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Central Lincolnshire Green Infrastructure Steering Group

Biodiversity Opportunity Mapping Study for Central Lincolnshire

October 2013

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Approved	Dominic Watkins
Position	Director
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Revision	FINAL

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Background

In December 2012, Chris Blandford Associates was commissioned by the Central Lincolnshire Green Infrastructure Steering Group to undertake a Biodiversity Opportunity Mapping (BOM) Study for Central Lincolnshire. The BOM Study has taken forward the recommendations of the Central Lincolnshire Green Infrastructure Study (CBA, 2011) by providing a spatial biodiversity opportunity evidence base to support Local Plan making, in accordance with the National Planning Policy Framework objectives.

The Biodiversity Opportunity Mapping Study provides an overview of the broad spatial characteristics for the protection, recreation and expansion of Central Lincolnshire's ecological network. The information contained within the BOM Study should be viewed as a starting point, rather than an end in itself, for planning biodiversity enhancement initiatives. Specifically, the Biodiversity Opportunity Mapping Study provides the basis for the development of Central Lincolnshire's Ecological Network Strategy, which is a key recommendation of the Green Infrastructure Study for Central Lincolnshire.

What is Biodiversity Opportunity Mapping?

The broad concept of a landscape-led approach to nature conservation, including the use of Biodiversity Opportunity Mapping, has been around for many years. However, the publication of The Lawton Review, *Making Space for Nature*, identified the need for *'a coherent and resilient ecological network'* designed to cope with future challenges, particularly the effects that climate change may have on biodiversity, the ecosystem services it underpins and upon which, ultimately, we rely on for our health and wellbeing. The Review concludes that there are currently serious failings in England's ecological network and identifies the need to: *"Establish a more coherent and resilient ecological network on land that safeguards ecosystem services for the benefit of wildlife and people."*

The Biodiversity Opportunity Mapping Study takes forward the proposed actions set out in The Lawton Review by creating GIS-based maps showing Biodiversity Opportunity Areas across Central Lincolnshire. These represent areas in which resources should be targeted to maintain, restore, buffer, link and expand wildlife habitats at a landscape-scale.

Study Objectives and Outputs

- To provide spatial biodiversity opportunity evidence in support of Local Plan making in accordance with the National Planning Policy Framework objectives, with specific reference to the emerging Central Lincolnshire Core Strategy and Lincolnshire Minerals and Waste Plan;

- To create a GIS-based map showing broad proposals for biodiversity opportunity areas across Central Lincolnshire, representing areas in which resources should be targeted to maintain, restore, buffer, link and expand wildlife habitats at a landscape scale;

- To produce detailed GIS-based maps and site information showing specific biodiversity opportunities for the Lincoln PUA/SUEs/WVCP, taking into account relevant strategies, plans, opportunities and constraints (existing and potential) within the next 20-50 years, and identifying areas in which resources should be targeted to maintain, restore, buffer, link and expand wildlife habitats at a landscape scale; and,

- To identify strategic biodiversity enhancement projects, including cost estimates for consideration in the development of the Infrastructure Delivery Plan for Central Lincolnshire.

This process was informed through a series of workshops with local stakeholder expertise to refine the GIS-based mapping process.

BOM Study Applications

Biodiversity opportunity mapping helps to identify and prioritise areas where investment in resources would achieve greatest benefits; for the economy and society, not just for nature. For the first time, this study provides Biodiversity Opportunity Mapping for the whole of Central Lincolnshire now exists to inform a range of applications in relation to land use planning and environmental land management. Taken together with the more detailed opportunity mapping within the Lincoln PUA/SUEs/WVCP, the Study is considered to provide a useful tool to assist decision-making in Central Lincolnshire. In order to maximise these benefits, the opportunity maps can be applied in in a number of ways as highlighted below.

Planning and the Growth Agenda

The three local authorities of City of Lincoln, North Kesteven and West Lindsey have come together as Central Lincolnshire to produce a single Local Plan under the auspices of the Joint Planning Unit. This plan needs robust evidence on which to base decision making. This BOM Study provides such an evidence base (as part of the wider Green Infrastructure Study) and can aid:

- Planners: to inform growth plans, identify strategic linkages and direct CIL funding to best effect; and,
- Developers: to identify opportunities in and around developments to enhance place and therefore prices;

The Witham Valley Country Park has been prioritised for environmental and leisure investment and project delivery. This initiative is in the early stages of development, and is being steered through an informal partnership of local authorities, statutory agencies and voluntary bodies. The proposed Witham Valley Country Park is an area where housing development and industry are expected to grow; where

aggregates are being extracted; and where there is scope for managing the risk of flooding in and around Lincoln. It is also an area of existing value for wildlife and has great potential to develop wildlife habitats on a landscape scale. The BOM Study can contribute to the evolution of the Witham Valley Country Park by identifying a range of opportunities for enhancing ecological connectivity within the context of future growth and the provision of a range of ecosystem services.

Biodiversity Action Planning

The Lincolnshire Biodiversity Action Plan, administered by the Greater Lincolnshire Nature Partnership, sets out the quantitative targets for increasing and enhancing the biodiversity resource of Lincolnshire. The BOM Study can be used as the spatial framework for identifying opportunities to deliver the BAP targets.

Minerals and Waste Site Restoration

The BOM Study can help as a tool for identifying appropriate end-use restorations for existing and future minerals sites in Central Lincolnshire. The appropriate restoration of minerals sites can contribute towards:

- Developing the Witham Valley Country Park's assets;
- Providing a significant contribution towards woodland creation and management including the development of adaptation strategies both for floodplain management and for biodiversity; and,
- Large scale habitat creation schemes, including the creation of grazing marsh, fenland habitats and heathland areas.

Water Framework Directive

The BOM Study can help as a tool for identifying biodiversity opportunities that contribute towards delivering interventions that will improve the chemical and ecological quality of Central Lincolnshire's watercourses and wetlands. This is a key component for meeting water quality and water resources obligations as required by the Water Framework Directive (WFD).

Environmental Land Management Targeting

The BOM Study can help to inform targeting of funding and advice to farmers and landowners where activities under agri-environment schemes can be targeted to best effect within the landscape. The BOM Study can also provide a framework to help implement reforms to the Common Agricultural Policy, which will result in considerable changes to funding for agri-environment measures and woodland planting.

1.0 INTRODUCTION

1.1 Background

1.1.1 Through the Central Lincolnshire Joint Planning Unit, a Local Plan is being developed jointly across the three districts of the City of Lincoln Council, North Kesteven District Council and West Lindsey District Council. These three district local authorities, in conjunction with Lincolnshire County Council, are working with other key partner organisations to develop a robust evidence base to support the development of the Plan. One component of the evidence base has been the formulation of a Green Infrastructure (GI) Study for Central Lincolnshire, which was completed in 2011[1]. A recommendation of the GI Study is to develop Biodiversity Opportunity Mapping to update and inform the delivery of the GI Strategy, including the proposed Central Lincolnshire Ecological Network Strategy and Local GI Delivery Plans[2].

1.1.2 An area to the south west of Lincoln, being promoted as the Witham Valley Country Park[3] has been prioritised for environmental and leisure investment and project delivery. This initiative is in the early stages of development, and is being steered through an informal partnership of local authorities, statutory agencies and voluntary bodies. The proposed Witham Valley Country Park is an area where housing development and industry are expected to grow; where aggregates are being extracted; and where there is scope for managing the risk of flooding in and around Lincoln. It is also an area of existing value for wildlife and has great potential to develop wildlife habitats on a landscape scale.

