16 February 2005

East of England Biodiversity Mapping Project

Prepared for the East of England Biodiversity Forum

by
Land Use Consultants
& Terra Consult

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1. INTRODUCTION

1.1. This report describes the techniques used to develop a regional biodiversity network map for the East of England region. The development of the map has been driven by the need for an informed response by the regional biodiversity forum to the environmental chapter of the Regional Planning Guidance (RPG14) currently in development for the East of England region. Given the high levels of growth outlined in RPG14, there is a need to establish a network of biodiversity areas and corridors to both conserve existing biodiversity and restore and regenerate biodiversity in areas which may be suffering from a current deficit, all set against the uncertain background of climate change. The preparation of this regional biodiversity map complements the regional biodiversity targets as it identifies opportunities for different scales of habitat enhancement. These opportunities must be taken if the regional habitat targets are to be achieved.

1.2. A parallel driver for this work is the vision set out by the Pan European Biodiversity and Landscape Diversity Strategy to establish a Pan European Ecological Network, following common objectives and characteristics throughout the EU.

1.3. The regional biodiversity network map that is the output of this project includes four components: Core Biodiversity Areas, Biodiversity Enhancement Areas, Strategic river corridors and Urban Biodiversity Deprivation Areas. Each of these will be discussed in more detail in the following methodology.

1.4. A corollary of preparing the regional biodiversity map is the provision of a proposed framework and methodology that can be used at the local level. This will be particularly relevant to Local Authorities who will need to prepare biodiversity / ecological network maps at a scale appropriate for inclusion within Local Development Frameworks. Such studies may be achieved through applying the methodology outlined in this document, using smaller study units, to enable a finer resolution output.

2. SCOPE AND DEFINITION

2.1. STUDY UNIT

2.1.1. The study required the use of a standard geographical unit that was relevant for use and interpretation at the regional scale and provided the ability to generalise some of the complex data underlying the study.

2.1.2. The Countryside Agency's Landscape Character Typology (LCT) is based upon the National Countryside Character Database and was developed by the Agency and its partners in conjunction with Steven Warnock, Parker Diacono, Reading University and SmartData (Warnock, 2002[1]). It was designed to provide a consistent hierarchy of land characterisation as the basis for landscape character assessment and for targeting agri-environment schemes. The fundamental building block of the hierarchy is the Landscape Description Unit (LDU). LDUs are relatively homogenous units of land that are distinct from each other. The boundaries of each LDU are defined on the basis of the analysis of a range of definitive attributes derived from published map-based data. The definitive attributes can be applied at two different scales in the LCT hierarchy (see Table 1).

Table 1: LDU definitive attributes

	Regional	County/District
	Level 1 (1:250,000)	Level 2 (1:50,000)
Natural	Physiography	Landform Geology (structure)
	Ground type	Geology (rock type) Soils
Cultural	Settlement	Settlement Farm type (structure)
	Landcover	Farm type (cover) Tree cover

2.1.3. The four definitive attributes at Level 1 (regional) are physiography, ground type, land cover and cultural pattern. At Level 2 each of these attributes can be further sub-divided.

2.1.4. Level 1 Landscape Description Units (LDUs) were selected as the basic unit of study because they offer a consistent environmental framework recognised and used by other bodies. In using these units an assumption has been made that at a broad scale, each LDU has a roughly uniform biogeographic character. The use of Joint Character Areas (JCAs) was considered as an alternative to LDUs, but rejected on the basis that only 22 JCAs were present in the East of England region, as opposed to 273 LDUs. The LDUs thus provided a much finer scale of analysis. With the use of any biogeographic units such as these, which are non-uniform in shape and size, there may be some distortion of the data (for example, 50% priority habitat in a 1,000 hectare LDU is very different to 50% priority habitat in a 100,000

[1] Warnock S. (2002) The Living Landscapes Project Landscape Characterisation Handbook: Level 2. Department of Geography, The University of Reading, Reading.

hectare LDU). However, to facilitate the clarity and interpretation of the output map, it was decided that this approach had significant benefits over an alternative, grid-based methodology.

2.1.5. Although the LDUs provide the basic unit for analysis and reporting in this study a wide range of other, more detailed, spatial data were also employed. These data were always used at the greatest level of detail available and then aggregated to LDU level as the final step.

2.2. BIODIVERSITY NETWORK COMPONENTS

2.2.1. The study brief required the identification and classification of a range of different biodiversity areas in the region; core biodiversity areas, biodiversity enhancement areas and strategic river corridors. In addition, urban biodiversity deprivation areas were also to be identified. It is vital to recognise that all components of the biodiversity network are important, no matter how impoverished or fragmented they are, or otherwise. The importance of each component cannot be underestimated.

2.2.2. **Core Biodiversity Areas**

These are priority areas for the management and enhancement of existing resources and for targeting the reversal of habitat fragmentation. They are intended to support a relatively diverse and resilient biodiversity resource and will have a significant quantity of priority habitats and statutory designated sites.

2.2.3. **Biodiversity Enhancement Areas**

These areas are, by definition, more impoverished than the core biodiversity areas; they are likely to have a lower coverage of semi natural habitat and less ecological connectivity than the core areas. Consequently, biodiversity enhancement areas are those with the greatest need or potential for the creation and/or restoration of biodiversity to meet regional targets and to ensure the integrity of the region's ecological network.

2.2.4. **Strategic River Corridors**

It is intended that these comprise continuous or aggregated areas of biodiversity value with the potential to link biodiversity conservation and enhancement areas to achieve connectivity through the landscape.

2.2.5. **Urban Biodiversity Deprivation Areas**

These are areas that support high levels of human population with relatively high levels of deprivation and/or areas where significant growth and development is planned.

2.3. BIODIVERSITY NETWORK CLASSIFICATION

2.3.1. Based upon examination of the data and discussions with the project steering group it was decided that these elements would have the following logical relationships with each other:

- All land is classified as either biodiversity conservation area or biodiversity enhancement area. These two categories are mutually exclusive.

