biodiversity Opportunity Area maps.

6.3 Locally, it is anticipated that the final, peer reviewed maps will be incorporated into the draft Site Allocations Development Plan Document to be published as part of the Brighton & Hove Local Development Framework. This will provide an opportunity for all LDF consultees to comment on the maps. A Supplementary Planning Document is also planned to interpret and apply local policy regarding the implementation of the network.

7.0 Assumptions and Limitations

7.1 The project group have identified a number of assumptions and limitations in the Brighton and Hove green network project. These include:

- The Brighton and Hove network was developed without reference to surrounding administrative areas and may not harmonise with similar networks developed by neighbouring local authorities. Since its development, the South East Biodiversity Opportunity Area maps for the rural areas surrounding Brighton & Hove have been agreed and these include all of the rural parts of the Brighton and Hove network.

- Accessibility was not taken into account in the Brighton and Hove biodiversity audit. Nevertheless this project assumed that all the sites it identified were accessible natural green space (according to the Natural England definition). Although this disparity was taken into account at the interpretation stage of development, some refinement of the network may be necessary to ensure all of it is accessible or there is a reasonable likelihood that it could become accessible in the future.

- In contrast to the Regional methodology, the Brighton & Hove network methodology gave weight to an accessibility factor (Natural England ANG standards) and ignored geographical factors such as underlying soils, geology, topography (aspect and slope), hydrology and landscape descriptive units. This is because in urban areas geographical factors were considered to be of secondary importance to human factors in developing a useful green network.

8.0 Further information

8.1 The Brighton & Hove Green Network was developed by Angela Marlow (Sussex Wildlife Trust), John Lee (Geospec) and Matthew Thomas (Brighton & Hove Council). For further information on any aspect of the green network project, please contact Matthew Thomas, council ecologist on 01273 292371; e-mail matthew.thomas@brighton-hove.gov.uk

9.0 Appendix 1: Interim Map

Map Showing Designated Wildlife Sites and NSN compared with othe Biodiversity Areas

Statistics:

City Population: 251900

Within City Boundary:

Total area: 8265 hectares
Total area Natural/Semi Natural Greenspace: 709 hectares
Percentage Natural/Semi Natural Greenspace of total area: 8.6
Area per 1000 population: 2.8 hectares

Within Built Up Area:

Total area: 4250 hectares
Total area Natural/Semi Natural Greenspace: 99.8 hectares
Percentage Natural/Semi Natural Greenspace of total area: 2.35
Area per 1000 population: 0.4 hectares

Legend

- Designated Wildlife Sites
- Open Space Natural Semi Natural
- Potential Core Areas
- Green buffers
- Connection Zones

Scale: 1:40,578

Brighton & Hove City Council