1.1.3 In order to help shape the future of the landscape and to improve the biodiversity resilience of the area, the partners identified a need to carry out a broad assessment of biodiversity opportunities for the whole of Central Lincolnshire, and a more detailed assessment of the Lincoln Principal Urban Area/Sustainable Urban Extensions and the Witham Valley Country Park (Lincoln PUA/SUEs/WVCP).

1.1.4 At both the broad Central Lincolnshire and the more detailed Lincoln PUA/SUEs/WVCP scales, biodiversity underpins a range of ecosystem services that are pivotal in water resource and water quality management. The Biodiversity Opportunity Mapping project identifies a range of potential interventions that support the aims and objectives of improving resource and quality management of surface and ground waters, as required under the Water Framework Directive[4].

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[1] http://microsites.lincolnshire.gov.uk/centrallincolnshire/local-development-framework/eco-town-intiative/green-infrastructure-study-for-central-lincolnshire/107237.article?tab=downloads
[2] See para 4.8.4 of the Green Infrastructure Study for Central Lincolnshire (CBA for the Central Lincolnshire Joint Planning Unit, 2011)
[3] http://withamvalleypark.co.uk
[4] http://www.environment-agency.gov.uk/research/planning/33362.aspx

1.2 Purpose

1.2.1 The purpose of the Biodiversity Opportunity Mapping Study for Central Lincolnshire is to take forward the GI Study by providing evidence to shape the future of the landscape through the enhancement and creation of semi-natural habitats. Within this context the Study seeks to identify:

- Broad proposals for 'Biodiversity Opportunity Areas' within the whole of Central Lincolnshire which could be delivered through a series of strategic projects; and,
- Detailed 'Biodiversity Opportunity Areas' mapped at the Lincoln PUA/SUEs/WVCP scale.

1.2.2 The Biodiversity Opportunity Maps aim to identify areas for habitat creation and enhancement, taking into account the following key drivers:

- Requirements of the Water Framework Directive;
- Central Lincolnshire Local Plan, including Sustainable Urban Extensions for Lincoln proposed by the draft Central Lincolnshire Local Plan Core Strategy[5] and the growth agenda;
- Use of S106/Community Infrastructure Levy funds and the potential for biodiversity offsetting;
- Lincolnshire County Council Minerals & Waste Local Plan[6] (in preparation);
- Lincolnshire Biodiversity Action Plan;
- Biodiversity 2020: A strategy for England's wildlife and ecosystem services[7];
- Lincolnshire Joint Flood Risk and Drainage Management Strategy;
- Upper Witham Flood Risk Management Plan; and,
- Agri-environment scheme targeting.

1.3 Objectives

1.3.1 The study's objectives are to:

- Create a GIS-based map showing broad proposals for biodiversity opportunity areas across Central Lincolnshire, representing areas in which resources should be targeted to maintain, restore, buffer, link and expand wildlife habitats at a landscape scale;

- Provide spatial biodiversity opportunity evidence in support of Local Plan making in accordance with the National Planning Policy Framework objectives, with specific reference to the emerging Central Lincolnshire Core Strategy and Lincolnshire Minerals and Waste Plan;

- Produce detailed GIS-based maps and site information showing specific biodiversity opportunities for the Lincoln PUA/SUEs/WVCP, taking into account relevant strategies, plans, opportunities and constraints (existing and potential) within the next 20-50 years, and identifying areas in which resources should be targeted to maintain, restore, buffer, link and expand wildlife habitats at a landscape scale; and,

[5] http://microsites.lincolnshire.gov.uk/centrallincolnshire/consultations/past-consultations/partial-draft-core-strategy-consultation-july-2012/102650.article?tab=downloads
[6] http://www.lincolnshire.gov.uk/residents/environment-and-planning/planning-and-development/minerals-and-waste/
[7] Biodiversity 2020: A strategy for England's wildlife and ecosystem services (Defra, 2011)

- Identify strategic biodiversity enhancement projects, including cost estimates for consideration in the development of the Infrastructure Delivery Plan for Central Lincolnshire.

1.3.2 The Central Lincolnshire Study Area is shown on **Figure 1.1**. The Lincoln PUA/SUEs/WVCP Area is shown on **Figure 1.2**.

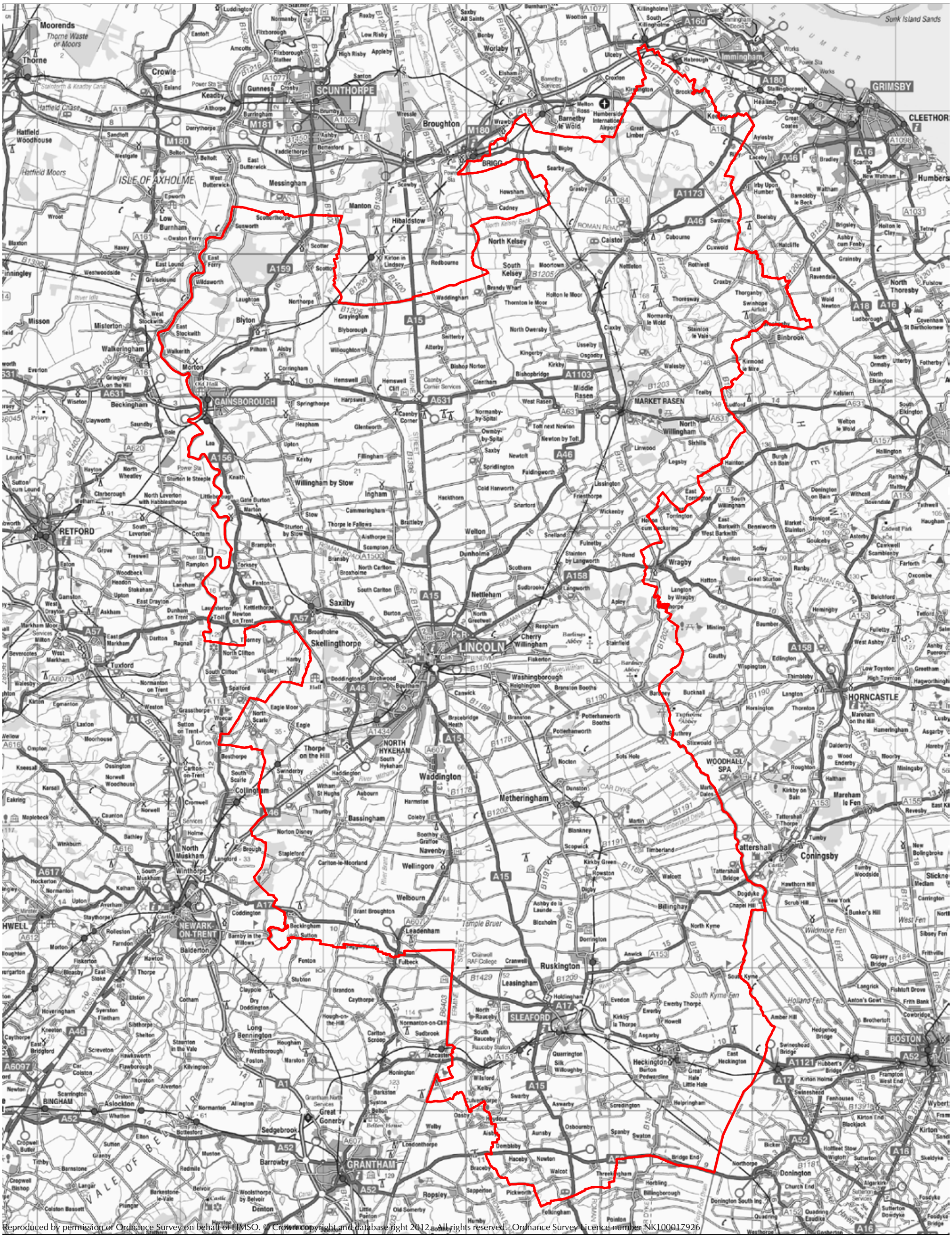
1.4 Acknowledgements

1.4.1 The Biodiversity Opportunity Mapping Study for Central Lincolnshire was developed by Chris Blandford Associates (CBA) in conjunction with a steering group comprising:

- Brooke Smith (Central Lincolnshire Joint Planning Unit);
- Gill Wilson (City of Lincoln Council);
- Fran Hitchinson (Greater Lincolnshire Nature Partnership);
- Andy Bailey (Environment Agency);
- Helen Barber (Environment Agency);
- Liz Fleuty (Lincolnshire County Council);
- Caroline Steel (Lincolnshire Wildlife Trust);
- Elizabeth Biott (Lincolnshire Wildlife Trust);
- Ryan Hildred (Natural England); and,
- Marcus Craythorne (Witham Valley Country Park).