- Strategic river corridors and urban biodiversity deprivation areas overlap with core biodiversity areas and biodiversity enhancement areas. These two categories are NOT mutually exclusive. Thus, for example, an LDU may be a core biodiversity area and also be partly covered by an urban biodiversity deprivation area and/or strategic river corridor.

2.3.2. Where Priority Habitat is mentioned in this report, it is taken to mean those habitats identified by the Regional Biodiversity Forum as having highest regional importance. These habitats comprise: Lowland Grass and Heath, Semi-natural Woodland, Coastal, Reedbeds & Fens, Arable & Cereal Margins, Hedgerows, and Freshwater.

2.3.3. Where GIS calculations have taken place with the priority habitat data, these exclude hedgerows, for which no regionally consistent data resource was found, and arable, cereal margins, which were provided as a point data set only, with each point representing the field centroid & the length of the margin attributed to each point. The exclusion of these habitats was made purely on the basis of data availability, this does not mean that farmland habitats have been viewed as having a low priority with respect to opportunities for enhancement. The priority habitat data was derived from a range of data sets, as listed in Table 2. In the main these were habitat inventory data for the major priority habitats in the region. With the exception of the arable, cereal margins, these data were supplied in GIS vector formats in the form of polygons representing areas of habitat.

Table 2: Priority Habitat data resources

Priority Habitat	Data sets used	Source
Lowland Grass and Heath	Lowland Calcareous Grassland	English Nature
	Lowland Dry Acid Grassland	English Nature
	Lowland Meadows	English Nature
	Coastal and Floodplain Grazing Marsh	English Nature
	Lowland Heath	English Nature
	Grassland (Broads ESA)	DEFRA
	Heathland (EA Heath)	Heathland Opportunities Mapping project (Steering group: English Nature, Forest Enterprise, Forestry Commission and the Royal Society for the Project of Birds. Technical: Suffolk Biological Record Centre. Funding: East of England Development Agency, Government Office for the East of England, English Nature, the Forestry Commission and the Royal Society for the Protection of Birds.)
Semi-Natural Woodland	Ancient Woodland	English Nature
	Lowland Mixed Deciduous Woodland	English Nature
	Wet Woodland	English Nature
	National Inventory of Woodland & Trees	Forestry Commission
	~~Woodland Pasture & Parkland~~	(not available)

Priority Habitat	Data sets used	Source
Coastal	Coastal Sand Dunes	English Nature
	Coastal vegetated shingle	English Nature
	Maritime Cliff and slope	English Nature
	Mudflats	English Nature
	Saline Lagoons	English Nature
	~~Coastal Saltmarsh~~	(not available)
	~~Sublittoral sands and gravel~~	(not available)
Reedbeds & Fens	Fens	English Nature
	Reedbeds	English Nature
	~~Lowland Raised Bogs~~	(not available)
	Fens (Broads ESA)	DEFRA
	Fens	Broads Authority
Arable & Cereal Margins	Field Centroid > 6m margins	DEFRA (Countryside Stewardship Agreement)
Hedgerows	No data	
Freshwater	Rivers and Broads	Broads Authority
	Chalk Rivers	Environment Agency

2.3.4. In landscape ecology terms it is often more important for ecological integrity for a landscape to have contiguous areas of semi-natural habitat than to have the contiguous areas of the same kind of habitat. For this reason all the priority habitat data were combined into a 'super' priority habitat layer in the project GIS by selecting all individual habitat data sets, merging them and dissolving internal boundaries in the new polygons. This layer was used for some of the analyses where the habitat area or patch size of all habitat collectively was required.

3. METHODS

3.1. CORE BIODIVERSITY AREAS

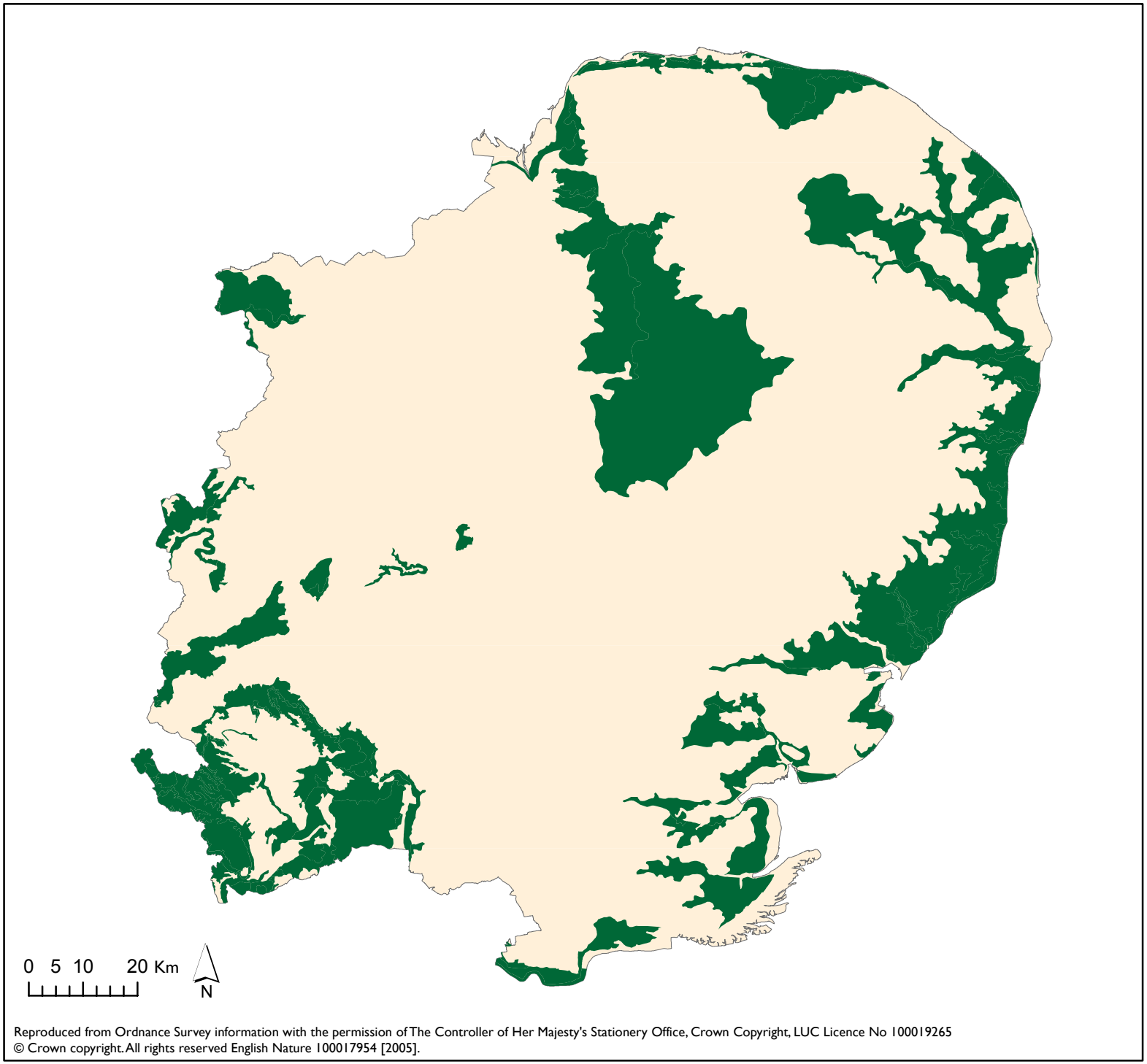
3.1.1. The core biodiversity areas were identified at an LDU level by applying a set of criteria. To qualify, an LDU had to pass any one of the following tests:

