GREEN ESSEX

A STRATEGY THAT ADVOCATES FOR HIGH QUALITY GREEN SPACE AND GREEN INFRASTRUCTURE IN ESSEX

2019

Appendices Part C – Technical Research Papers

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13. APPENDIX C1 – GREEN INFRASTRUCTURE SPATIAL ANALYSIS BY UNIVERSITY OF EAST ANGLIA

Front Cover Image of Essex Natural Capital by Place Services.

ESRC Business and Local Government Data Research Centre

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Spatial data integration and analysis to support the Essex Green Infrastructure Strategy

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ABSTRACT

Essex County Council are producing a green infrastructure strategy and require an understanding of both current provision in the county and how this relates to the sites for future housing and economic development put forward within the Local Development Plans for Essex. This report describes work which has:

i. combined a number of spatial data sources to map the distribution of green infrastructure assets across Essex;
ii. identified the functions performed by these assets and the benefits they provide to the local populations;
iii. investigated associations between green infrastructure provision in neighbourhoods and socio-economic characteristics of their resident populations;
iv. examined the prevalence of current green infrastructure assets in the vicinity of proposed sites for future housing and economic development.

The results are intended to help identify needs and opportunities to enhance green infrastructure across the county and inform strategic planning in Essex.

Keywords: Green Infrastructure, Assets, Functions, Benefits, Essex

1 INTRODUCTION

The population of Greater Essex is projected to increase by over 18% to approximately 2.1 million by 2041 (ONS, 2018). This compares to a 12% average increase for England and there are individual local authorities in Essex where the projected growth is over 20%, particularly linked to new garden communities and other housing developments. As part of initiatives to manage these growth pressures, as well as enhancing the quality of life for residents, Essex County Council are currently producing a green infrastructure strategy. This report describes work undertaken to support the evidence base underpinning the strategy by assessing the current provision of green infrastructure and how it compares with the distribution of proposed sites for new housing and economic development.

Green infrastructure (hereafter GI) has been defined as “the network of multifunctional natural and semi-natural features, green spaces, rivers and lakes that intersperse and connect villages, towns and cities and is integral to the quality of life in sustainable communities” Natural England (2009, p.7). The types of GI encompass formal parks and gardens, amenity greenspace, natural and semi-natural urban greenspaces, green corridors and other public spaces as diverse as allotments and city farms. Together these assets provide areas for recreation and education, habitats for wildlife and supply ecosystem services such as flood defence or absorption of air pollution (UK-NEA, 2011). Information on GI provision is increasingly important for many planning purposes and the recent 25 Year

Environment Plan explicitly encourages more investment in the quality and provision of GI, particularly in towns and cities (Defra, 2018).

Since there are many types of GI the range of possible data sources is extensive. Many local authorities created their own GI datasets in response to Planning Policy Guidance 17 (DCLG, 2002), but relatively few of these have been regularly updated and consequently the provision of consistent information across larger regions can be problematic. More recently, the Ordnance Survey (OS) have released two national greenspace mapping products, the OS MasterMap Greenspace Layer (OS, 2019a) and OS Open Greenspace (OS, 2019b). However, coverage of the former is restricted to larger town and cities, while the latter focuses on publicly-accessible areas such as parks, sports facilities or allotments. As a consequence, although both sources are valuable they do not provide a comprehensive spatial database of GI assets.

The approach adopted in this piece of work stems from a previous project within the ESRC-funded Business and Local Government Data Research Centre (BLGDRC) which combined data from the crowdsourced OpenStreetMap (OSM) database (https://www.openstreetmap.org) and OS MasterMap (https://www.ordnancesurvey.co.uk/business-and-government/products/mastermap-products.html) to create a county-wide GI database for Essex (Taigel *et al.*, 2017). This method has been refined in the present analysis by including additional data layers (such as the new OS products mentioned above). In addition, previous work by the North West Green Infrastructure Unit (2008) and Liverpool City Region (2014) has been drawn upon to associate GI assets with the functions they perform and the benefits provided to local populations. The result is a broad definition of GI and it should be noted that this is rather different from the previous study by Buell (2009) on accessible natural greenspace provision in Essex. As a consequence, the results of the two analyses are not directly comparable.

2 Data and Methods

The overall approach adopted is summarised in Figure 1. Potentially relevant sources were identified and spatial data imported into the ArcGIS Desktop software (http://desktop.arcgis.com/en/). Most of the data sets were available through the Open Government Licence or other open data usage policies. A small number were obtained from Essex County Council or accessed through widespread local government licences (e.g. the Ordnance Survey Public Sector Mapping Agreement). This was an important consideration because of the wish to ensure that the mapping methodology could be implemented for any English local authority.

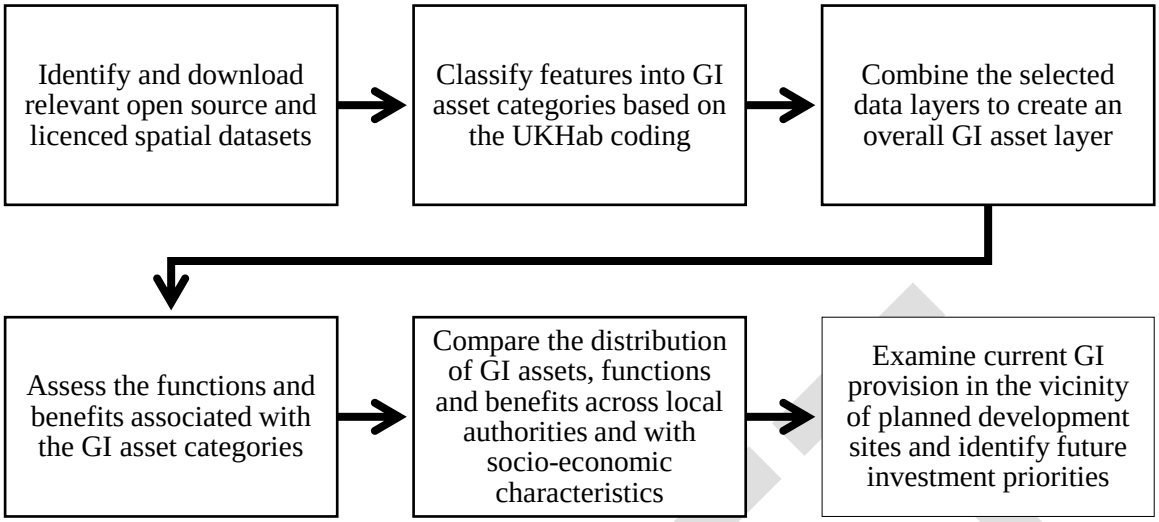

Figure 1 - Process diagram for the mapping and assessment of green infrastructure

Nearly 30 possible data sources were identified in the initial scoping stage. One challenge was that similar assets were sometimes described in different ways so to provide more consistency the features were coded into a set of 13 GI types based on the categories used in the UK Habitat Classification (UKHab) (http://ecountability.co.uk/ukhabworkinggroup-ukhab/). The list in Table 1 is based on the UKHab Secondary Codes for GI, with a few departures from the higher level groupings where certain types of features were considered particularly important to distinguish in Greater Essex.

Table 1 – Categories used in the mapping of GI assets

Category	Category
Parks and gardens	Outdoor sports facilities
Natural and semi-natural open space	Amenity green spaces
Ancient woodland	Open space around premises
Reservoirs, lakes and ponds	Cemeteries and churchyards
Coastal features	Allotments, community gardens and city farms
Waterways	Productive spaces
Greenways	

Having coded the possible layers into GI asset categories a number of overlaps or redundancies between sources were identified and ultimately the set of 21 layers listed in Table 2 formed the basis of the mapping. Several alternatives existed for an underlying land cover layer and the OSM dataset was selected for two main reasons:

i. It was in vector format and so more immediately comparable to the other data layers (all of which were vector lines or polygons) than sources derived from satellite imagery (such as CORINE Land Cover, https://land.copernicus.eu/pan-european/corine-land-cover) with an underlying grid structure.

ii. Due to recent work at Geofabrik (Ramm, 2017) the process of extracting land cover information from OSM was much easier than previously and included productive agricultural land as well as other types of features. Although it was decided not to include 'productive spaces' (i.e. arable land and livestock pasture) in the final definition of green infrastructure because they would have completely dominated all of the other categories in terms of areal extent, it was also considered advantageous that they could be distinguished in a broad database, rather than being identified from a separate source such as the Agricultural Land Classification for England (https://data.gov.uk/dataset/952421ec-da63-4569-817d-4d6399df40a1/provisional-agricultural-land-classification-alc). In the results that follow the distribution of productive spaces is presented as a separate layer and compared with that for the GI assets.

Several considerations arose in the process of combining the data layers into a single GI map. One was that there were variations in the source scales (and consequently spatial detail) of layers and consequently scope for generating sliver polygons (i.e. small, narrow, ribbon-like shapes along boundaries) when two representations of the same feature were overlaid. Coding all the two features into the UKHab GI categories and dissolving boundaries where two adjacent polygons had similar codes was one strategy used to reduce such effects. Whilst undertaking the overlays it also became apparent that there were duplicates of features in some layers and it proved quite time-consuming to identify and remove them. It had been anticipated that there would be duplicates in a sources such as OSM (which is largely crowdsourced from citizen volunteers), but they also occurred in other cases (such as Ordnance Survey greenspace data) which was not expected.

A third issue was that there were differences between data layers in the specificity with which types of GI were identified. On some occasions this arose because certain data layers focused on categories of land cover (e.g. natural and semi-natural open space), whilst others classified the same features in terms of use (e.g. a park, sports facility or reservoir). To overcome this issue the individual data layers were overlaid in a particular order, starting with those consisting primarily of more general land cover categories and finishing with those containing more precise feature definitions. The actual order used was that in which the layers are listed in Table 2 and the type of overlay employed was one termed an Update in ArcGIS so that when two layers were combined any features in the second input that coincided with those in the first one completely replaced it. Output from the first Update operation (i.e. involving the OSM Land Use/Land Cover and Natural Trust Land layers) then formed the input to the next one so that there was a cumulative sequence of updating. The final input was the Ordnance Survey MasterMap Green Space so that all features from this were preserved in the overall results.

Due to the updating approach there were some instances where areas categorised as one type of feature (e.g. ancient woodland) relatively early in the process had this replaced with another classification (e.g. natural and semi-natural open space) from a different source (e.g. the Ordnance Survey layers) at a later stage. It also became apparent that certain water features (e.g. lakes and reservoirs) were obscured due to the GI coding of polygons emphasising the surrounding land so these were reinstated using boundaries from the OS OpenMap – Local database. In addition, the geographical extent of the mapping was extended 10 km beyond the boundary of Greater Essex to allow for the inclusion of relevant features in neighbouring counties in the assessment of access to GI assets for Essex residents.