1.4.2 In addition, consultation was undertaken with a range of stakeholders as the study developed and their contribution is gratefully acknowledged.

1.4.3 The views in this study are those of CBA. The CBA team comprised: Dominic Watkins (Project Director), Bill Wadsworth (Project Manager), Rosie Marston (GIS Specialist/Project Ecologist) and Harriet Stanford (GIS/Technical Support).



KEY

Central Lincolnshire boundary

0 5 10 km

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BIODIVERSITY OPPORTUNITY MAPPING STUDY FOR CENTRAL LINCOLNSHIRE

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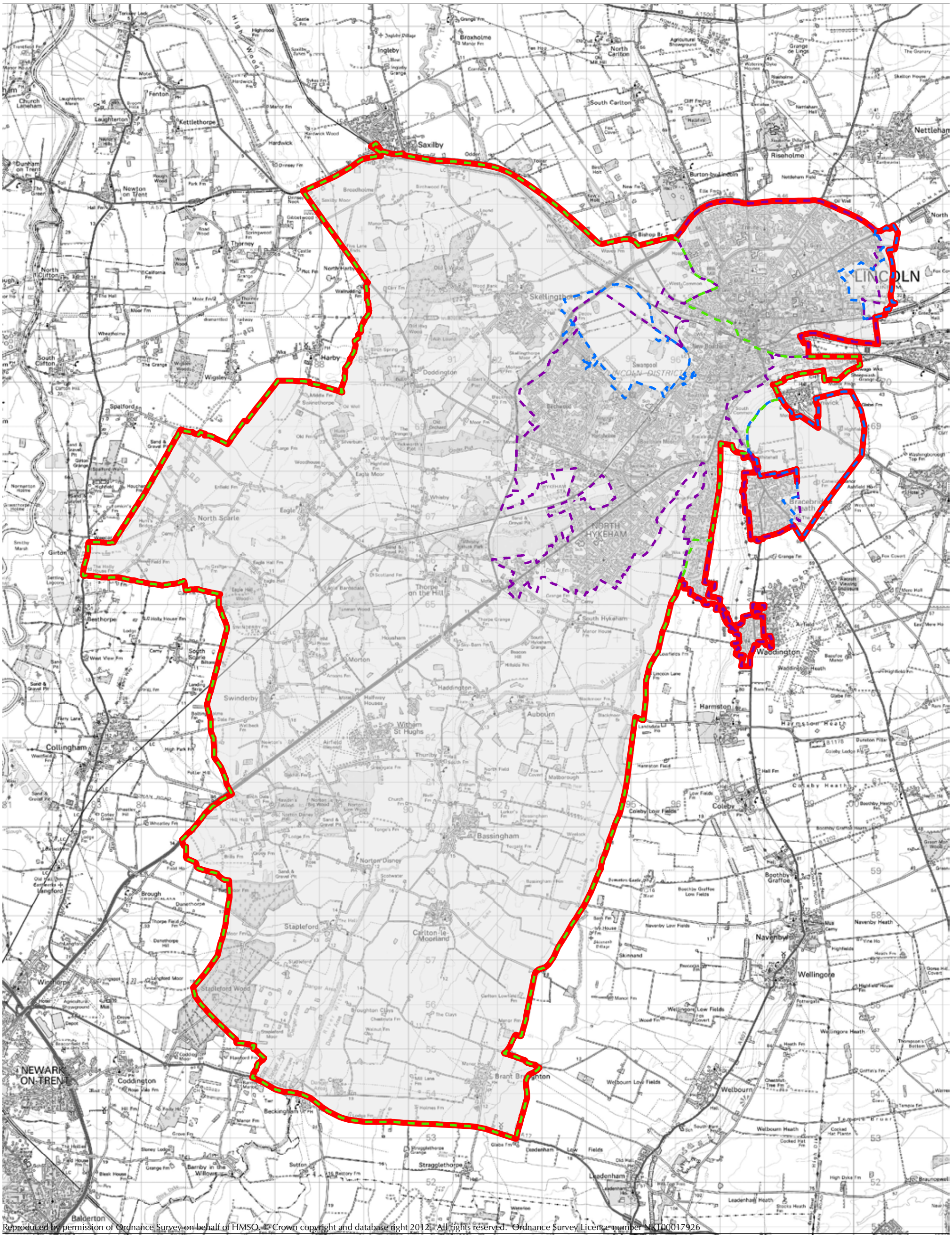
FIGURE 1.1
Central Lincolnshire Study Area

OCTOBER 2013



KEY

- Study Area
- Witham Valley Country Park boundary
- Principal Urban Area boundary
- Sustainable Urban Extension boundary

0 1 2 km

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BIODIVERSITY OPPORTUNITY MAPPING STUDY FOR CENTRAL LINCOLNSHIRE

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FIGURE 1.2
Lincoln PUA/SUEs/WVCP Study Area

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2.0 RATIONALE AND METHODOLOGY

2.1 General

2.1.1 This Section describes the rationale behind Biodiversity Opportunity Mapping in relation to recent developments in Government policy, which seeks to encourage a landscape-led approach to nature conservation. A brief overview of the methodological approach is described below. A detailed methodology is set out in **Appendix A**.

2.1.2 The mapping of biodiversity opportunities for Central Lincolnshire involved an evidence-based approach using analysis of available habitat and other relevant data by CBA, with validation of outputs by stakeholders with local expert knowledge of the area. As outlined in **Figure 2.1**, the Biodiversity Opportunity Mapping Study process involved four key elements of work:

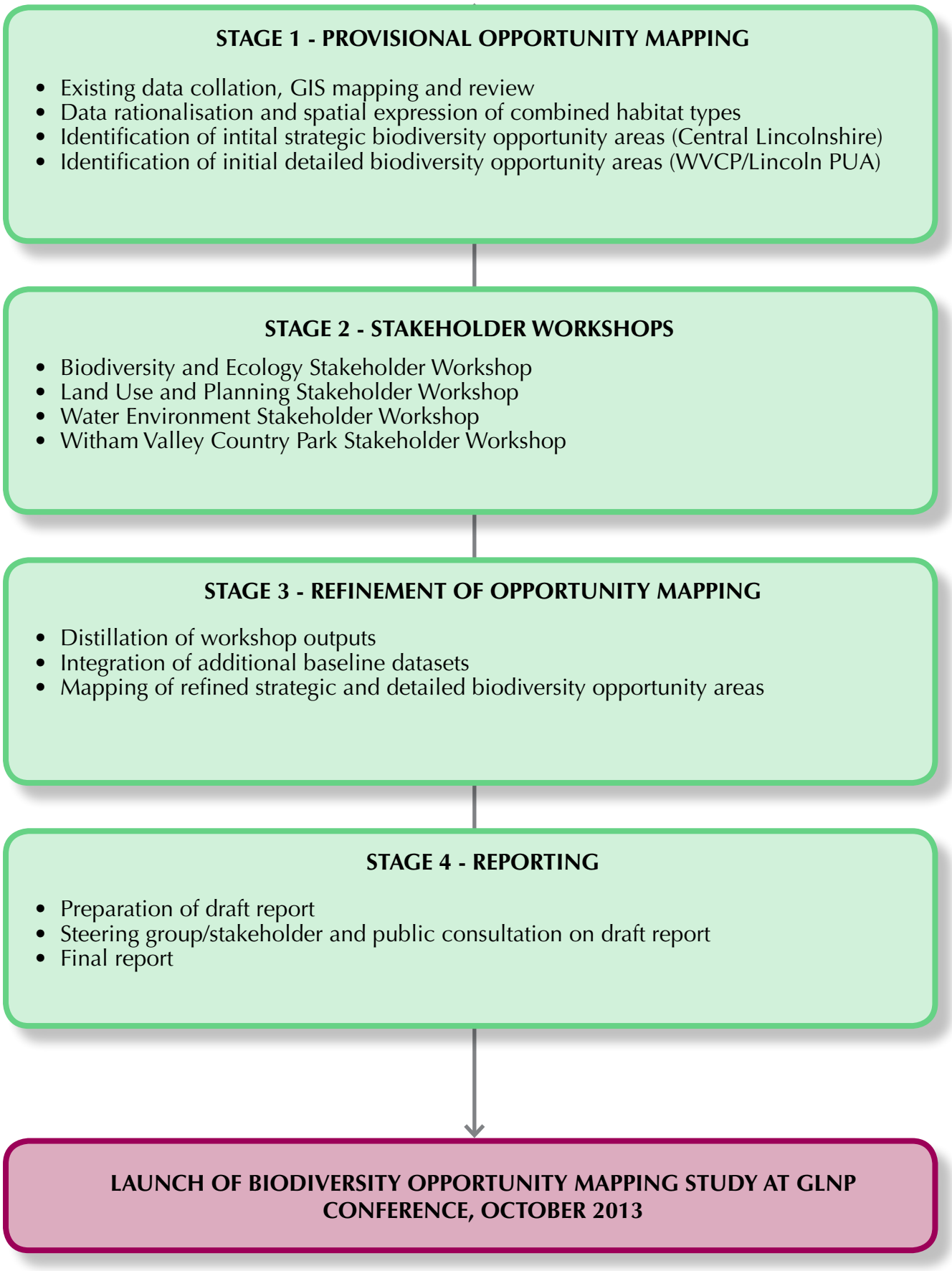
- Provisional Opportunity Mapping;
- Stakeholder Workshops;
- Refinement of Opportunity Mapping; and,
- Reporting.

2.2 Rationale

2.2.1 The broad concept of a landscape-led approach to nature conservation, including the use of Biodiversity Opportunity Mapping, has been around for many years. However, the publication of The Lawton Review, *Making Space for Nature*[8] (herein referred to as the Review), identified the need for *'a coherent and resilient ecological network'* designed to cope with future challenges, particularly the effects that climate change may have on biodiversity, the ecosystem services it underpins and upon which, ultimately, we rely on for our health and wellbeing.

2.2.2 The Review concludes that there are currently serious failings in England's ecological network and that in its current state it can be described as neither coherent nor resilient. '*Notably, many of England's wildlife sites are too small; losses of certain habitats have been so great that the area remaining is no longer enough to halt additional biodiversity losses without concerted efforts; with the exception of Natura 2000 sites and SSSIs, most of England's semi-natural habitats important for wildlife are generally insufficiently protected and under-managed; many of the natural connections in our countryside have been degraded or lost, leading to isolation of sites; and too few people have easy access to wildlife*.' To address this, the Review identifies the following Priority Action: *Establish a more coherent and resilient ecological network on*

[8] Lawton, J. (2010). Making Space for Nature: A review of England's Wildlife Sites and Ecological Network. Defra.


STAGE 1 - PROVISIONAL OPPORTUNITY MAPPING
• Existing data collation, GIS mapping and review
• Data rationalisation and spatial expression of combined habitat types
• Identification of intital strategic biodiversity opportunity areas (Central Lincolnshire)
• Identification of initial detailed biodiversity opportunity areas (WVCP/Lincoln PUA)
STAGE 2 - STAKEHOLDER WORKSHOPS
• Biodiversity and Ecology Stakeholder Workshop
• Land Use and Planning Stakeholder Workshop
• Water Environment Stakeholder Workshop
• Witham Valley Country Park Stakeholder Workshop
STAGE 3 - REFINEMENT OF OPPORTUNITY MAPPING
• Distillation of workshop outputs
• Integration of additional baseline datasets
• Mapping of refined strategic and detailed biodiversity opportunity areas
STAGE 4 - REPORTING
• Preparation of draft report
• Steering group/stakeholder and public consultation on draft report
• Final report
LAUNCH OF BIODIVERSITY OPPORTUNITY MAPPING STUDY AT GLNP CONFERENCE, OCTOBER 2013

land that safeguards ecosystem services for the benefit of wildlife and people (summarised in four words):

- ***Better*** *– improving the quality of the existing ecological resource of priority habitats (inside and outside protected sites);*
- ***Bigger*** *– increase the size of remaining areas of priority habitat where appropriate;*
- ***More*** *– we will create new areas of priority habitat where appropriate; and,*
- ***Joined*** *– we will enhance ecological connections between, or join up, existing areas of priority habitat, increasing opportunity for wildlife to move around the landscape by making use of 'stepping stones', 'corridors' and other features.*

2.2.3 By acting on these principles, the Review provides a 'roadmap' for achieving a **coherent ecological network** as one that "has all the elements necessary to achieve its overall objectives; the components are complementary and mutually reinforcing so that the value of the whole network is greater than the sum of its parts."; and, a **resilient ecological network** as one that "can absorb, resist or recover from disturbances and damage caused by natural influences and human activities (including climate change), while continuing to meet its overall objectives of supporting biodiversity …".

2.2.4 The theme of the coherent and resilient ecological network has been enshrined in the Government's white paper on the natural environment, The Natural Choice[9], and recognises 'the consensus amongst conservationists and land managers that integrated action at a 'landscape scale' is the best way forward'.

2.2.5 The Lawton Review and Natural Environment White Paper set out a series of fundamental components (set out in *italics* in the following paragraphs below), which are required to create a coherent and resilient ecological network. The methodology for developing the Biodiversity Opportunity Maps at both the Central Lincolnshire and the Lincoln PUA/SUEs/WVCP scales are discussed in relation to each component below.