1. Over 10% of the LDU area is covered by priority habitat;
2. Over 10% of the LDU area is covered by a statutory designation for nature conservation-related purposes, i.e. SAC, SPA, SSSI, Ramsar, NNR, or LNR;
3. Over 10% of the LDU area is designated County Wildlife Site status.

3.1.2. The resultant set of Core Biodiversity Areas can be seen in Figure 1. These core areas support the highest concentrations of existing priority habitat in the region, and as such there is a need to protect and enhance them. Given these high concentrations of existing priority habitat it can be inferred that these areas possess suitable edaphic conditions, topography, ecological connectivity and other conditions to provide the greatest potential for restoring and re-creating high quality habitat.

East of England Regional Biodiversity Map

Figure 1: Core Biodiversity Areas



Key

- Core Biodiversity Area
- East of England Region

Land Description Units (LDU) (1:250,000 scale) developed for the Countryside Agency by Steven Warnock (in association with the Living Landscape project). Copyright: Countryside Agency, Living Landscapes Project and Cranfield University (soil component) 2001.

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3.2. BIODIVERSITY ENHANCEMENT AREAS

3.2.1. The qualification steps for core biodiversity areas produced a set of 115 LDUs that qualified as core biodiversity areas. The remaining LDUs, by definition, fell into the biodiversity enhancement area category. However, these encompass a range of characteristics, therefore the biodiversity enhancement areas were subdivided into three sub-classes to represent LDUs with different potential and opportunities for habitat re-creation and enhancement. All three categories of Enhancement Area are important but each provides different opportunities for different scales of habitat enhancement.

3.2.2. The sub-division of the biodiversity enhancement areas was based upon examination of characteristics relating to:

- proportion of priority habitat area;
- the rural proportion of the LDU as an indicator of wildlife potential;
- patch size; and
- fragmentation.

3.2.3. These criteria were all given the same weighting, however, due to the perceived importance of Lowland Calcareous Grassland within the region by the Steering Group, the proportion of this habitat alone was additionally calculated for each LDU, with a further 10% weighting. Overall this led to a 110% weighting for Lowland Calcareous Grassland.

3.2.4. As with the core biodiversity areas, the proportion of priority habitat in each LDU was calculated, and those LDUs that did not form part of the Conservation Areas were given a standardised score, based on the percentage of habitat. The same procedure was carried out for the proportion of LDU that was rural (derived from the urban areas calculated from the Ordnance Survey's 1:250,000 Strategi data), the average patch size for areas of habitat within an LDU and the degree of fragmentation. An Inverse Distance Weighting (IDW) technique was used to provide an indication of fragmentation, and a fuller description of this procedure is outlined below (3.2.7).

3.2.5. Habitat potential can be assessed in terms of land suitability. In some cases soils data are used to help identify areas that can support different habitat types. However, the range of priority habitats included in this study is large and encompasses all soil types present in the region. Because different types of priority habitat have not been prioritised, soils data cannot provide a means of differentiating biodiversity enhancement areas at a strategic level. However, soils data would be useful in the future to develop capability profiles for different LDUs and at a more detailed level to support project planning.

3.2.6. Habitat patch size and fragmentation is important for habitat restoration and enhancement potential. There are various ways in which this can be

investigated and expressed, but not all are appropriate at the regional level. For the study we employed a GIS interpolation method with the priority habitat data to assess patterns in habitat occurrence.