Table 2 – Data sources used for GI asset mapping

Data Layer	Source
OpenStreetMap Land Use and Land Cover	https://www.openstreetmap.org/ and http://download.geofabrik.de/
National Trust Open / Limited Access Land	https://uk-nationaltrust.opendata.arcgis.com/datasets/
Local Nature Reserves	https://naturalengland-defra.opendata.arcgis.com/datasets/local-nature-reserves-england
National Nature Reserves	https://naturalengland-defra.opendata.arcgis.com/datasets/national-nature-reserves-england
Sites of Special Scientific Interest (SSSIs)	https://naturalengland-defra.opendata.arcgis.com/datasets/sites-of-special-scientific-interest-units-england
RSPB Sites	https://opendata-rspb.opendata.arcgis.com/datasets/
Special Areas of Conservation (SACs)	https://naturalengland-defra.opendata.arcgis.com/datasets/special-areas-of-conservation-england
Special Protection Areas (SPAs)	https://naturalengland-defra.opendata.arcgis.com/datasets/
RAMSAR Sites	https://naturalengland-defra.opendata.arcgis.com/datasets/ramsar-england
Priority Habitats	http://naturalengland-defra.opendata.arcgis.com/datasets/
Traditional Orchards	https://naturalengland-defra.opendata.arcgis.com/datasets/
National Woodland Inventory	https://data.gov.uk/dataset/5f869d9b-c517-4cc8-b78d-ece59e8573f3/national-inventory-of-woodland-and-trees
Ancient Woodland	https://naturalengland-defra.opendata.arcgis.com/datasets/ancient-woodlands-england
Country Parks	https://naturalengland-defra.opendata.arcgis.com/datasets/country-parks-england
Registered Parks and Gardens	https://data.gov.uk/dataset/88cfe0de-85cd-431f-9836-2bee841d8165/registered-parks-and-gardens-gis-data
Lake and Reservoir Outlines	https://www.ordnancesurvey.co.uk/opendatadownload/products.html#OPMPLC
Sustrans National Cycle Network	Provided by Sustrans
Essex Promoted Routes	Provided by Essex County Council
Public Rights of Way	Provided by Essex County Council
Ordnance Survey Open Green Space	https://www.ordnancesurvey.co.uk/opendatadownload/products.html
Ordnance Survey MasterMap Green Space	https://www.ordnancesurvey.co.uk/business-and-government/products/os-mastermap-greenspace.html

Identifying GI Functions and Benefits

The approach used in previous studies in north-western England (e.g. North West Green Infrastructure Unit, 2008; Liverpool City Region, 2014) was adapted through discussions with Essex County Council officers to associate the mapped GI assets with the functions they perform and the benefits provided to local populations. This involved creating matrices where first the links between asset types and benefits were defined, and then those between functions and benefits. The assessment was relatively simple, with linkages being specified on a binary yes/no basis rather than any quantification of strength of associations. This was considered appropriate given current knowledge and because the main purpose was to demonstrate the multiple functions and benefits associated with GI assets. Table 3 shows the associations identified between asset categories and 10 functions. Additional tables in Appendix A summarise the identified linkages between these functions and 19 types of economic, social and environmental benefits.

Table 3 – Identified associations between GI assets and the functions they perform

Asset Type	Functions Performed									
	Recreation	Green travel route	Habitat provision	Heritage and cultural asset	Food production and productive landscapes	Pollution absorption and removal	Flood attenuation and water resource management	Coastal storm protection	Cooling effect	Accessibility to nature
Parks and gardens	x	x	x	x		x	x		x	x
Natural and semi-natural open space	x		x	x	x	x	x		x	x
Ancient woodland	x		x	x		x	x		x	x
Reservoirs, lakes and ponds	x		x		x		x			x
Coastal features	x	x	x				x	x		x
Waterways	x		x			x				x
Greenways			x		x	x	x			
Outdoor sports facilities	x	x	x							x
Amenity green spaces	x									
Open space around premises	x			x						
Cemeteries and churchyards	x		x			x				x
Allotments, community gardens and city farms			x	x						x
Productive spaces	x		x		x	x				x

Note: an x in the table cell indicates that the asset type was identified as providing the corresponding function.

Assessing the Distribution of GI Assets

Further overlay operations were carried out in ArcGIS to calculate the area of different GI assets within the 14 authorities in Greater Essex. A similar approach was also used to determine the distribution of GI across the 1,076 Lower Level Super Output Areas (LSOAs). These areas can be thought of as a 'neighbourhood' scale and typically have a population of between 1,500 and 2,000 residents. Calculating the extent of GI in such administrative areas also made it possible to compare the pattern of current provision with socio-economic variables such as the Index of Multiple Deprivation (IMD) (Ministry of Housing, Communities & Local Government, 2015), population ethnicity from the 2011 Census (ONS, 2019a) and age distributions from 2017 mid-year population estimates (ONS, 2019b).

Access to green infrastructure was examined using Natural England's Accessible Natural Greenspace Standard (ANGSt) (Handley *et al.*, 2003). This provides a set of benchmarks recommending that people should have:

i. an accessible natural greenspace of at least two hectares in size, no more than 300 metres (approximately 5 minutes walk) from home;
ii. at least one accessible 20 hectare site within two kilometres of home;
iii. one accessible 100 hectare site within five kilometres of home;

iv. one accessible 500 hectare site within ten kilometres of home.

These criteria were combined with a detailed (10 m resolution) population surface derived from integrating 2011 census postcode headcounts and OS OpenData Vector Map District building outlines (GeoData Institute, 2019) to assess the number of Essex residents meeting the four access benchmarks. However, it should be emphasised that the results of such calculations can be quite sensitive to certain assumptions. For instance, one issue is how a 'site' is defined and in this analysis the presence of roads or paths bisecting GI assets (e.g. woodland or other natural open spaces) particularly restricted the number of 500 hectare sites. In addition, the long but narrow corridors around Public Rights of Way or other paths were excluded from the ANGSt calculations because otherwise the levels of access would have been rather artificially inflated. Furthermore, defining an 'accessible' site can be difficult (e.g. access may vary over time or with individual physical capacity). This analysis uses a broad GIS definition, so the results are not directly comparable with some previous studies, but applying the ANGSt benchmarks still provides indicators of population proximity to GI and allows relative variations across Greater Essex to be examined.

The final step was to compile GIS data layers representing sites approved for future housing and employment growth in Local Development Frameworks or Plans. This information was provided by individual district or unitary authorities via Essex County Council, but was not complete for Greater Essex because some authorities had not finalised the relevant documents. Nevertheless, the available information made it possible to assess current GI provision in and around a number of sites, such as the proposed garden communities in north Essex.

3 Results

The total land area of Greater Essex was calculated at 3,677 km^2. Added together, the 21 individual input data layers totalled 1,821 km^2, but there were many overlaps so that the final area of GI assets generated by the updating process was 782 km^2 (i.e. 21.3% of the land area). Within this total, 328 km^2 (41.9%) was coded as 'natural and semi-natural open space', 102 km^2 (13.0%) as 'coastal features', 86 km^2 (11.0%) as 'open space around premises' and 77 km^2 (9.9%) as 'parks and gardens'. Figure 2 shows the spatial distribution of the GI assets, highlighting the way that the different types of features form a network across the county. Overall, there were 6,531 km of Public Rights of Way within Greater Essex and 592 km of Promoted Routes.

In addition to the GI, the OSM Land Use/Land Cover layer contained 2,240 km^2 coded as 'productive spaces' such as arable land and livestock pasture (i.e. 60.1% of Greater Essex). This leaves approximately 655 km^2 (17.8%) of other land consisting of built-up areas, infrastructure or other types of land cover.

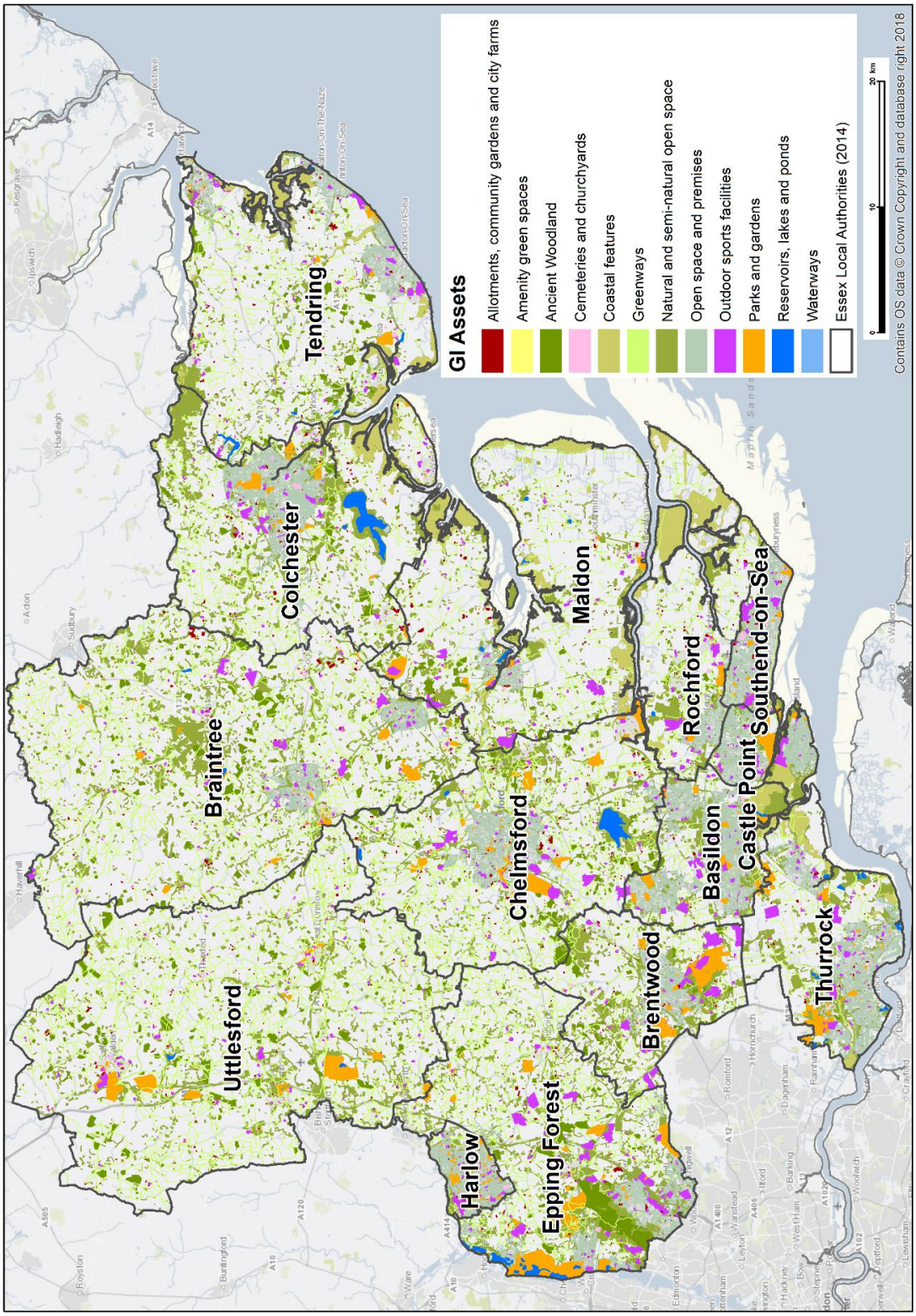

Figure 2 – Distribution of GI assets in Greater Essex

Table 4 summarises the distribution of GI assets across district and unitary authorities in Greater Essex. As might be anticipated, the composition of GI varies between authorities with features such as 'natural and semi-natural open space' and 'ancient woodland' being more common in rural areas and categories such as 'parks and gardens' and 'outdoor sports facilities' proportionally more important in urban centres. There is also an appreciable variation in the percentage of each local authority area classed as GI, with values ranging from 12% to 49%. Figure 3 shows that there is a tendency for higher GI percentages to occur in the south of Greater Essex, while the map of 'productive spaces' in Figure 4 demonstrates that the authorities in northern Essex have higher proportions of arable land and pastures. This contrast further emphasises the differences in land cover and use across Essex.