2.3 Provisional Opportunity Mapping

2.3.1 ***Core areas of nature conservation value*** *which contain rare or important habitats. They include protected wildlife sites and other areas of high ecological value*. The Study has used all digital datasets available for the mapped coverage of semi-natural habitats for Central Lincolnshire (**Appendix A**, **Table A1**), encompassing both designated sites and land mapped as areas of semi-natural habitat. In total there are 87 separate classifications for semi-natural habitats. In order to rationalise the mapping process, the 87 classifications were amalgamated

[9] Defra (2011). *The Natural Choice: securing the value of nature*. TSO.

into 6 broad habitat classes, aligned with the relevant priority habitats identified in the Lincolnshire Biodiversity Action Plan (3rd edition)[10]:

Table 2.1: Existing Habitat Types

Amalgamated Habitat Type	Lincolnshire BAP Priority Habitat
Woodland	Lowland mixed deciduous woodland; Wet woodland
Wetland	Fens; Ponds, lakes and reservoirs; Reedbeds; Rivers, canals and drains
Neutral grassland	Grazing marsh; Lowland meadows
Heathland	Heathland and peatland
Acid grassland	Lowland dry acid grassland
Calcareous grassland	Lowland calcareous grassland

2.3.2 ***Buffer zones*** *that protect core areas, restoration areas, and 'stepping stones' from adverse impacts in the wider environment*. Buffer zones have two separate applications within the context of the Study. Firstly, buffers were used to identify 'nearest neighbour' associations of similar habitat types (see **Figs 3.1 – 3.4**). Buffer width varied between habitat type, based on academic research (see **Appendix A**) which identifies mean dispersal distances for a range of species associated with each habitat type. Areas where buffers intersect can infer a spatial relationship between areas of existing habitat as they may be sufficiently close to one another to allow some level of species interaction.

2.3.3 Secondly, the buffers are also applied to identify land where interventions such as land management or habitat creation would be best suited to protect existing habitats. In the case of both applications, buffers identify priority areas for targeting interventions for habitat protection, enhancement and/or creation.

2.3.4 With respect to the opportunity mapping for **woodland** in Central Lincolnshire and Lincoln PUA/SUEs/WVCP, 500m buffers were applied to the existing areas of ancient woodland only, due to their longevity and recognised inherent ecological value. Opportunities to create buffers intended to protect or extend woodland coverage are generally unrestricted (in terms of the types of land that trees can be planted on or allowed to regenerate naturally). The 500m limit has therefore been applied principally to identify agglomerations of existing woodlands, as a means of prioritising opportunities in those areas where greatest gains in protecting woodland through buffering and/or the creation of linkages could be achieved with limited effort (i.e. the creation of large areas of contiguous woodland could be achieved through the planting (or natural regeneration) of relatively small areas of new woodland). Non-ancient woodlands, by contrast, can vary considerable in their (ecological) quality and therefore predictions regarding the appropriate application of buffering are that much more difficult on a woodland by woodland basis (i.e. buffers could be applied to coniferous plantations that would

[10] www.glnp.org.uk/our-publications/biodiversity/

be better suited to clear felling, or structural improvements to woodlands by e.g. selective thinning or coppicing may be a more appropriate management interventions in the first instance). For this reason buffers have not been applied to non-ancient woodlands.

2.3.5 Mapping opportunities for protecting and/or linking open (**heathland**, **grassland** and **wetland**) habitats is more nuanced. Open habitats can be more susceptible to the effects of external influences such as water availability, agricultural spray drift and/or diffuse urban pollution, which may require localised interventions for their protection and/or enhancement. Furthermore, the role of influencing factors such as geology, overlying soil and hydrological conditions, play a more significant role in determining the geographical extent for creating and/or extending these habitat types. In reality, the identification of opportunities to protect existing open habitats through the application of buffers at the Central Lincolnshire scale are too narrow to be observed or legible (e.g. 6m – 20m wide conservation (grass) headlands). By contrast, similar opportunities at the Lincoln PUA/SUEs/WVCP scale are better identified on the maps on a field by field basis.

2.3.6 200m buffers were therefore only applied to the open (heathland, neutral, acid and calcareous grasslands) and wetland habitats for Central Lincolnshire, as a means of illustrating the spatial relationship between existing habitats and thereby identifying priority opportunities for their extension and/or creation. The neutral grassland resource in Central Lincolnshire is currently very limited, restricted to small isolated patches and roadside verges. Nevertheless, opportunities for future creation of neutral grasslands on suitable soils, not necessarily in contiguous relationship with existing sites, will arise.

2.3.7 ***Restoration areas****, where strategies are put in place to create high value areas (the 'core areas' of the future), restoring ecological functions and wildlife*. In essence the combination of the existing habitat patches, as well as the creation of new 'stepping stone' habitats, their associated buffer zones and habitat linkages, form the restoration areas for this Study.

2.3.8 Restoration Areas are characterised as follows:

- Management of existing semi-natural habitat: the positive and effective management of the existing habitat resource should be considered a priority, to ensure a 'no net loss' in species diversity from the current position. Additionally, these sites provide the reservoir of species for migrating between, dispersing through and populating newly created sites;
- Protection of existing semi-natural habitat through adjacent land management (buffering); and,
- Extension (of existing) and/or creation (of new) areas of semi-natural habitat: to both strengthen and extend the existing resource.

2.3.9 The protection and enhancement of the existing ecological resource is enshrined in the National Planning Policy Framework and the emerging Central Lincolnshire Local Plan Core

Strategy (see **Section 5.0** for details). The purpose of the opportunity mapping is therefore to focus on what could be achievable through the restoration and/or creation of habitats in order to strengthen and extend the ecological network.

2.3.10 ***Sustainable use areas****, areas of surrounding land that are managed in a sustainable and wildlife friendly way* but whose use is not primarily related to biodiversity conservation and protection. For example, initiatives such as agri-environment land management schemes (e.g. Natural England's Environmental Stewardship programme and the Forestry Commission's English Woodland Grant Scheme), and their successors, due to be introduced in 2015, encourage revisions to land management practices that support biodiversity conservation within the context of commercial agricultural and/or forestry enterprise. Whilst not necessarily actively seeking to create new semi-natural habitats, the changes in land management encouraged through the schemes, results in the wider landscape becoming more permeable for species dispersal and migration, which in turn strengthens the interconnectivity between semi-natural habitats.

2.3.11 Similarly, land under local authority control can also contribute significantly to the restoration of semi-natural habitats such as, for example, the sensitive management of calcareous grassland roadside verges.

2.3.12 Sustainable use areas can also encompass the built environment, which present an opportunity for both the creation of new habitats and/or retrofitting habitat interventions as part of the fabric of the urban environment. Such opportunities may include:

- Creation of rain gardens;
- Creation of SuDS schemes;
- Creation of urban woodlands and planting street trees; and,
- Creation of new (or retrofitting) green roofs and living walls.

2.3.13 ***Corridors and 'stepping stones'*** *enabling species to move between core areas*. These can be made up of a number of small sites acting as 'stepping stones' or a mosaic of habitats that allows species to disperse through the wider landscape. Existing habitats that are isolated i.e. remain unconnected to similar areas of semi-natural habitat, once the GIS mapped buffers are applied, may be considered to be 'stepping stones' for some highly mobile species, such as birds and some flying insects, for example but largely they remain isolated fragments of habitat. The degree to which 'stepping stones' may provide suitable habitat and a suitable dispersal network for a full range of species, depends greatly on the permeability (the relative ease with which species can move) of the surrounding landscape. This may be a function of distances between individual 'stepping stones', buffer intersections between similar habitats, agri-environment land management schemes and/or lack of physical barriers (towns, villages and

major roads). Similarly, linear features such as roadside verges, rivers, drains and hedgerows, may be considered to be corridors. In both cases, there remains a limited understanding of what the minimum patch size for a 'stepping stone' (for a given habitat type), or the minimum width of a corridor should be, to support a stable habitat and its associated species.

Supporting Datasets

2.3.14 To support decision making relating to the distribution of extant habitats and predictions relating to where these habitat types could potentially be extended or created, an understanding of the existing conditions that favour their creation or extension is also required. The supporting datasets listed below were therefore also mapped to help define the opportunity areas (see **Appendix F**).