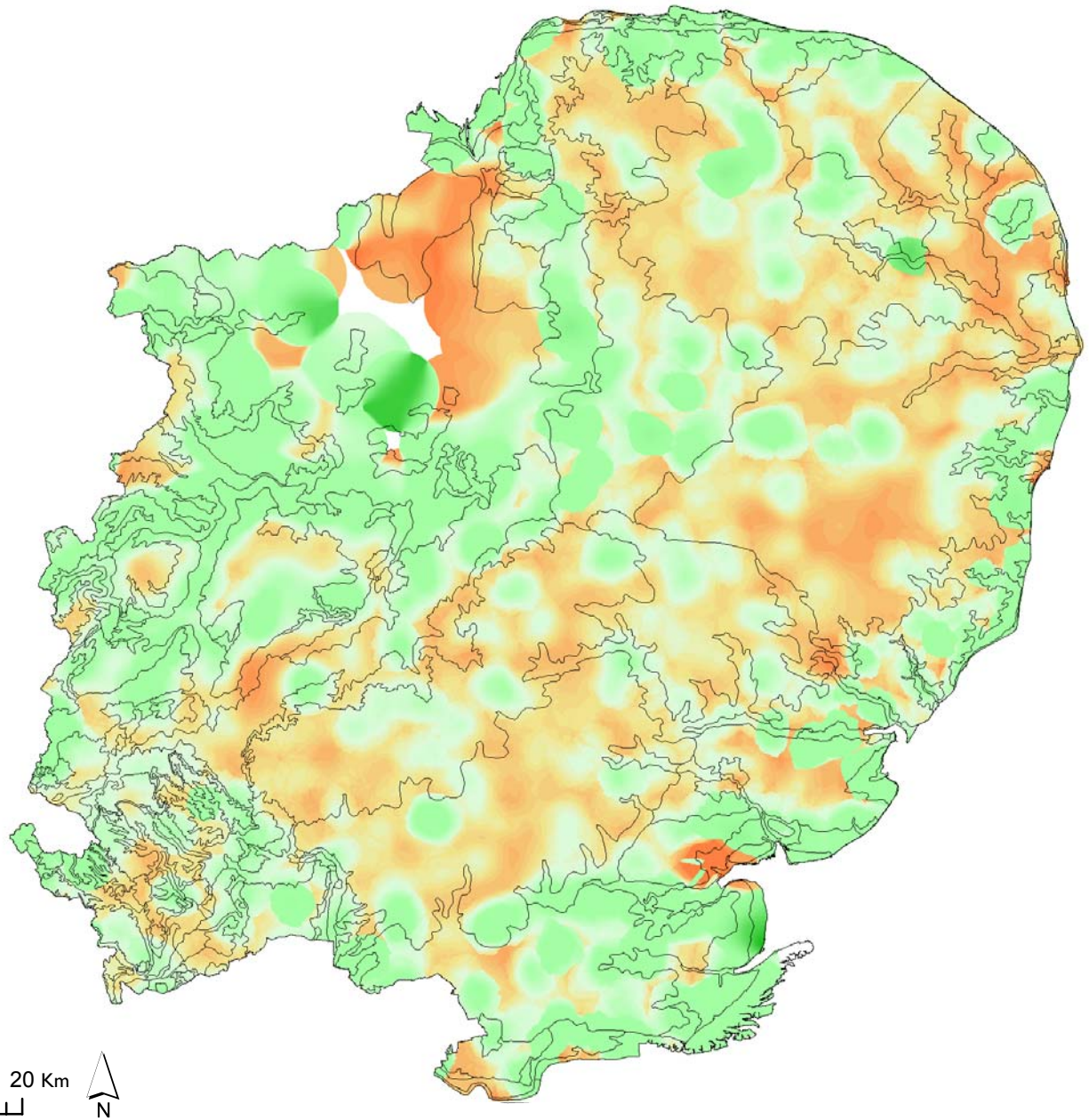
3.2.7. Priority habitat inverse distance area weighting model

3.2.8. This analysis was based upon all priority habitat polygon centroids weighted by the area of the parent polygon (in hectares). Inverse distance weighting (IDW) is a moving average interpolation technique that is suitable for use with highly variable data. The IDW model calculates a value for each grid node by examining surrounding data points within a search radius and a node value is calculated by averaging the weighted sum of all the points. Data points at increasing distances away from the node of influence are attributed far less value than those that lie closer. The model used here has a cell size of 100m, the exponential rate of decay was 2 (attributing relatively low influence to more distant points). The output grid, shown in Figure 2, provides a smoothed representation of priority habitat occurrence, effectively mapping the concentration of habitat distribution in terms of proximity to significant habitat resource.

3.2.9. In habitat re-creation and restoration terms this provides a representation of proximity to existing priority habitat with higher values (darker greens) evident where there are larger and more continuous areas of habitat. Where there are smaller areas of more fragmented habitat the map is shaded orange.

East of England Regional Biodiversity Map

Figure 2: Inverse Distance Weighted Grid for Priority Habitat



0 5 10 20 Km

N

Key

- Least indication of fragmentation (by proximity to existing habitat)
- Greatest indication of fragmentation (by proximity to existing habitat)

Land Description Units (LDU) (1:250,000 scale) developed for the Countryside Agency by Steven Warnock (in association with the Living Landscape project). Copyright: Countryside Agency, Living Landscapes Project and Cranfield University (soil component) 2001.

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3.2.10. It can be seen that outside the core biodiversity areas there are a number of LDUs with smaller quantities of more fragmented priority habitat (orange areas) but also LDUs with apparently significant areas of habitat – most likely produced by a few large sites.

3.2.11. To explore the use of the IDW grid data at a LDU level the GIS was used to query the average grid score inside each LDU. As with the other indicators used for the identification of the Biodiversity Enhancement Areas, these results were then put into a standardised scale, allowing the various criteria to be evaluated consistently and with the same degree of importance.