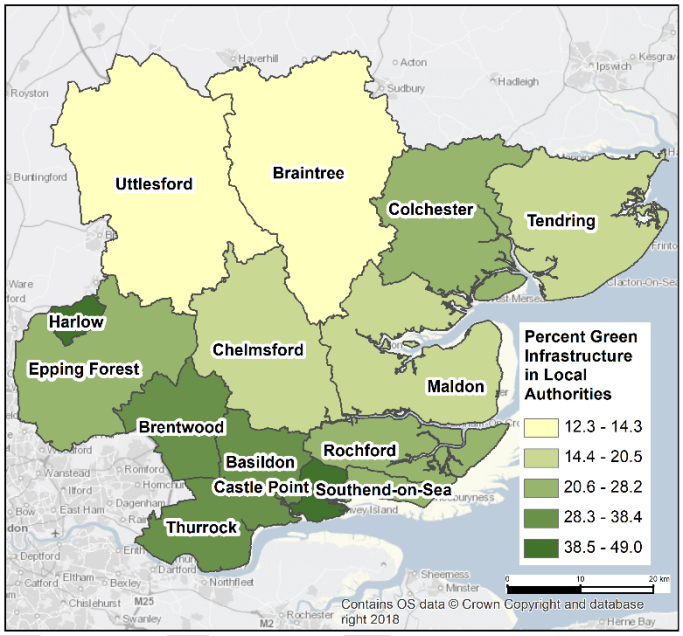

Figure 3 – Percentage of authority areas classed as GI in Greater Essex

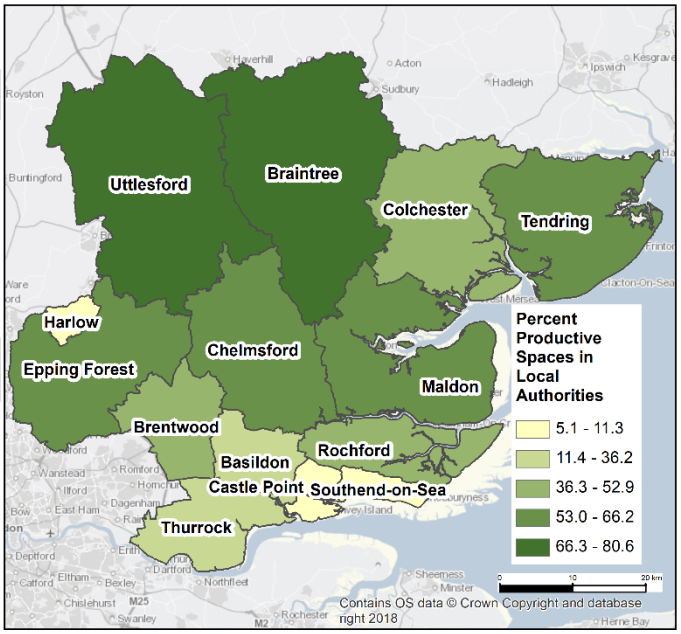

Figure 4 – Percentage of authority areas classed as productive spaces in Greater Essex

Table 4 – The distribution of GIS assets across district and unitary authorities in Greater Essex

Authority Name	Authority Area	Parks and gardens	Natural and semi-natural open space	Ancient Woodland	Reservoirs, lakes and ponds	Coastal features	Waterways	Greenways	Outdoor sports facilities	Amenity green spaces	Open space around premises	Cemeteries and churchyards	Allotments, community gardens and	Total GI	% GI in Authority
Basildon	110.0	3.6	15.2	0.4	0.1	5.3	0.0	0.5	3.9	0.1	12.7	0.3	0.1	42.3	38.4
Braintree	611.6	5.1	51.4	12.7	0.3	0.1	0.0	4.8	6.2	0.1	4.5	0.7	1.4	87.4	14.3
Brentwood	153.1	8.3	22.8	4.5	0.0	0.0	0.0	0.9	7.4	0.0	3.8	0.3	0.2	48.1	31.4
Castle Point	45.1	3.1	4.0	0.0	0.0	4.1	0.0	0.2	2.5	0.0	7.9	0.1	0.1	22.1	49.0
Chelmsford	342.2	8.6	31.9	8.2	3.6	0.8	0.0	2.9	5.9	0.1	6.5	0.4	1.2	70.2	20.5
Colchester	333.1	4.6	41.1	4.8	5.0	14.3	0.0	2.1	3.6	0.1	9.8	0.6	1.0	87.1	26.2
Epping Forest	338.9	17.3	36.9	15.9	2.2	0.0	0.0	2.7	8.9	0.0	10.1	0.5	0.7	95.5	28.2
Harlow	30.5	2.3	2.8	0.0	0.0	0.0	0.0	0.1	1.8	0.0	6.6	0.2	0.2	14.2	46.4
Maldon	358.7	3.0	25.0	4.2	0.0	27.4	0.0	2.1	4.5	0.0	1.2	0.3	0.7	68.6	19.1
Rochford	169.4	1.3	12.3	1.7	0.5	24.5	0.0	1.2	2.7	0.0	1.9	0.2	0.3	46.6	27.5
Southend-on-Sea	41.7	1.5	1.0	0.0	0.1	0.4	0.0	0.0	3.0	0.0	4.9	0.4	0.3	11.8	28.2
Tendring	337.7	2.0	20.2	5.5	0.8	16.8	0.0	1.7	4.2	0.1	4.7	0.6	0.6	57.2	16.9
Thurrock	163.4	5.8	19.9	0.1	0.9	7.8	0.0	0.6	4.5	0.1	11.0	0.3	0.4	51.5	31.5
Uttlesford	641.0	10.5	42.8	14.8	0.2	0.0	0.0	6.2	2.9	0.1	0.1	0.5	0.8	79.0	12.3
Total	3,676.4	77.1	327.8	72.9	13.9	101.5	0.1	26.2	62.0	0.7	85.9	5.5	8.1	781.6	21.3

Notes: Areas are in km^2. There are some small variations from Greater Essex totals due to differences in boundary resolutions. Due to the updating method there are instances where areas initially categorised as one type of feature had this replaced with another classification from a different source at a later stage. This, for instance, is the reason for the apparent absence of ancient woodland in Castle Point when such habitats exist at Thundersley.

GI Functions and Benefits

Figure 5 shows the numbers of functions provided by GI assets in Greater Essex. Seventy seven percent of the 782 km^2 supported at least six of the 10 functions identified in Table 3. This multi-functionality also existed at a finer resolution within urban areas, illustrated by the inset map of Harlow in Figure 5.

The GI functions provide multiple benefits. Nineteen economic, social and environmental benefits are documented in Appendix A and the map in Figure 6 indicates that over three-quarters of the asset area directly provided between 12 and 14 benefits. Overall these results highlight the multiple societal contributions from GI assets and that they extend across Greater Essex.

Associations with Socio-Economic Characteristics

Figure 7 maps the percentage of area covered by GI assets for the 1,706 LSOAs in Greater Essex. These percentages were correlated a number of socio-economic variables and the results are summarised in Table 5. Correlation coefficients can vary from +1.0 (a perfect positive relationship), through 0 (no association) to -1.0 (perfect negative relationship), so the values in Table 5 indicate that none of the socio-economic variables had a particularly strong linear association with the distribution of GI. Of the five variables examined the strongest relationship was with the percentage of Black and Minority Ethnic population which was positively associated with the distribution of GI. This indicates that there was a tendency for LSOAs with a higher percentage of Black and Minority ethnic population to also have a greater proportion of their area classed as GI.

Table 5 – Correlations with the percentage of GI area in LSOAs

Socio-Economic Indicator	Spearman Rank Correlation Coefficient
Index of Multiple Deprivation (IMD), 2015	+0.10
% of Black and Minority Ethic Population, 2011	+0.28
% of Population Aged 0-15, 2017	+0.10
% of Population Aged 65+, 2017	-0.15
Population Density (Residents per Hectare), 2017	-0.16

Note: All of the correlations are statistically significant at the 0.05 level due to the relatively large sample size.

Subsequent analysis examined variations in GI when the LSOAs were classified according to their values on two or more of the socio-economic characteristics. This approach proved more informative than the correlation coefficients because it allowed the combined influence of multiple socio-economic factors to be investigated and also for change in the relative prevalence of GI to be non-linear. In particular, the percentage of GI was found to vary appreciably with different combinations of IMD and population density characteristics. Figure 8 shows the outcome of first dividing the LSOAs into thirds (i.e. three equal groups) on the basis of their IMD and population density values, then cross-tabulating the two classifications to define nine groups. Six of these contain between 100 and 190 LSOAs, and the other three between 68 and 88 LSOAs, so there is a substantial denominator area in each group. Darker colours on Figure 8 represent higher values for the IMD score and population density with, for example, the blue shades

corresponding to the highest third of IMD values (i.e. more deprived areas) and the darkest blue identifying those LSOAs which also have the highest population densities.