- **The National Landscape Description Units** provide a broad characterisation of land type within each character area. The characterisation provides an insight on the broad land cover, and types of semi-natural habitats occurring within a defined area;
- **Agricultural Land Classification** is used as a means for identifying the relative (agricultural) quality of land. Generally, land considered poorer for agriculture tends to support a broader range of semi-natural habitats;
- **The Environment Agency's Flood Zone maps** indicate land which may be better suited to the creation of wetland habitats within the existing or historic extent of the floodplain. Water Framework Directive (WFD) Water Quality Classification data aids the targeting of wetland habitat opportunities as a means of improving the management of water resources and quality;
- **Superficial deposit data** relating to sands and gravels to determine the actual and potential extent of acid grassland and heathland habitats, and chalk bedrock and limestone data to determine the actual and potential extent of calcareous grassland habitats; and,
- **Strategic Housing Land Availability Assessment (SHLAA)** data, to help identify the current extent of semi-natural habitats that may be affected by future planned growth, and what opportunities there may be to protect and/or extend these habitats ahead of any potential planned development.

2.4 Stakeholder Workshops

2.4.1 In recognition of the inherent limitations that mapping biodiversity opportunities using GIS-based methods and available data can achieve, workshops were held with stakeholders to help validate the provisional opportunity maps and to enable more fine grained and local knowledge to be captured. Four workshops were held as follows:

- **Biodiversity & Ecology Stakeholder Workshop** - this workshop focused on identifying opportunities that stakeholders considered may be available for securing and extending the existing ecological network of semi-natural habitats across Central Lincolnshire as a whole;
- **Land Use & Planning Stakeholder Workshop** - this workshop focused on understanding how Biodiversity Opportunity Mapping can contribute to the planning and implementation of commitments to biodiversity protection and enhancement within the Minerals and

Waste Local Plan (in preparation[11]) and the broader planning framework for Central Lincolnshire as whole and for the Lincoln PUA/SUEs/WVCP;

- **Water Environment Stakeholder Workshop** - this workshop focused on understanding how Biodiversity Opportunity Mapping can contribute towards identifying and delivering Water Framework Directive targets for improving water quality and resources across Central Lincolnshire as a whole; and,
- **Witham Valley Country Park Stakeholder Workshop** - this workshop focused on identifying opportunities that stakeholders considered may be available for securing and extending the existing ecological network of semi-natural habitats within the Witham Valley Country Park in support of the Park's vision and objectives.

2.4.2 Participants in the workshops were asked to provide views on the provisional opportunity maps. The comments received were categorised as: information, clarifications and potential opportunities. Information and clarifications have been recorded as a separate report, which can be used to amend or refine the baseline datasets held by the relevant organisations.

2.4.3 In total around 250 items of information and clarifications and around 195 opportunities were recorded during the 4 workshops. These numbers include some repetition as the same issues or opportunities were identified more than once. In general terms, however, the main issues that arose from the workshops related to:

- Data anomalies;
- Habitat quality and management;
- Landuse;
- River engineering and management;
- Species information; and,
- Access and recreation.

2.4.4 Similarly, there was repetition in the identification of opportunities, particularly around the following areas:

- Lincoln PUA;
- Lincoln SUEs;
- South west of Lincoln, towards Newark;
- The Upper Witham and Brant; and,
- The Lower Witham.

2.4.5 The opportunities have been incorporated into the Biodiversity Opportunity Area (BOA) descriptions (**Section 3.4** for Central Lincolnshire and **Sections 4.1 – 4.4** for the Lincoln PUA/SUEs/WVCP) and the information gathered through the Workshops is summarised in **Appendices B – E**.

[11] http://www.lincolnshire.gov.uk/residents/environment-and-planning/planning-and-development/strategic-planning/minerals-and-waste-local-plan/66543.article

2.5 Refinement of Opportunity Mapping

2.5.1 The testing of the provisional GIS mapping at the Stakeholder Workshops provided a range of additional information to inform the refinement of the provisional opportunity mapping.

Opportunities for Biodiversity Mapping

2.5.2 The opportunities identified during the workshops were analysed in the context of the methodology in contributing towards a '*coherent and resilient*' ecological network for Central Lincolnshire. The analysis used the following criteria to ensure each opportunity is:

- Consistent with the categorisation of existing habitats (*core areas of nature conservation value*);
- Appropriately located within the context of supporting data (*core areas of nature conservation value*);
- Prioritised in relation to their location in the broad opportunity areas (*buffer zones*);
- Consistent with the aims of protecting, enhancing, extending existing, and/or creating new, habitats (*restoration areas*);
- Consistent with, and/or contribute towards, the protection and/or enhancement of semi-natural greenspace associated with existing centres of population and projected growth around Lincoln (*sustainable use areas*); and,
- Prioritised on the basis that the creation of buffer zones to protect existing *stepping stones* is preferable to the creation of new stepping stones and that the creation of new *corridors* should be prioritised within existing buffer zones.

Information/Clarifications

2.5.3 In addition to a range of opportunities, the workshops also provided additional information and clarifications in relation to the mapped habitat data. The value of this information in taking forward and developing the Biodiversity Opportunity Maps for Central Lincolnshire is discussed in further detail in **Section 5.0**.

2.6 Reporting

2.6.1 The findings of the BOM Study are drawn together in this report, which is structured as follows:

- A Strategic Biodiversity Opportunity Map for Central Lincolnshire (**Section 3.0**), which sets out:
  - A description of the Central Lincolnshire Biodiversity Area Opportunity Maps;
  - A description of each of the 13 identified Biodiversity Opportunity Areas; and,
  - A schedule of Proposed Strategic Projects for each of the Biodiversity Opportunity Areas.

- Detailed Biodiversity Opportunity Mapping for the Lincoln PUA/SUEs/WVCP (**Section 4.0**), which sets out:
  - A description of the Biodiversity Opportunity Mapping for the Lincoln PUA/SUEs/WVCP;

- Opportunities for the enhancement of the ecological network, on a habitat by habitat basis; and,
- A schedule of Biodiversity Opportunities based on geographical location.

- Conclusions and Recommendations (**Section 5.0**), which sets out:
  - Conclusions drawn from the Study process, including constraints and limitations that were identified during the Study process; and,
  - A series of recommendations for the future development of the BOM Study, how its findings may be applied and how the information derived from the Study process may be translated into action on the ground.

3.0 PART 1: BIODIVERSITY OPPORTUNITY MAPPING FOR CENTRAL LINCOLNSHIRE

3.1 Biodiversity Opportunity Area Maps

3.1.1 The Biodiversity Opportunity Mapping for Central Lincolnshire provides a landscape-led approach for conserving biodiversity and restoring the ecological network through the identification of Biodiversity Opportunity Areas.

3.1.2 The purpose of the Biodiversity Opportunity Maps is to provide a spatially explicit basis for targeting resources to facilitate the effective delivery of Lincolnshire's Biodiversity Action Plan (BAP) targets, within the context of the growth agenda, legislative drivers such as the Water Framework Directive (WFD), managing land use change and available funding (including developer contributions, agri-environment schemes and their successors).

3.1.3 Biodiversity Opportunity Mapping seeks to build on the work already achieved through the traditional, site specific, approach to nature conservation, by identifying the potential to rebuild the network of ecologically valuable habitats at a landscape scale. This approach is endorsed through the Lawton Review (Making Space for Nature) and the government's white paper on the Natural Environment (The Natural Choice), as discussed in **Section 2.0**.

3.1.4 A robust, landscape-scale, ecological network is critical not only for conserving Central Lincolnshire's existing natural heritage, but also in ensuring that biodiversity can adapt to the influences of climate change through the provision of high quality habitat.