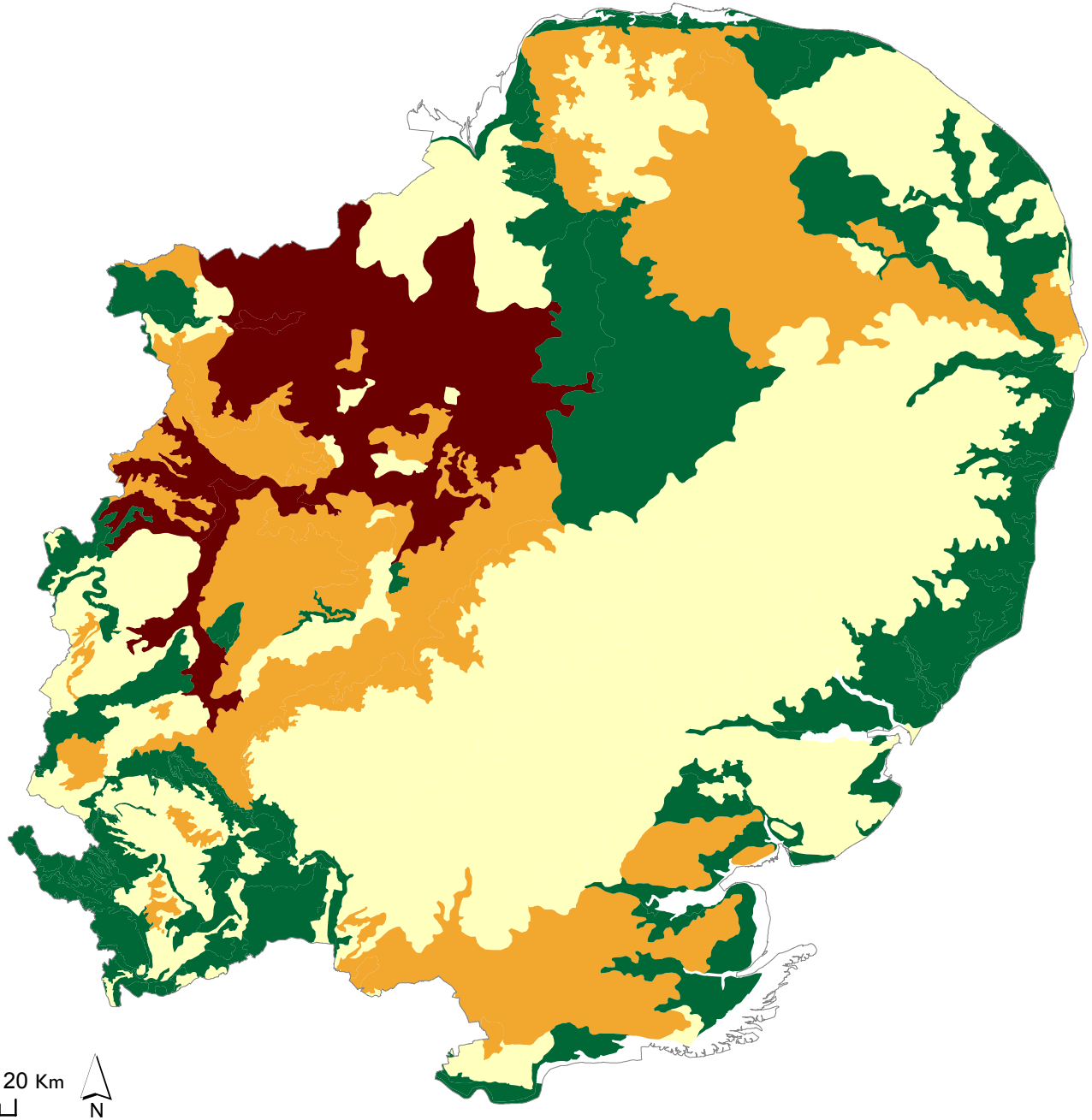
3.2.12. The resultant LDU scores were sub-divided into three categories. Yellow Enhancement Areas, as shown in Figure 3, are generally those with the least proportion of rural area, the greatest degree of fragmentation as indicated by a low average habitat patch size and a low IDW score, and the lowest level of existing priority habitat. Due to these characteristics, these areas may be deemed as those where there is the greatest need for biodiversity enhancement. It is likely that these areas would be most suitable for small-scale habitat restoration projects, which concentrate on minimising the existing pattern of fragmentation. The East Anglian Plain seems typical of Yellow Enhancement Areas, with relatively little priority habitat (other than the unquantified arable, cereal margins) and a high degree of fragmentation.

3.2.13. Orange Enhancement Areas, shown in Figure 3, are middle ranking in terms of all criteria. The East Anglian Chalk area seems typical of this level, where considerable resources of priority habitat can be found (e.g. for lowland calcareous grassland and semi-natural woodland), but the habitat is reasonably fragmented, indicating that habitat restoration and recreation projects would be valuable.

3.2.14. Finally, Brown Enhancement Areas, also depicted in Figure 3, are those with the highest proportion of rural area, the greatest proportion of existing priority habitat and the least degree of fragmentation. LDUs at this level have relatively more priority habitat which is likely to be concentrated in fewer, larger sites. This means that there is some potential to link sites in the future or concentrate on the large areas between sites with little or no priority habitat. The Fens seem typical of LDUs at this level, where there is great opportunity for large scale habitat restoration and recreation.

East of England Regional Biodiversity Map

Figure 3: Biodiversity Enhancement Areas



Key

- Core Biodiversity Area

Biodiversity Enhancement Area

- Buffer fragmented habitats
- Extend and link fragmented habitats
- Large scale habitat recreation and restoration
- East of England Region

Land Description Units (LDU) (1:250,000 scale) developed for the Countryside Agency by Steven Warnock (in association with the Living Landscape project). Copyright: Countryside Agency, Living Landscapes Project and Cranfield University (soil component) 2001.

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3.3. URBAN BIODIVERSITY DEPRIVATION AREAS

3.3.1. The largest urban centres within the region were selected (those with populations over 35,000 in 2001). Any of these urban regions that fulfil one or more of the following criteria were then identified as Urban Biodiversity Deprivation Areas, subject to the following tests:

- fall within an ODPM Growth Area; or
- fall within a district with high predicted growth levels (of over 20% of existing housing, as outlined in the Regional Planning Guidance); or
- has an Index of Multiple Deprivation (IMD) Score above of over 20;
- fails on a one or more counts of the Accessible Natural Green Space model (ANGSt) guidelines provided by English Nature.