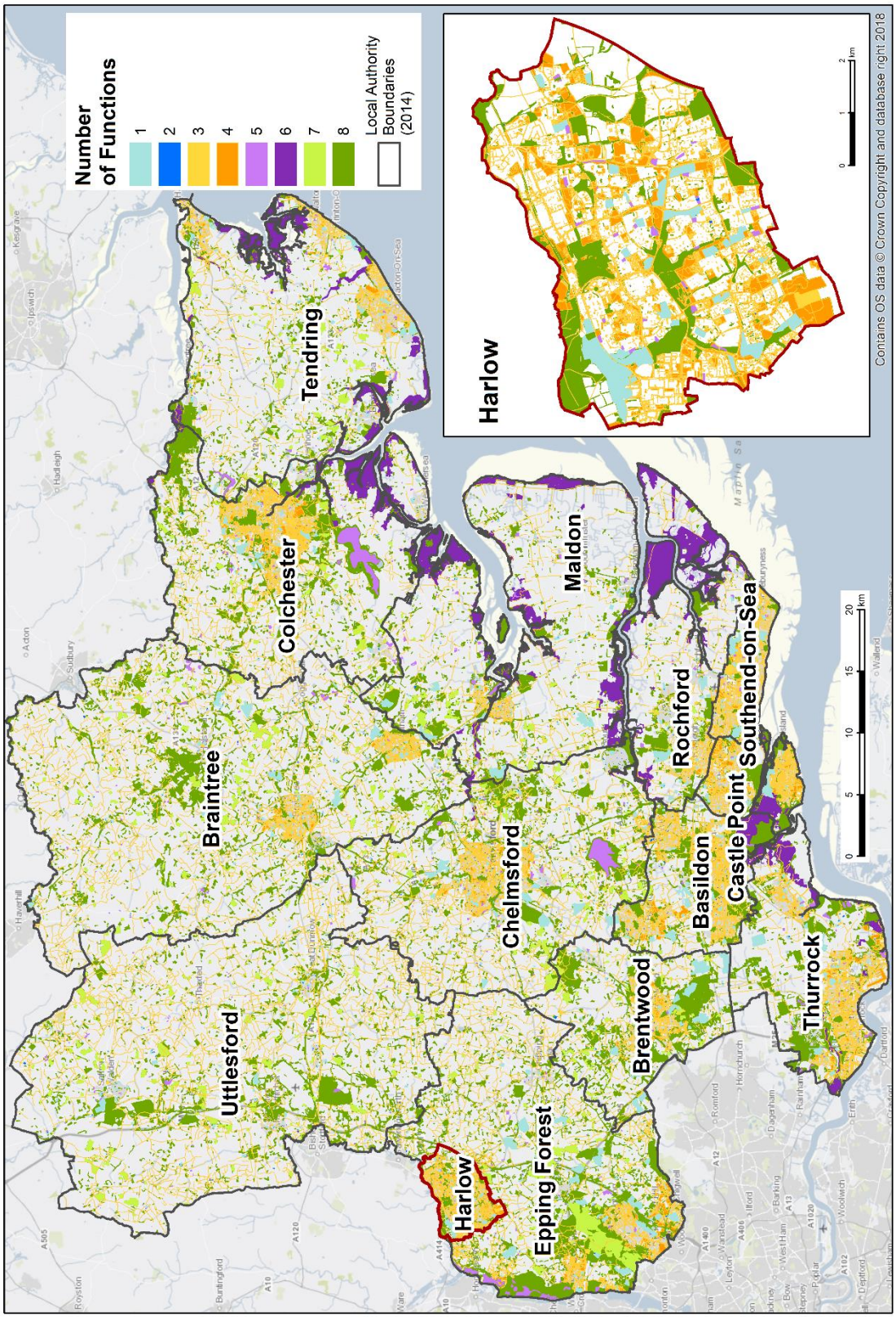

Figure 5 – Number of functions provided by GI assets in Greater Essex

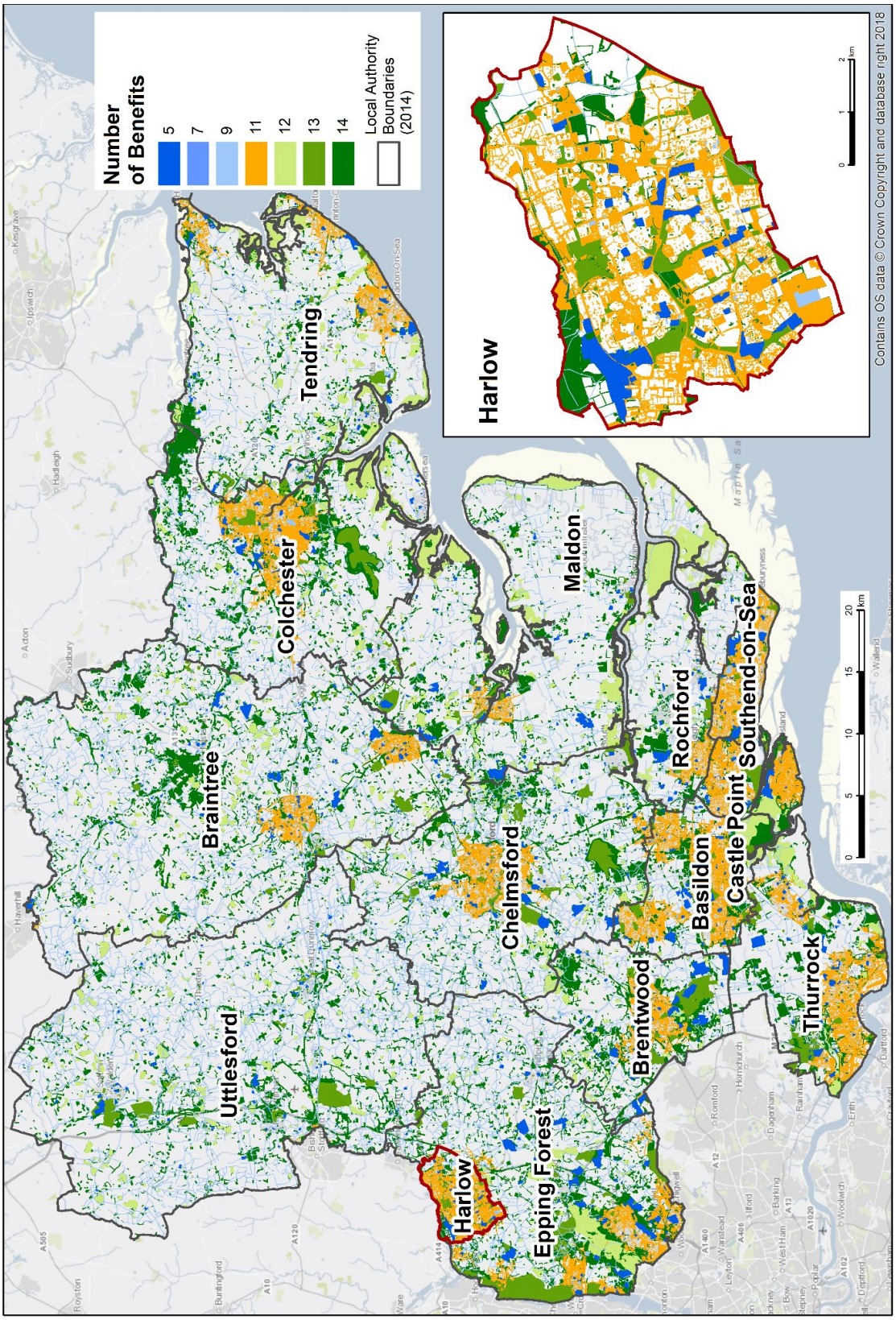

Figure 6 – Number of benefits directly provided by GI assets in Greater Essex

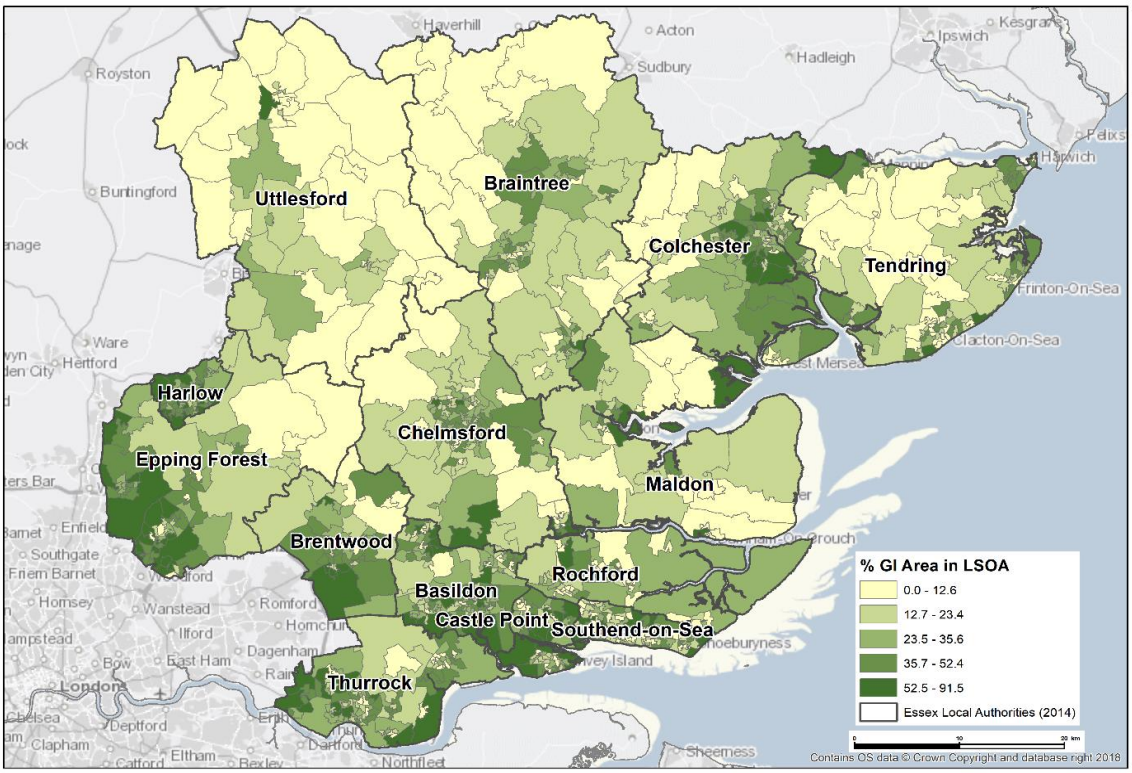

Figure 7 – Percentage of LSOA areas classed as GI in Greater Essex

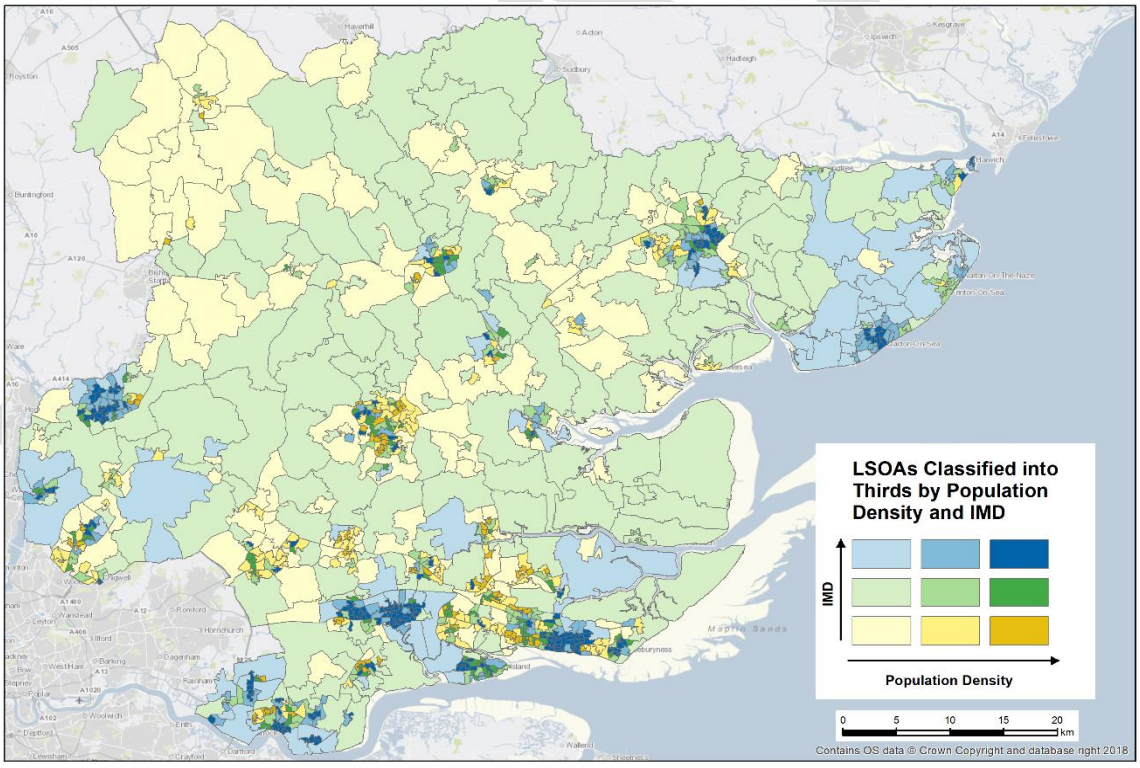

Figure 8 – LSOAs in Greater Essex classified according to their IMD and population density values