3.1.5 In addition to enabling the achievement of BAP targets, Biodiversity Opportunity Mapping also provides the basis for restoring the semi-natural habitats and processes that underpin the ecosystem services upon which human health and wellbeing rely. Part of this Study focuses on how Biodiversity Opportunity Mapping may influence and contribute towards delivering a suite of interventions that will improve the chemical and ecological quality of Central Lincolnshire's watercourses and wetlands. This is a key component of a suite of initiatives intended to meet obligations for improving water quality and water resources set out in the WFD.

3.1.6 Biodiversity Opportunity Mapping also plays a role in identifying an appropriate suite of options for the restoration of old minerals workings and/or waste sites.

3.1.7 In combination, therefore, BOAs seek to expand, link and buffer existing habitats and sites to restore and improve ecological functionality through defragmentation and provide a more robust approach to the stewardship of our natural environment.

3.1.8 A total of 13 strategic BOAs have been identified for Central Lincolnshire, encompassing approximately 43% of the land area. They were selected through the methodological process outlined in Section 2.0 and described in detail in Appendix A. The boundaries of these BOAs are indicative and are intended to provide a broad, strategic, indication of where the current (limited) ecological resource could most easily be strengthened and extended across Central Lincolnshire. In particular the BOAs enable attention to be focused on where investment in biodiversity enhancements would deliver greatest benefits. It is expected that these areas may be refined as further work/new data becomes available.

3.1.9 The BOAs are not designations, and should not be seen as constraints on other land uses. The BOAs are intended to be used as a tool for informing decision-making in relation to land-use planning and management.

3.1.10 Land outside BOAs within Central Lincolnshire may also have biodiversity value, and opportunities for enhancing biodiversity within these areas will also exist. The BOAs are only intended as a guide to focusing conservation effort and do not preclude any projects or initiatives for enhancing biodiversity outside of these areas.

3.1.11 The BOA Map for Central Lincolnshire is shown on **Figure 3.5**. A profile has been prepared for each BOA to indicate the opportunities for improving the ecological connectivity of existing 'core sites' (see para 2.2.6) to reduce habitat fragmentation and reverse species decline within the area.

3.1.12 The profiles include the following information:

- BOA Ref No/Name
- Key Environmental Characteristics
- General Description
- List of BAP Habitats
- List of Designated Sites
- Ecological Network Enhancement Opportunities

3.2 Key Habitat Opportunity Mapping

3.2.1 The BOAs represent the full suite of opportunities identified through the Study process and comprises the mapping of individual habitat types, described below and illustrated on **Figures**

The BOAs represent the priority areas of opportunity within Central Lincolnshire for the restoration and creation of Biodiversity Action Plan (BAP) and other habitats. They are intended to be a spatial representation of the Lincolnshire BAPs habitat targets and are areas of opportunity, not constraint. The BOAs shown in the map do not necessarily include all BAP habitat in Central Lincolnshire, nor do they include all the areas where habitat could exist.

This Figure includes relevant data available at the time of the Study, and may not be exhaustive. The digital datasets have been used in good faith without any modification or enhancement, and their accuracy cannot be guaranteed.

KEY

- Central Lincolnshire boundary

Habitats:

- Heathland
- Acid grassland
- Calcareous grassland
- Neutral grassland
- Wetlands
- Woodland

Biodiversity Opportunity Areas (see Section 3.4):

- (A) Gainsborough Woodlands
- (B) Lincolnshire Limewoods
- (C) River Ancholme
- (D) Trent Vale
- (E) River Till and Fossdyke Navigation
- (F) River Brant and Upper Witham
- (G) Lower Witham Peatlands and Barlings Eau
- (H) River Slea
- (I) Heathland/Acid Grassland North of Gainsborough
- (J) Heathland/Acid Grassland around Market Rasen
- (K) Mosaic South-West of Lincoln
- (L) Calcareous Grassland South of Lincoln
- (M) Lincolnshire Wolds Calcareous Grassland

0 5 10 km

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BIODIVERSITY OPPORTUNITY MAPPING STUDY FOR CENTRAL LINCOLNSHIRE

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FIGURE 3.5
Biodiversity Opportunity Map for Central Lincolnshire

OCTOBER 2013

3.1 – **3.4**. Individual habitat mapping enables each habitat type to be fully represented and for habitat specific opportunities to be clearly identified without the danger of some individual sites being lost in the 'noise' of strategic BOAs (**Figure 3.5**).

Woodland Habitat Opportunity Mapping

3.2.2 The Woodland Habitat Opportunity Mapping for Central Lincolnshire is shown on **Figure 3.1**.

3.2.3 The existing habitats comprise:

- Ancient woodland;
- Planted Ancient Woodland Sites (PAWS);
- Other broadleaved woodland; and,
- Plantation woodlands.

3.2.4 Targeted opportunity areas comprise:

- A buffer zone within 500m of ancient woodlands;
- Minerals and waste sites; and,
- Areas of greenspace.

3.2.5 The Woodland BOAs encompass the greatest aggregations of existing broadleaved woodland that are intersected by the 500m buffers. They comprise 3 broad areas within Central Lincolnshire; 2 of which have been identified as priorities for focusing on woodland protection, enhancement and creation, whilst the third comprises a mosaic of opportunities (discussed in further detail in **Section 4**).

Wetland Habitat Opportunity Mapping

3.2.6 The Wetland Habitat Opportunity Mapping for Central Lincolnshire is shown on **Figure 3.2**.

3.2.7 The existing habitats comprise:

- Rivers and watercourses, expressed in terms of their current WFD ecological status;
- Wetlands, comprising of: open waterbodies, fens, reedbeds, wet woodland; and,
- Neutral grassland (comprising almost entirely of grazing marsh and small areas of lowland meadows[12]).

3.2.8 Targeted opportunity areas comprise:

[12] All neutral grasslands have been included as a component of the Wetland Opportunity Mapping since the overwhelming majority of currently recorded neutral grasslands are floodplain grazing marsh; a habitat intimately linked with the water table. The current extent of digitally mapped dry neutral grassland is too small for it to warrant its own habitat opportunity map, or for it to be included in, for example, the calcareous grassland habitat mapping. As more dry neutral grasslands are digitally mapped, the BOM Study can be developed to specifically address opportunities for the protection, creation and enhancement of dry neutral grasslands.

This Figure includes relevant data available at the time of the Study, and may not be exhaustive. The digital datasets have been used in good faith without any modification or enhancement, and their accuracy cannot be guaranteed.

KEY

Central Lincolnshire boundary

Habitats:

Coniferous plantation woodland

Woodland (other)

Ancient woodland

Opportunity Areas:

Woodland Biodiversity Opportunity Area

Mosaic Biodiversity Opportunity Area - heathland, acid grassland, wetland and woodland

Targeted opportunity areas for the creation and restoration of:
- broadleaved woodland habitat
- ancient woodland buffer zones
- linear woodland corridors
- woodland stepping stones

0 5 10 km

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FIGURE 3.1
Woodland Habitat Opportunity Mapping

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This Figure includes relevant data available at the time of the Study, and may not be exhaustive. The digital datasets have been used in good faith without any modification or enhancement, and their accuracy cannot be guaranteed.

KEY

Central Lincolnshire boundary

Habitats:

Wetlands

Neutral grassland

Ecological Status of Rivers:

Good

Moderate

Poor

Bad

MOD Airbase (constraint)

Opportunity Areas:

Wetland Biodiversity Opportunity Area

Mosaic Biodiversity Opportunity Area - heathland, acid grassland, wetland and woodland

Soil most suitable for wetland habitat creation

Targeted opportunity areas for the creation and restoration of:
- wetland habitat
- wetland buffer zones
- linear wetland corridors
- wetland stepping stones

0 5 10 km

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FIGURE 3.2
Wetland Habitat Opportunity Mapping

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- 200m wetland buffer zones;
- Permitted and submitted minerals and waste sites;
- Areas of 'greenspace';
- The Lincoln Eastern Bypass; and,
- The Washlands.