3.3.2. The IMD scores of each urban area were calculated by selecting the Super Output Areas (SOAs) that intersect with the urban areas, according to the Ordnance Survey outlines, and calculating the mean IMD score for the contributory SOAs.

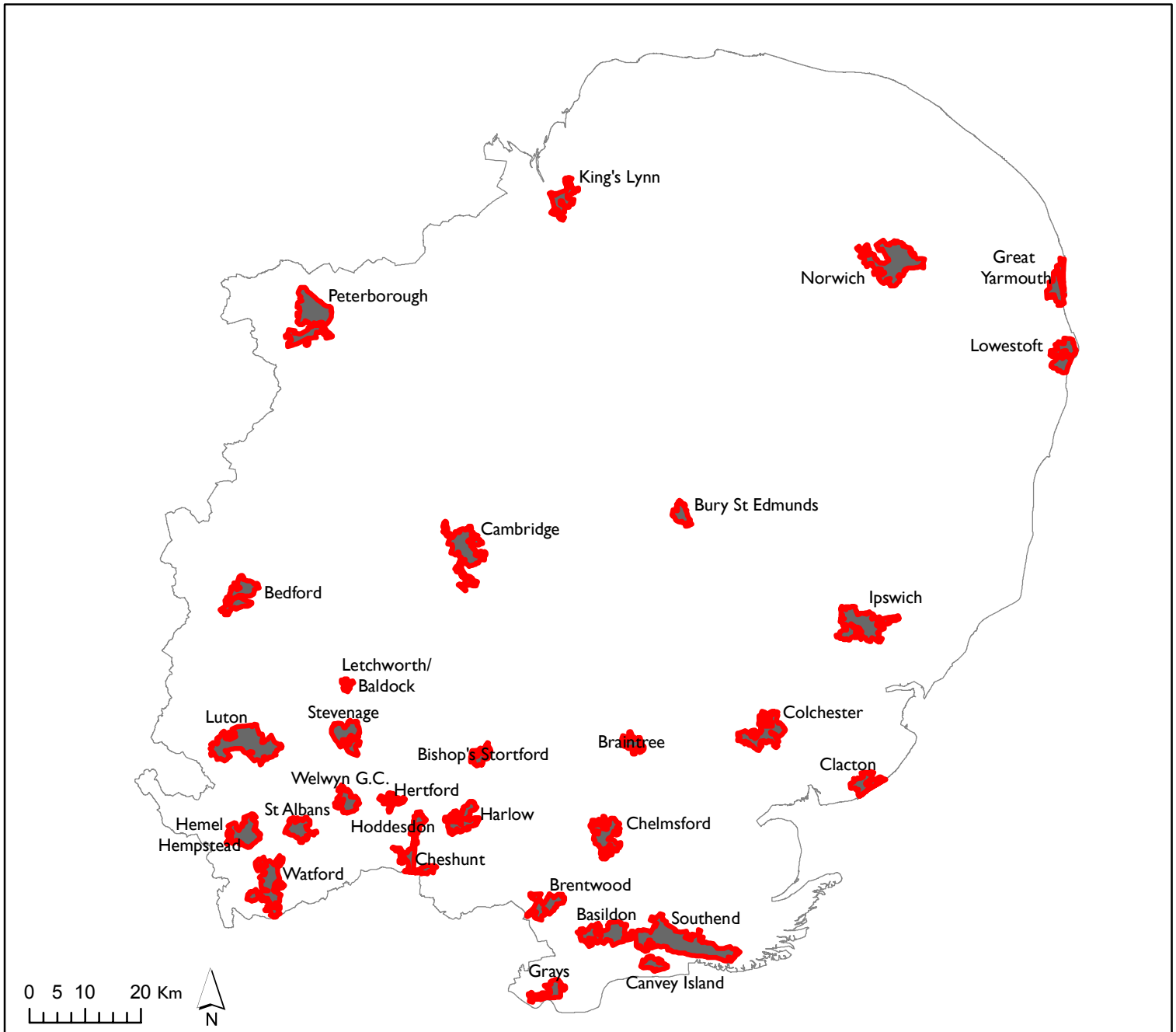
3.3.3. The ANGSt guidelines advocate that every home should be within 300m of at least one 2ha accessible green space, and within the distances outlined in the table below for each size of site:

Size of site	**Recommended maximum distance**
2 ha	300m
20 ha	2km
100 ha	5 km
500 ha	10 km

Table 3: ANGSt guidelines

3.3.4. The criteria above were applied in terms of access to Local Nature Reserves (LNRs) as these are wildlife sites designated for both people and wildlife. If an urban area failed on one or more counts of the ANGSt criteria, it was designated as an urban improvement area.