Table 6 presents the result of calculating the percentage of area covered by GI assets for each of the nine groups of LSOAs depicted in Figure 8. The values indicate a tendency for the % of GI to be highest in those LSOAs in the middle third of population density (e.g.

suburban area) and lower in sparser or more densely populated localities. For IMD, the % of GI tends to be higher in the LSOAs in the top third of IMD scores (i.e. the least affluent areas). Overall, the category with the lowest proportion of GI (14%) is the most affluent and densely populated LSOAs, whilst those which are least affluent and in the middle third for population density have the highest GI coverage (40%). These contrasts therefore imply that there are some appreciably differences in the distribution of GI according to the socio-economic characteristics of areas.

Table 6 – Percentage of GI in LSOAs classified by IMD and population density

	Population Density			
IMD Score	**< 15.9 Persons/Ha**	**15.9-45.5 Persons/Ha**	**> 45.5 Persons/Ha**	**Total**
< 10.6 (most affluent)	21.0%	32.3%	14.4%	21.8%
10-6 to 21.1	17.6%	33.9%	21.0%	18.2%
> 21.1 (least affluent)	32.3%	40.3%	24.5%	32.4%
Total	20.4%	35.0%	21.4%	21.2%

Although there is no evidence of a simple gradient of reduced GI in less affluent LSOAs, it is also important to recognise that there are parts of Greater Essex where such a combination of characteristics occurs. There are 358 LSOAs in the top third of IMD scores and 93 of these are also in the lowest third in terms of % of area covered by GI assets (i.e. with < 17.1% of GI). Figure 9 shows the locations of these 93 LSOAs and while many are scattered across Essex it is also apparent that there are some geographical concentrations. Fifty three of the 93 LSOAs are in either Southend-on-Sea (31) or Tendring (22) so if there are opportunities for further investment in GI the clusters highlighted in Figure 9 would appear worthwhile priorities for further investigation.

Accessible Natural Greenspace Standards

Variations in the proximity of residential populations to GI assets are summarised in Table 7. This analysis included other GIS assets within 10 km of Greater Essex to avoid any boundary effects. However, since there were only two polygons meeting the ANGSt criterion of a 500 hectare site it is not especially meaningful to expect all four access benchmarks to be attained and consequently the table combines the outcomes for achieving three or four standards. In total, just over 50% of Greater Essex residents lived in locations meeting at least three of the access benchmarks, another 33% attained two benchmarks and 2% none at all. From Table 7 it is clear that there are some variations in proximity between authorities, with over 40% of residents in Braintree, Chelmsford and Tendring living in places achieving no more than a single benchmark. Figure 10 maps the GI benchmark results across Essex and complements Figure 9 in identifying localities where further investigation of GI provision could be merited. On the basis of Figure 10 there are parts of northern Braintree, northern Chelmsford, eastern Tendring and eastern Uttlesford that would appear to fall into this category.

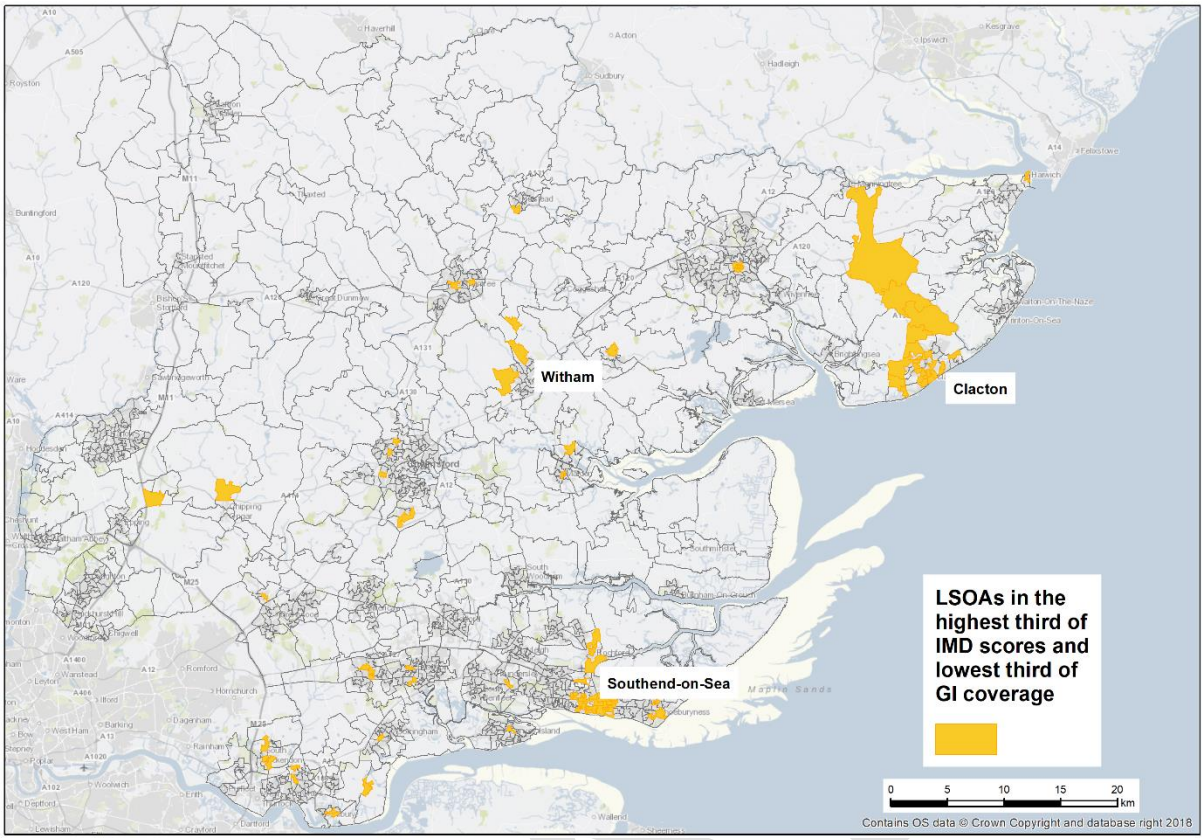

Figure 9 – The distribution of LSOAs with higher IMD scores and a lower % coverage of GI assets

Table 7 – Percentage of GI in LSOAs classified by IMD and population density

	Percentage of Population Meeting Different ANGSt Benchmarks			
Authority Name	**0**	**1**	**2**	**3 or 4**
Basildon	0.0%	0.1%	32.4%	67.5%
Braintree	11.6%	29.9%	38.6%	19.9%
Brentwood	0.0%	2.4%	28.5%	69.1%
Castle Point	0.0%	0.3%	29.1%	70.6%
Chelmsford	4.4%	40.8%	40.2%	14.7%
Colchester	0.2%	3.7%	26.5%	69.5%
Epping Forest	0.3%	5.0%	28.2%	66.5%
Harlow	3.0%	28.5%	60.7%	7.9%
Maldon	0.6%	7.2%	30.2%	62.1%
Rochford	0.0%	3.1%	22.1%	74.8%
Southend-on-Sea	0.0%	7.7%	24.8%	67.5%
Tendring	2.1%	45.7%	39.8%	12.4%
Thurrock	0.1%	1.9%	36.8%	61.3%
Uttlesford	6.8%	20.2%	36.2%	36.8%
Total	2.0%	14.3%	33.6%	50.1%

Note: Calculations based on a gridded population surface derived from 2011 Census headcounts (the most recent available) so the results exclude new residential developments since 2011.

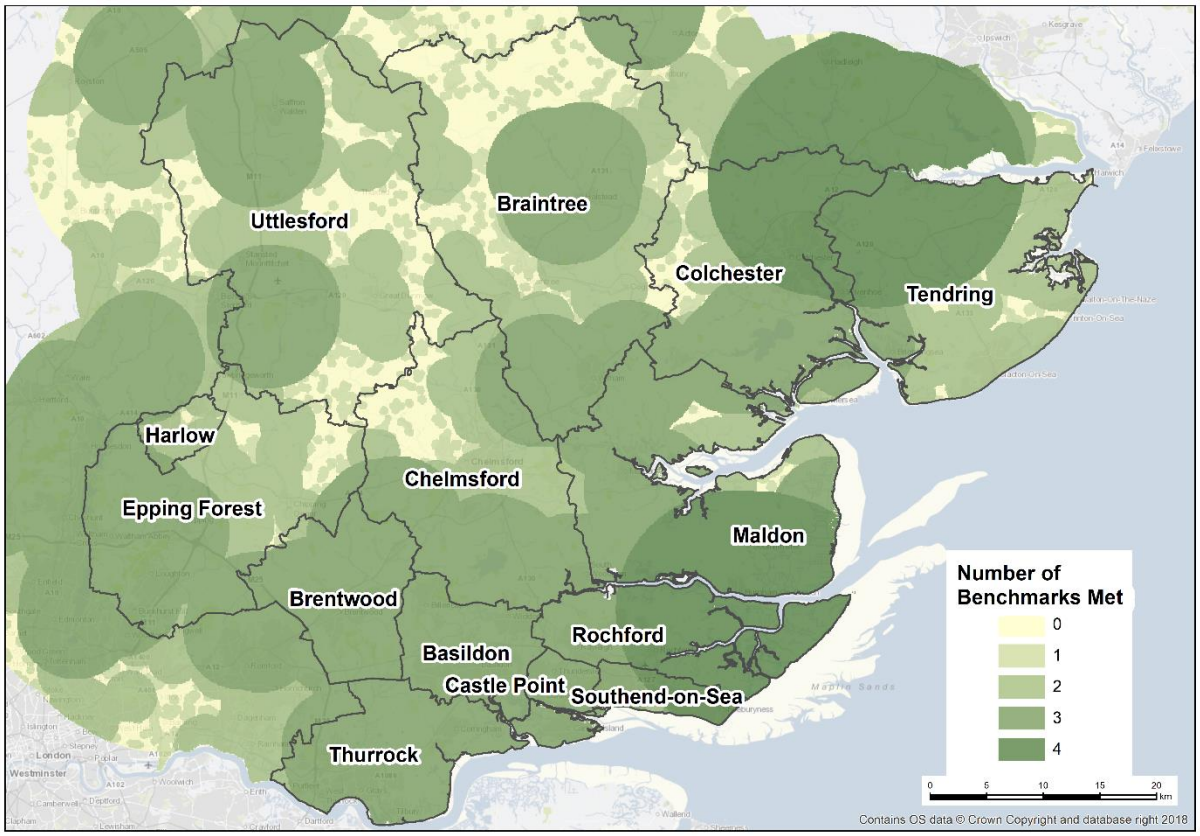

Figure 10 – ANGSt benchmark results for Greater Essex

Implications for Proposed Residential Development Sites

Figure 11 maps sites of at least 50 hectares approved for future housing and employment growth in Local Development Frameworks or Plans. A key to the site numbers is given in Table 8. It should be noted that the site information is incomplete because some district or unitary authorities are still to finalise the relevant planning documents.