3.3.5. Figure 4 shows the distribution of the urban biodiversity deprivation areas.



East of England Regional Biodiversity Map

Figure 4: Urban Biodiversity Deprivation Areas

Key

- Urban Biodiversity Deprivation Area
- East of England Region

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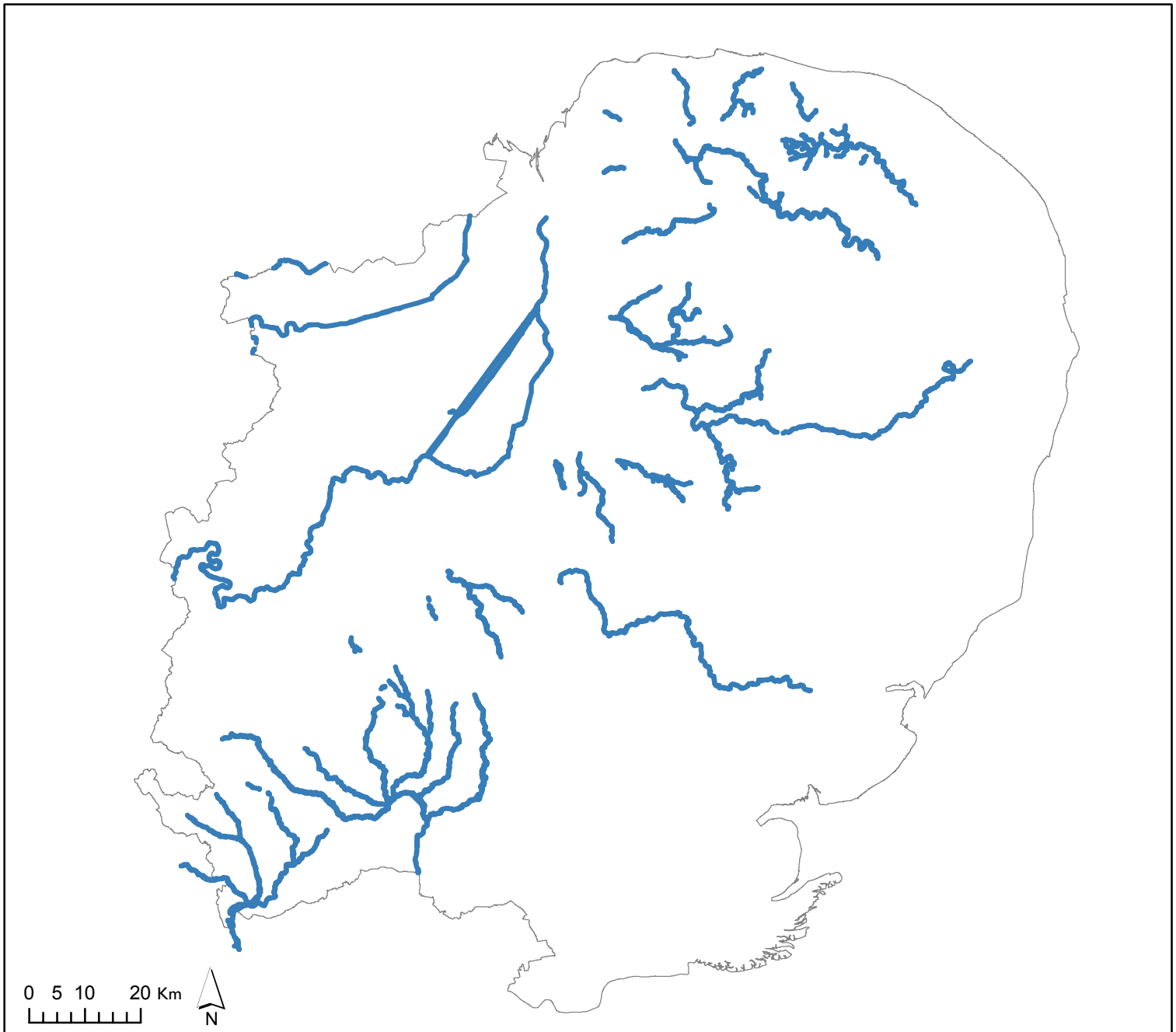
3.4. STRATEGIC RIVER CORRIDORS

3.4.1. While it is recognised that the Core Biodiversity Areas and Biodiversity Enhancement Areas need to be linked and connected via wet and dry biodiversity corridors, it was not possible to map these components in a meaningful way at the regional level. Land based biodiversity corridors were not necessarily apparent in the data and it can be inappropriate to infer function on the basis of habitat shape or landform identified on a map.

3.4.2. In reality little is known about the strategic ecological function of corridors in human-impacted landscapes. Individual species studies show that corridor requirements can vary greatly by species making it impossible to generalise to function at a landscape level. However, it is safer to assume that linear physiographic structures that once existed in more 'natural' landscapes do fulfil ecological functions for species dispersal. On this basis it was decided that strategic river corridors would be identified, comprising all main rivers and all chalk rivers, with a 100 metre buffer, as shown in Figure 5. It may be more appropriate to map biodiversity corridors at a county scale if the derivation of these corridors can be based upon suitable data and an understanding of ecological function and specific species requirements.

East of England Regional Biodiversity Map

Figure 5: Strategic River Corridors



Key

- Strategic River Corridors
- East of England Region

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4. CONCLUSIONS

4.1. The biodiversity network map, which results from the work described above, can be seen in Figure 6. It can be seen from the map that many of the core biodiversity areas are located in the coastal LDUs, such as the Norfolk Broads, north Norfolk and the Suffolk coast, together with Breckland and some smaller, scattered LDUs in Bedfordshire, Hertfordshire and Essex. Much of these areas are those with already high levels of statutory protection, but some areas, particular the LDUs identified as core biodiversity areas in Bedfordshire are afforded a certain level of protection from County Wildlife Sites, but are less well protected in terms of statutory designations.

4.2. The three levels of biodiversity enhancement area cover the rest of the map, with yellow enhancement areas being characterised largely by the East Anglian Plain and other smaller LDUs throughout the region. Orange enhancement areas are concentrated in the East Anglian Chalk region, North Norfolk, South Essex, and smaller areas within Cambridgeshire and Peterborough. Finally, brown enhancement areas are concentrated almost exclusively in the Fens and some areas of the West Anglian Plain.

4.3. The Urban Biodiversity Deprivation Areas are superimposed over the LDUs that form the core and enhancement areas, and are distributed throughout the region, although as might be expected, the majority of the areas are in the south of the region, closer to London.

4.4. Finally, the strategic river corridors are also distributed throughout the region, with a concentration of chalk rivers in the Chilterns, but also distributed throughout Breckland, North Norfolk and the East Anglian Chalk areas. Also of note are those rivers which are covered by Natura 2000 designations such as the Ouse and the Waveney.

4.5. It is important to emphasize that this project has derived the biodiversity network components on the basis of the priority habitats identified by the Regional Biodiversity Forum, namely Lowland Grass and Heath, Semi-natural Woodland, Coastal, Reedbeds & Fens, Arable & Cereal Margins, Hedgerows, and Freshwater. As far as possible, on the basis of the data available, these habitats have been treated equally. However, as noted in section 2, some data sets were either not available (such as Woodland Pasture & Parkland, Coastal Saltmarsh, Sublittoral sands and gravel, Lowland Raised Bogs and Hedgerows) or not available in a format that could be sufficiently analysed by this study (arable & cereal margins). The development of these data sets would greatly aid this and similar studies, and it is recommended that this work is carried out at the earliest opportunity. Data availability aside, key, irreplaceable habitats such as ancient semi-natural woodland, even when small and highly fragmented, should be protected, appropriately managed, and where possible enhanced.

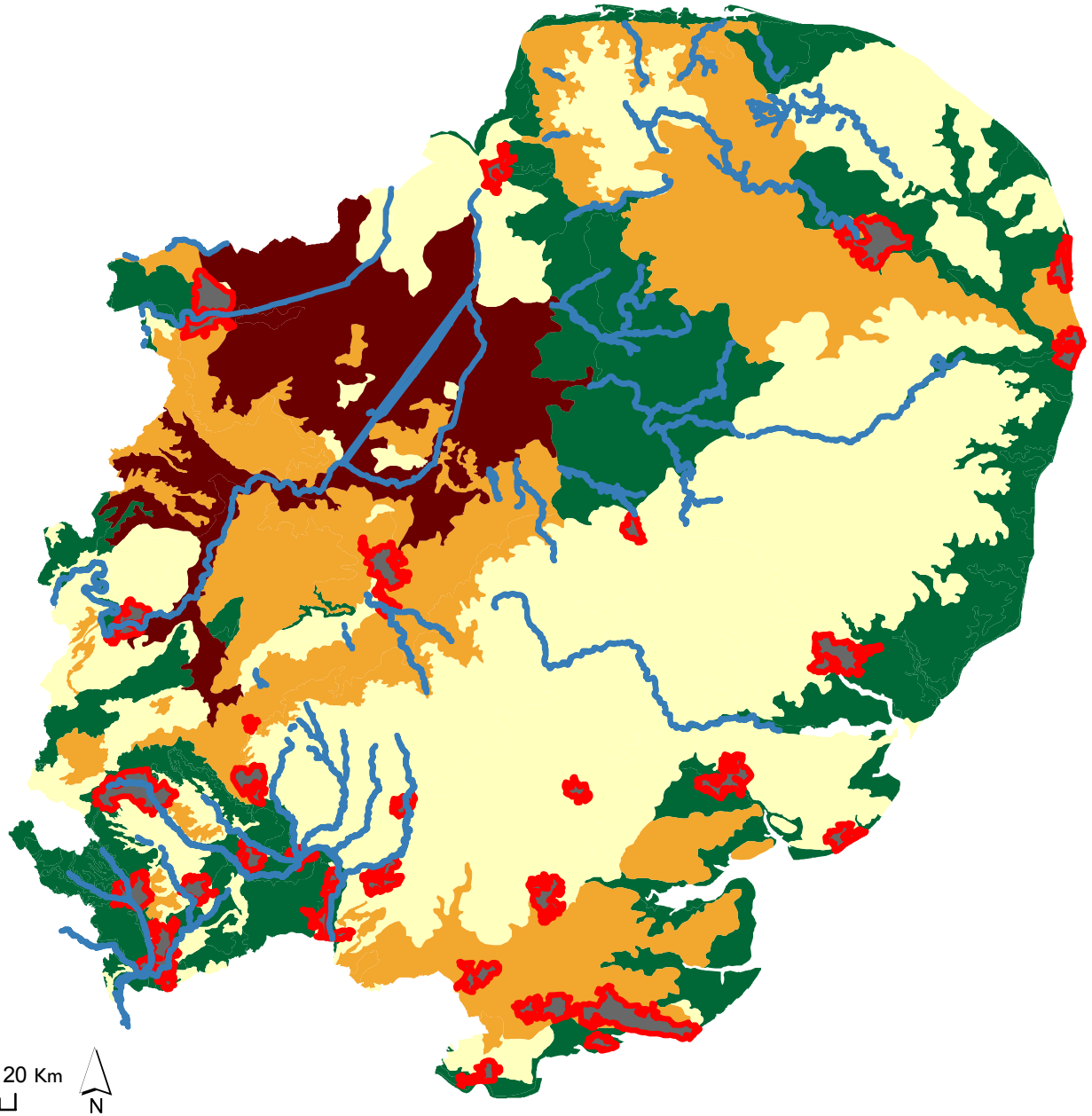
4.6. The development of this network has not identified specific habitats to be targeted for particular LDUs. Biodiversity restoration and re-creation

projects should always take account of landscape character and key landscape features such as ancient field patterns, ancient hedgerows and ancient semi-natural woodlands. Obvious further criteria for habitat selection are driven by soil conditions, water availability and further environmental considerations. A leaflet produced by the Regional Biodiversity Forum 'The East of England Regional Habitat Biodiversity Targets' indicates the regional targets for priority habitat maintenance, restoration and creation to be achieved by 2010.

4.7. It is clear that throughout the East of England region there are areas of critical importance for nature conservation and enhancement. Given the high levels of growth planned in the region, there is a strong need to both conserve the existing biodiversity resource and restore and regenerate biodiversity throughout the region.

East of England Regional Biodiversity Map

Figure 6: Biodiversity Network Map



Key

- Core Biodiversity Area

Biodiversity Enhancement Area

- Buffer fragmented habitats
- Extend and link fragmented habitats
- Large scale habitat recreation and restoration
- Urban Biodiversity Deprivation Area
- Strategic River Corridors

Land Description Units (LDU) (1:250,000 scale) developed for the Countryside Agency by Steven Warnock (in association with the Living Landscape project). Copyright: Countryside Agency, Living Landscapes Project and Cranfield University (soil component) 2001.

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