To evaluate current GI provision in the vicinity of these sites Figure 12 plots their boundaries on top of the outcome for the ANGSt benchmarks assessment. The map shows that most sites are in localities where at least two benchmarks are met, the main exception being Site 23 (Colchester & Braintree Borders Garden Community) where much of the area does not attain any benchmarks. It would therefore seem relevant for discussions to take place with developers of this site to investigate opportunities to improve local GI provision.

4 CONCLUSIONS

This report has presented a method for combining a number of spatial data sources to generate a detailed map of GI assets across Greater Essex. The results identify 782 km^2 of GI assets (21.3% of the land area), with higher proportions (above 30%) in many

authorities across the south of Greater Essex and lower ones further north where productive spaces (i.e. arable land and pasture) are more prevalent. These assets, in turn, provide multiple economic, social and environmental benefits to local residents.

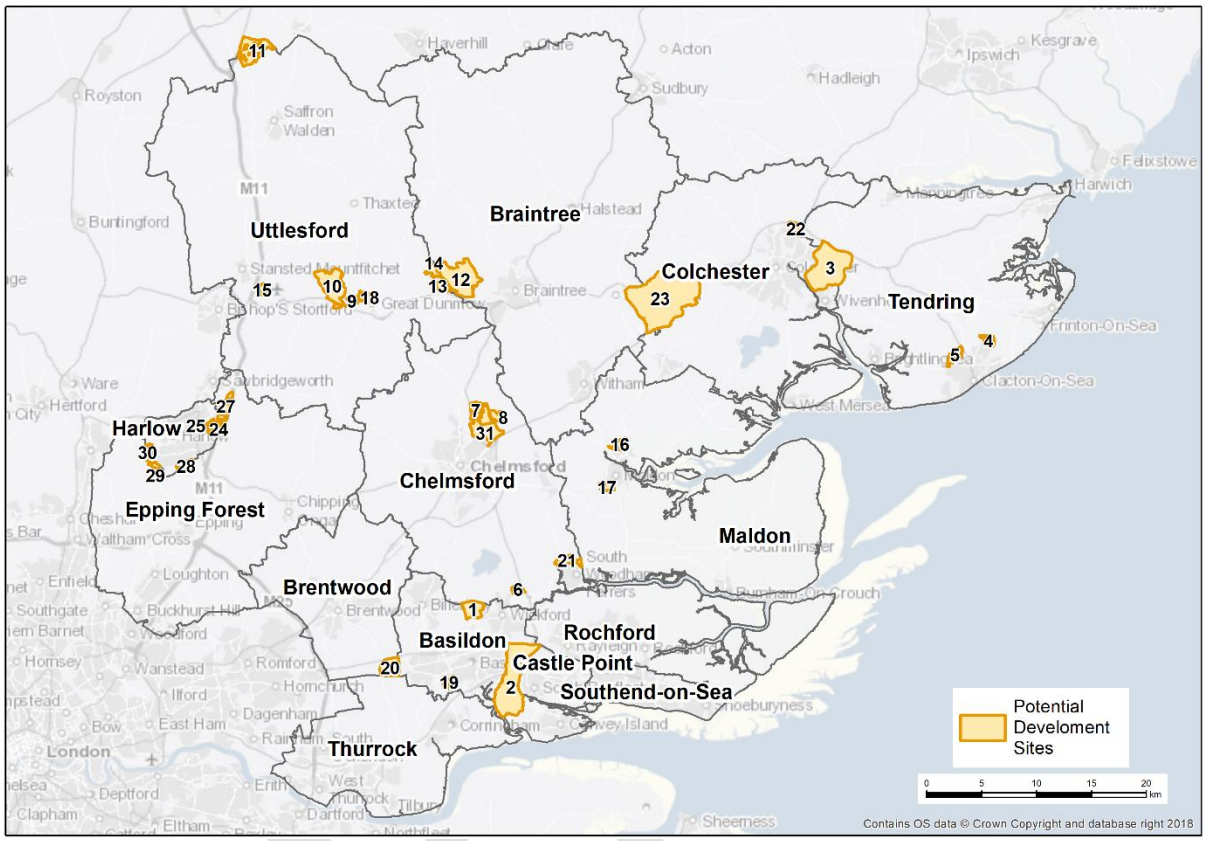

Figure 11 – Major sites approved for future housing in Local Development Frameworks or Plans

Table 8 – Key to development site numbers on Figure 11

ID	Site Name	ID	Site Name
1	Land close to Ramsden Bellhouse	17	South of Limebrook Way
2	East Basildon	18	Woodlands Park, Great Dunmow
3	Tendring & Colchester Borders Garden Community	19	Land north of Dry Street
4	Oakwood Park	20	Dunton Hills Garden Village
5	Hartley Garden Village	21	North of South Woodham Ferrers
6	Former Runwell Hospital	22	Severalls Park, Colchester

7	North East Chelmsford [A]	23	Colchester & Braintree Borders Garden Community
8	North East Chelmsford [B]	24	Land east of Newhall
9	West of Woodside Way, Great Dunmow	25	Newhall Phase 2 & 3 [A]
10	Easton Park	26	Newhall Phase 2 & 3 [B]
11	North Uttlesford	27	Land east of Harlow, north of Church Langley
12	West of Braintree Garden Community [A]	28	Land to east of Rye Hill Road
13	West of Braintree Garden Community [B]	29	West of Harlow [A]
14	West of Braintree Garden Community [C]	30	West of Harlow [B]
15	North Stansted	31	Greater Beaulieu Park and Channels Area
16	North of Heybridge		

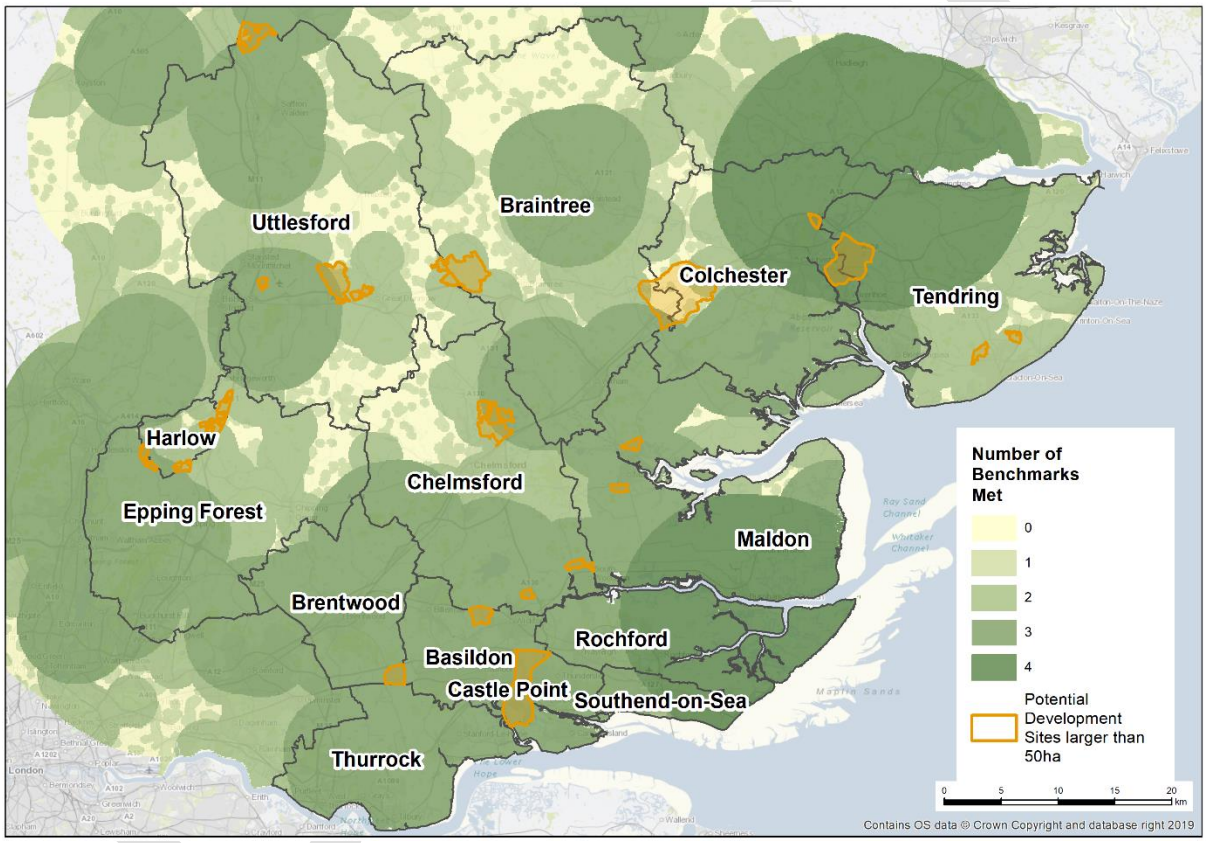

Figure 12 – Distribution of major housing development sites relative to ANGSt benchmark results

The prevalence of GI varies with socio-economic characteristics such as population density and affluence, though there is no simple trend for provision to be lower in neighbourhoods with higher levels of multiple deprivation. Across Greater Essex as a whole over 80% of residents live in locations meeting at least two of the four ANGSt benchmarks for GI proximity, though for three authorities (Braintree, Chelmsford and Tendring) this proportion is less than 60%. It is also possible to identify some specific localities where it would appear particularly appropriate to seek opportunities to increase GI provision. Some of these are neighbourhoods where indicators of socio-economic

deprivation coincide with limited extent of GI (see Figure 9) and others occur where major housing developments are planned at sites where existing proximity to GI is poor (see Figure 12). The results therefore identify several needs and opportunities to enhance GI across the county and inform strategic planning in Greater Essex.

5 Acknowledgements

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Appendix A

Identified associations between GI functions and economic, social and environmental benefits.

Table A1 – Identified associations between GI functions and economic benefits

Functions	Economic Benefits Provided							
	Quality of place	Land an property values	Economic growth and investment	Labour productivity	Tourism	Products from the land	Inward investment	Cost savings
Recreation	D	I	I	I	D		I	I
Green travel route	D	I	I	I	I	I	I	I
Habitat provision	I	I	I	I	I	I	I	I
Heritage and cultural asset	D	I	I	I	D		I	I
Food production and productive landscapes		I	D	I		D	I	I
Pollution absorption and removal	D	I	I	I	I	I	I	D
Flood attenuation and water resource management	I	I	I	I	I	I	I	D
Coastal storm protection	I	I	I	I	I		I	I
Cooling effect	I	I	I	I	I		I	I
Access to nature	I	I	I	I	I		I	

Note: D signifies that the function directly provides this benefit, I indicates that the association is indirect.

Table A2 – Identified associations between GI functions and social benefits

Functions	Social Benefits Provided					
	Health and well-being	Recreation and leisure	Sense of place	Community resilience	Education	Encourage Sustainable travel
Recreation	I	D	D	I	I	I
Green travel route	I	D	D	I		D
Habitat provision	I	I	D	I	D	I
Heritage and cultural asset	I	D	D		D	
Food production and productive landscapes	I				I	
Pollution absorption and removal	I		D	D		I
Flood attenuation and water resource management	I		I	D		I
Coastal storm protection	I		I	D		
Cooling effect	I			D		
Access to nature	I	D		I	D	

Note: D signifies that the function directly provides this benefit, I indicates that the association is indirect.

Table A3 – Identified associations between GI functions and environmental benefits

Functions	Environmental Benefits Provided				
	Climate change adaptation and mitigation	Flood alleviation and water management	Environmental quality and aesthetics	Biodiversity	Heritage preservation
Recreation	I		D		I
Green travel route	I		D	I	
Habitat provision	D	I	I	D	I
Heritage and cultural asset	I		I	I	D
Food production and productive landscapes				I	
Pollution absorption and removal	D	D	D	I	
Flood attenuation and water resource management	D	D	I	I	
Coastal storm protection	D	D	I	I	
Cooling effect	D		I	I	
Access to nature			D	I	

Note: D signifies that the function directly provides this benefit, I indicates that the association is indirect.

APPENDIX C2 - HEALTH IMPACT ASSESSMENT

Health impact Assessment – Green Essex Strategy

Arrthi Pangayatselvan, Public Health Registrar

Introduction

The purpose of this Health Impact Assessment is to identify the potential impact of the Green Essex Strategy on the health of Essex residents. It aims to highlight potential positive impacts on health and areas that require further consideration to mitigate negative health impacts.

Aims of this Health impact Assessment

1. To understand the potential positive and negative impacts of the Green Essex Strategy on health
2. To make recommendations based on these findings to mitigate or monitor potential negative impacts of the strategy

Strategy background

The Green Essex Strategy has been developed by the Essex Green Infrastructure Partnership to guide planning and delivery of green infrastructure across Essex in light of potential growth in population and development.

Vision:

> *'We will protect and grow a high quality connected Green Infrastructure network which extends from our city and town centres to the countryside and coast which, is designed for people and wildlife whilst being self-sustaining. This strategy developed seven key objectives: protect, improve, create, connectivity, inclusivity, health and sustainability.'*
>
> *Green Essex Strategy 2019*

This strategy aims to achieve this vision through seven key objectives centred around the following concepts: protect, improve, create, connectivity, inclusivity, health and sustainability.

Essex background

The Access to Healthy Assets and Hazards index (PHE fingertips, 2016) was designed to help policy makers understand which areas have poor environments for health. It is comprised of 3 domains – access to retail services, access to health services and physical environment (e.g. green space access and air pollutants). It highlights how conducive to good health an area may be compared to others. The indicator is the percentage of the population who live in a lower super output area (LSOA) which scores in the poorest performing 20% on the AHAH index. This index highlights that Essex (9.2%) performs better in these indicators than East of England as a whole (15.8%) and the national average (21.2%). 21.3% of adults in Essex and East of England walk for travelling at least 3 days per week (compared to 22.9% nationally) and 2.7% cycle compared to 4% in East of England and 3.3% nationally. Ability to walk and cycle in an area is linked to how well that area is adapted to allow for cycling and walking. These figures highlight the potential for strategies addressing environmental topics to influence health.

Supporting Evidence

There is much evidence which highlights the link between the environment and health. The PHE 'Improving Access to Green Space' (PHE, UCL Institue of Health Equity, 2014) document highlights the health benefits of access to good quality green space. This includes mental health and wellbeing improvements, lower levels of obesity and overweight, higher physical activity levels and better self-rated health. Green space can improve air and water quality, noise absorption and improve absorption of excess rain water, reducing the risks of floods and sewage overflow. People living in deprived areas are 10 times less likely to live in the greenest areas compared to those in the least deprived areas. These links to health impacts, highlight the potential for inequalities in health to develop or be exacerbated by differences in access to green space. It also highlights the potential for policies in other sectors including environmental sectors, to have a large impact on health.

Furthermore, there is growing evidence to suggest there is potential to reduce population-wide health inequalities (including availability of green space of good quality) across the social gradient through changes to the built environment. Studies have suggested that populations which had been exposed to green environments had lower levels of health inequality related to income deprivation (Braubach M et al, 2017). Improving access to good quality green space in disadvantaged areas may contribute to addressing health inequalities.

Structure of the report:

This report will go through the potential impacts of the strategy in 6 key areas as per the Wales HIA support unit Health Impact Assessment guide. These include:

1. Lifestyles
2. Social and community
3. Living/Environmental conditions affecting health
4. Economic conditions affecting health
5. Access and quality of services
6. Macro-economic, environmental and sustainability factors

Each section will review the potential positive impacts of the strategy and the supporting evidence. It will also outline considerations for monitoring or mitigating potential negative impacts.

Potential health impacts of strategy by health and wellbeing determinants

1. Lifestyles

1.1 Physical Activity

This strategy has the potential to lead to many positive health outcomes secondary to enabling increased physical activity. This would be facilitated by improved access to green space, improvement and creation of multi-user paths including cycle and walking paths, coastal paths encouraging walking and creating opportunity for sport e.g. green gyms. Opportunity for sport would be also be enabled by working collaboratively with Active Essex to identify opportunities to utilise green space for this function. These actions can impact health in the following ways:

- ➔ **Increase physical activity**
- ➔ **Decrease levels of obesity, improve cardiovascular health**
- ➔ **Psychological benefits from increasing exercise**

1.1.1 Supporting evidence

The PHE 'Improving access to green space' (PHE, UCL Institue of Health Equity, 2014) *document highlights the evidence to show how increased access to green space can increase physical activity levels. The Foresight model* (UK Foresight programme, 2007) *highlights the complexity in factors affecting obesity and how they interact. This includes the concept that the environment in which an individual lives is a key factor that affects obesity levels. It highlights factors such as the walkability of the living environment, opportunity and safety of unmotorized transport and access to opportunities for physical activity as important components of the model affecting obesity.*

1.1.2 Considerations:

- Potential actions arising out of the strategy may risk favouring areas with less deprivation where there may already be green spaces to build upon. This could risk potentially increasing inequalities. Therefore, actions arising from the strategy will need to refer to the study to be included in appendix 9 where mapping will highlight how access to green space varies with deprivation level. This can be referred to, to ensure that areas with higher deprivation levels and lower access to green space are given the required attention.
- There is a risk that actions arising from this strategy may not address the potential to improve physical activity in those with physical disabilities or specific needs. This strategy will require more specifics around the potential to maximise opportunities for those with disabilities and mobility issues or others with specific needs with regards to improving

physical activity in these groups e.g. partnership working to ensure interventions arising from the strategy meet the needs of vulnerable groups.

1.1.3 Workshop feedback

Stakeholder feedback appreciated the potential benefit that could arise from the strategy with regards to opportunities to improve physical activity through access to green space. However, stakeholders also expressed concern around the need to ensure that green space access is also accessible to those living in areas of higher deprivation and vulnerable groups.

1.2 Diet

This strategy may have some potential to lead to positive effects on diet through encouraging the development of community gardens. Dependent on how this is developed, it has the potential to increase access to fruits and vegetables, particularly in areas where there may be less access, thus also decreasing inequalities in access to healthy foods.

→ improved diet

→ opportunity to contribute to decreasing obesity

1.2.1 Supporting Evidence

There has been some evidence to suggest that the presence of green spaces may have a positive effect on diet. In particular, community gardens have been suggested to improve availability of fresh vegetables (Castro DC, 2013)*. This is thought to be of particular benefit in urban areas where there may be limited access to fresh fruit and vegetables and may provide a way of reducing inequalities in access to healthy food whilst bringing the community together.* (Jennings et al, 2017)

1.2.2 Points for consideration

- When developing specific actions arising from the strategy, there will need to be consideration of how green spaces are linked to food outlets selling unhealthy food. For example, there will need to be an awareness that attractiveness of certain areas may inadvertently improve access to fast food outlets. Efforts will need to be taken to mitigate such consequences.

2. Social and Community Influences on Health

The social and community influences that could arise from this strategy, have the potential to have a number of positive effects on health:

- Social supports and networks can develop through communal use of green space and joint projects/events held in green spaces
- Decreased risk of social isolation where communities are able to use green spaces for communal activities and events
- Opportunity for increased local pride through projects such as Essex Green Permit scheme which may help to unite community and improve mental wellbeing within the community
- Empowers the community to improve their own health and wellbeing– e.g. through volunteering opportunities to get involved with local projects within green spaces
- Suggestion for public transport to stop in front of green spaces can improve ease of access for those who may otherwise not have easy access to green spaces. This can improve access to community events and other activities enabling people to link in with their community.
- Suggestion for using green spaces for environmental therapies through mental health services can provide the opportunity for potentially vulnerable groups to access the benefits of green space.

➔ **Improved social cohesion**
➔ **Decreased social isolation**
➔ **Increased community spirit**
➔ **Improved mental health and well-being**

2.1 Supporting Evidence

The 'Public health and landscape' (The landscape Institute, 2013)*paper describes the evidence showing how access to green space and presence of vegetation can increase positive social interaction, reduce noise pollution, improve quality of life for older people and can have positive effects on mood, concentration and stress. A Swedish study showed how the more often people visited green space, the less they reported stress-related illnesses. It also highlighted that distance to green spaces was key to the amount they were used.* (Grahn P, Stigsdotter U, 2003)

2.2 Considerations

- There is a risk that individuals who are currently socially isolated may not have the confidence or access to activities in green spaces promoted through this strategy. This could be addressed through specific targeted promotion towards this group and monitoring who accesses the green space and activities within. This has been referred to

in the ‘targeted promotion’ section but could be more specific to ensure that those vulnerable to social isolation are considered when marketing and promoting activities.

- There is a possibility that the strategy may enhance the experience for those already within social/community networks who access green spaces without appealing to some community groups such as minority ethnic/traveller/refugee groups who may not readily access these spaces. This will require monitoring to ensure that the green spaces meet the needs of different groups of people and reach these groups. This may also require targeted promotion towards groups who are normally less likely to use green spaces and facilities. Actions should utilise the mapping study in appendix 9 of the strategy and the online consultation to aid understanding around areas that may require attention. Information from the online consultation can also be used to better understand who is more likely to utilise green spaces and tailor actions to improve inclusivity.

2.3 Stakeholder feedback

Stakeholders also acknowledged the opportunities to improve social cohesion and reduce loneliness and social isolation as a result of this strategy. However, stakeholders also identified a risk of increasing social isolation for groups unable to participate in some of the green space related activities that could arise from this strategy. This re-enforces the need to be mindful of the needs of vulnerable groups and individuals who may be at risk of becoming further isolated through actions arising from the strategy and developing actions that cater for their needs as well.

3. Living/environmental conditions affecting health

This strategy has the potential to improve living and environmental conditions affecting health in several ways.

- Improving green infrastructure has the potential to increase the attractiveness of areas improving the living conditions and mental health and well-being of those in these areas.
- The development of cycle paths and pedestrian walking paths may increase the safety of travel for those who wish to walk or cycle. Where more people choose to walk or cycle instead of driving, this in turn may improve air quality in the area, indirectly improving the physical health of those living nearby. This may also decrease noise pollution in these areas.
- Development of street trees, parklets and urban greening through green walls and green roofs has the potential to reduce air pollution by trapping and removing fine particulate matter.
- Green infrastructure can also lower air temperatures through the evaporation of water from vegetation and shading. This has the potential effect of cooling urban heat islands.
- Green corridors within urban areas could reduce pedestrian exposure to pollution.

- Flood protection with natural flood management techniques can lead to safety improvements in the area.
- Developing and maintaining green infrastructure can conserve and enhance biodiversity which in turn can support regulation of infectious diseases, climate change adaptation and food security. Biodiversity can also have social and cultural importance within communities. These benefits are dependent on the scale and way in which infrastructure is developed and maintained.

➔ **Improved physical health (e.g through decreased exposure to pollution)**
➔ **Improved safety (e.g through flood protection and cycle/walking paths)**
➔ **Improved mental health and general well-being**

3.1 Supporting Evidence

Much evidence points towards the positive health impacts of green infrastructure in relation to the living environment. These include improved air and water quality, noise absorption and reduced urban heat island effects (PHE, UCL Institue of Health Equity, 2014)*. Urban areas can often experience higher temperatures compared to more rural areas in view of the presence of extensive heat absorbing surfaces such as tarmac and concrete. The evaporation of water from vegetation and shading can lower air temperatures* (Wilebore, Wentworth et al (POST), 2013) *having a cooling effect on urban heat islands. Trees and vegetation can also trap and remove particulate matter decreasing air pollution. The strength of these effects are dependent on factors such as pollution concentration, type and quality of vegetation and the weather* (Nowak, Crane, Stevens, 2006)*. Conserving and enhancing biodiversity can also support climate change adaptation, food security and can have social and cultural importance within communities.* (World Health Organisation and Secreatrait of the Convention on Biological Diversity, 2015)*. This is dependent on the scale and way in which green infrastructure is developed and maintained.*

There are also studies highlighting the potential negative impacts on health though evidence in this area is less consistent. Potential negative effects have included exposure to pesticides, allergenic pollen, vectors of infectious disease (e.g ticks) and increased risk of injuries. It should be noted that the evidence related to allergens is inconsistent with some studies suggesting that green space has a protective effect and others saying it has a harmful effect (Braubach M et al, 2017)*. Lohmus and Balbus* (Lohmus M, Balbus J, 2015) *argue that developments can mitigate potential negative impacts through proper design, maintenance and operation of negative effects. Therefore, design of green spaces should take into account these potential negative impacts and take measures to minimise them. The 'Improving Access to Green Space' report highlights how amenities in rural green spaces such as lighting, safety, upkeep and suitability of*

play equipment and paths can often be of poor standard (PHE, UCL Institue of Health Equity, 2014)*. An intervention aiming to increase engagement with green spaces amongst hard to reach groups found that fear around personal safety was a barrier to access of green space. Therefore it is important to ensure that green spaces are well maintained and safe to use.*

3.2 Considerations:

- When developing visitor attraction sites which attract visitors from afar, potential risks of increased motorised traffic in these areas should be acknowledged and monitored. Potential impacts on road safety should be monitored to maintain safety in these areas.
- Though there is much benefit to be gained from incorporating green infrastructure into new developments, efforts should be made to ensure that those not living in new developments are also able to benefit from actions arising from the strategy.
- Where green infrastructure such as new cycle and pedestrian paths and green spaces are developed, care should be taken to ensure that safety is maintained. This will include amenities such as lighting, play equipment and paths to be of good quality and well maintained. Actions arising from the strategy should take into account how green spaces will be maintained as safe spaces and be appropriately looked after without becoming potential areas for anti-social activity.
- Potential impacts of allergenic pollen, pesticides and risk for increased risk of injuries should be considered when developing plans for green space.

4. Economic Conditions affecting health

There are a number of positive effects that could arise from this strategy in this area:

- Through mitigating negative health impacts of residential development and creating a healthy living environment, this may improve quality of life for residents and increase attractiveness of these areas for potential residents. This may encourage movement into Essex areas potentially improving economic regeneration.
- Maintenance or development of green infrastructure may improve working conditions for those working near or within these areas.
- Improving country parks through expanding facilities and new visitor centres to increase access may generate revenue. For example, development of the Green Discovery Park can create opportunities for employment and generate income. This may lead to positive effects on mental well-being.

- Improving cycle and walking paths may improve access to services and places of work. This may increase attractiveness of Essex based employment opportunities and improve mental and physical well-being of employees.
- Natural flood management techniques have the potential to save money associated with short and long-term effects from flooding.
- If development of high quality and sustainable green infrastructure is considered early in the design process for large and small developments, it can improve developers' financial return through producing multiple benefits from single pieces of land. Early consideration of green infrastructure could lead to easier and more cost-effective construction, improved quality of life and wellbeing of residents and increased chance of planning permission being granted with fewer conditions.
- Sustainable developments can have increased resilience to the effects of climate change improving safety and well-being of residents. Developments with green infrastructure can also lead to improved mental health and wellbeing of residents.

➔ **Improved employment opportunities and attractiveness of working environment**
➔ **Improved mental health**
➔ **Improved safety and wellbeing**

4.1 Supporting Evidence

PHE 'Improving access to green spaces' (PHE, UCL Institue of Health Equity, 2014) *document illustrate economic advantages of green space access through the national walking for health and green gyms schemes. This highlighted the potential savings that can made be made to the NHS through prevention through these methods.*

4.2 Considerations

- There is a risk that employment opportunities arising out of green space innovations may not reach the more vulnerable in the community such as those currently unemployed, those with physical or learning disabilities, minority ethnic groups etc. Actions arising from the strategy should consider how to benefit these groups and those living in more deprived areas. For example, action plans arising from the strategy should incorporate need for early partnership with employment services to maximise opportunities for those currently unemployed.
- Development and expansion of these spaces such as the Green Discovery Park will require financial investment. The need for a fiscal plan is noted in the strategy. Care will

need to be taken to consider the opportunity costs associated with such work as well as the sustainability and net benefit long term of large-scale projects.

- Though there are potential positive impacts of green infrastructure on travel to work, actions arising from this strategy should consider how development of green spaces could impact on travel to work in a negative way e.g. increased traffic congestion in the surrounding areas. Through improving transport to and popularity of green spaces, the potential impact on the local populations' routine access to places of work/services will need to be considered.

5. Access and quality of services

The strategy has the potential to improve access to and quality of services.

- The use of green infrastructure within and around health care and other facilities has the potential to improve mental well-being for staff and patients.
- Such green infrastructure has the potential to improve safety of these locations and surrounding areas through reducing flood risk through structures such as rain gardens.
- The strategy refers to the potential for expanding visitor centres and facilities for green spaces which may improve quality of green spaces for the local population.
- New environmental projects e.g. methods for flood mitigation, development of green infrastructure with multiple functionality and development of visitor centres with a focus on green infrastructure and sustainability, present opportunities for education and training.

➔ **Improved well-being for service users where green infrastructure is developed in and around service locations e.g. hospitals**

➔ **Potential opportunities for education through highlighting methods for sustainability**

5.1 Supporting Evidence:

The positive effects of greenspace highlighted in the sections above are also likely to apply to those visiting health care services with green infrastructure. The positive effects on mental wellbeing may be a potential benefit for those attending these services. Reducing flood risk through structures such as rain gardens may decrease risk of damage to sites from flooding (County Health Rankings and Roadmaps, 2017) *as well as providing positive health and well-being impacts from access to a green space on site.*

5.2 Challenges:

- There is a risk that there may be need to charge for entry to certain sites. This could result in inequalities in access to green space across socio-economic groups. Where

possible, efforts should be taken to learn from other models to see how costs of sustaining green spaces can be reduced or how green spaces can become self-sustaining.

- Where there will be development of facilities within green spaces around new developments there may be a risk of neglect of populations of high need where there are barriers to development of green space. There will need to be specific consideration of how to improve access for groups who currently experience barriers to access green space.
- Actions arising from this strategy will need to ensure that, where facilities and green infrastructure are developed, access from areas with higher deprivation and poor health indicators are reviewed and improved.
- The actions arising from the strategy will need to consider how shops and commercial services may link into potential green spaces. There will need to be consideration for what types of shops or food outlets may be developed in these areas and how these may impact on the health and well-being of those who use these spaces. Where possible, actions should be taken to mitigate negative consequences and promote healthy food choices.
- Where spaces such as the Green discovery park may be developed, there will need to be consideration for the potential increase in car traffic that can be developed from increased popularity and potential demand for parking facilities. The potential consequences in terms of road safety, noise pollution and air pollution should be monitored and addressed.

6. Macro-economic, environmental and sustainability factors

This topic has been largely covered in previous sections. However, a summary of how this strategy addresses this topic is outlined below.

This strategy has the potential for positive impacts on bio-diversity and sustainability as outlined in the sections above. These can in turn positively affect the mental and physical health and well-being of those who are able to access and benefit from green infrastructure.

There appears opportunities for economic development though care will need to be taken to monitor who benefits and specific purposeful actions taken to ensure that those in vulnerable or disadvantaged groups benefit from the strategy as well.

Conclusion

There are a large number of potential health benefits that could arise from this strategy. Potential benefits highlighted throughout this document fall predominantly under the following areas:

- Improved mental well being
- Increased physical activity and improved physical health
- Improved social cohesion and reduced social isolation

Despite the many potential health benefits that could arise from this strategy, it is important to be aware of the risks that could arise. These largely fall around ensuring equitable access to green space across the county and across all groups of people as well as ensuring safety and adequate maintenance of green spaces. The considerations outlined under each section throughout this report can be summarised as follows (see sections above for details related to each topic area):

Further consideration will be needed for how the strategy can ensure that those from vulnerable/disadvantaged groups can benefit from opportunities created through green infrastructure. Actions arising out of this strategy should pay consideration to the potential impacts of the strategy on inequality (as highlighted in the sections above). Where possible, actions should be taken to mitigate negative impacts on health or inequality.

It will be imperative to ensure that green spaces are well-maintained, safe and practical to use to be able to facilitate positive impacts on health to be experienced.

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