3.2.9 Soils most suitable for wetland habitat creation are mapped to provide the broad context for defining the Wetland BOAs. The Wetland BOAs comprise areas identified through the Study and also include work previously undertaken by the Lincolnshire Wildlife Trust. The boundaries were drawn to encompass:

- Sites identified as having potential for wetland creation or restoration (listed above as targeted opportunity areas);
- The largest extents of existing wetland sites;
- Watercourses which are currently assessed as having 'moderate', 'poor' or 'bad' ecological status; and,
- Areas identified as important peatlands and sites important to birds and wetland plants.

Heathland & Acid Grassland Habitat Opportunity Mapping

3.2.10 The Heathland & Acid Grassland Habitat Opportunity Mapping for Central Lincolnshire is shown on **Figure 3.3**.

3.2.11 The existing habitats comprise:

- Lowland heathland; and,
- Lowland dry acid grassland.

3.2.12 Targeted opportunity areas comprise:

- 200m heathland / acid grassland buffers;
- Plantation woodlands on superficial acidic soils deposits; and,
- Permitted and submitted (sands and gravels) minerals and waste sites.

3.2.13 Soils most suitable for heathland / acid grassland habitat creation are mapped to provide the broad context for defining the Heathland / Acid Grassland BOAs. The Heathland / Acid Grassland BOA boundaries were drawn to encompass:

- Soils identified as having potential for heathland / acid grassland creation or restoration;
- All existing sites of heathland / acid grassland;
- Coniferous (non- ancient) plantation woodland situated within suitable soils deposits; and,
- All targeted opportunity areas for the protection, enhancement, creation and extension of heathland / acid grassland habitat.

This Figure includes relevant data available at the time of the Study, and may not be exhaustive. The digital datasets have been used in good faith without any modification or enhancement, and their accuracy cannot be guaranteed.

KEY

Central Lincolnshire boundary

Habitats:

Sites including heathland

Acid grassland

Opportunity Areas:

Heathland/Acid Grassland Biodiversity Opportunity Area

Mosaic Biodiversity Opportunity Area - heathland, acid grassland, wetland and woodland

Soil most likely suitable for heathland and acid grassland habitat creation

Targeted opportunity areas for the creation and restoration of:
- heathland and acid grassland habitat
- heathland and acid grassland buffer zones
- linear heathland and acid grassland corridors
- heathland and acid grassland stepping stones

0 5 10 km

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FIGURE 3.3
Heathland & Acid Grassland Habitat Opportunity Mapping

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Calcareous Grassland Habitat Opportunity Mapping

3.2.14 The Calcareous Grassland Habitat Opportunity Mapping for Central Lincolnshire is shown on **Figure 3.4**.

3.2.15 The existing habitats comprise:

- Calcareous grassland.

3.2.16 Targeted opportunity areas comprise:

- 200m calcareous grassland buffers;
- Greenspace overlying calcareous bedrock;
- The Lincoln Eastern Bypass; and,
- Permitted and submitted (limestone) minerals and waste sites.

3.2.17 Soils most suitable for calcareous grassland habitat creation are mapped to provide the broad context for defining the Calcareous Grassland BOAs. The Calcareous Grassland BOA boundaries were drawn to encompass:

- Soils identified as having potential for calcareous grassland creation or restoration;
- All existing sites of calcareous grassland; and,
- All targeted opportunity areas for the protection, enhancement, creation and extension of calcareous grassland habitat.

3.3 Mapping Habitat Sensitivity

3.3.1 The application of both GIS-based mapping and expert knowledge gained through the workshops may identify opportunities for the creation of more than one type of habitat for a given area of land. In an attempt, therefore, to try and rank which (habitat creation) opportunities should be considered in preference to another, the Study provides an initial ranking based on the relative resilience and sensitivities of each of the broad habitat types. The ranking has been undertaken using the site quality criteria described in *A Nature Conservation Review*[13] and within the habitat descriptions of Lincolnshire's BAP. The ranking of habitat sensitivity has therefore been developed using criteria that includes:

- *Size*: a measure of viability and therefore a particular site's ability to support the range of species typically found within that habitat type;
- *Diversity*: a measure of differences in climate, topography, geology, derived soils and land-use and management;
- *Naturalness*: a measure of modification in relation to human influence;
- *Rarity*: including the rarity of the species that such habitats support; and,

[13] Ratcliffe, D. (1977). *A Nature Conservation Review: The selection of biological sites of national importance to nature conservation in Britain*. CUP.

This Figure includes relevant data available at the time of the Study, and may not be exhaustive. The digital datasets have been used in good faith without any modification or enhancement, and their accuracy cannot be guaranteed.

KEY

Central Lincolnshire boundary

Habitats:

Calcareous grassland

Opportunity Areas:

Calcareous Grassland Biodiversity Opportunity Area

Soil most suitable for calcareous grassland habitat creation

Targeted opportunities for the creation and restoration of:
- calcareous grassland habitat
- calcareous grassland buffer zones
- linear calcareous grassland corridors
- calcareous grassland stepping stones

0 5 10 km

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FIGURE 3.4
Calcareous Grassland Habitat Opportunity Mapping

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- *Fragility*: a measure of habitat sensitivity to land management practices either on the habitat itself, or in close approximation to it;

3.3.2 It should be stressed that this is something of a coarse filter, intended to provide an initial ranking based on broad habitat types. The ranking is a means of managing the process of identifying and mapping opportunities, which may require refinement and site specific judgements on a case by case basis, once opportunities are brought forward as potential projects. As a general rule, however, the process of ranking opportunities on the basis of habitat sensitivity was undertaken on the following basis:

- **Highest Sensitivity – heathland, neutral (lowland meadow), acid and calcareous grasslands**: these are the rarest habitat types to be found in Central Lincolnshire. The existing resource tends to be highly fragmented, restricted in its distribution due to their requirement for specific land type conditions and can, arguably, be highly vulnerable to external environmental influences such as nutrient enrichment and spray drift. Similarly, changes in agricultural practices over the last 1-200 yrs have had a direct effect on both the extent and the quality of these open habitat types. Moreover, minimum patch sizes of around 30ha. is considered appropriate for new heathland creation. These habitat types are therefore considered to be a priority for protection, restoration and extension;

- **Medium Sensitivity – wetlands**: although it is recognised that highly specialised wetland habitats (e.g. acid bog habitat) require very specific conditions, the majority of wetland habitat types in Central Lincolnshire, including wet neutral grassland (floodplain grazing marsh) can generally be created in a wide variety of locations, dependent on hydrological requirements. They are all, however, susceptible to degradation through changes in water availability, point and diffuse pollution, and adjacent land management; and,

- **Lower Sensitivity – woodlands**: Whilst the quality of woodlands can be influenced by external factors in the same way as the broad habitats discussed above, these influences may be more tempered and absorbed. With respect to woodland creation, therefore, the selection of appropriate species for a given set of soil and hydrological conditions is the primary consideration. Moreover, woodland creation may be better achieved through natural regeneration, rather than new planting, as the species mix will be self-selecting for a given set of conditions and may also help to protect against the spread of pests and diseases currently affecting a range of tree species (either by reducing the chance of introducing diseased specimens into areas that are currently unaffected or through natural resilience in the existing seedbank).

3.3.3 It is acknowledged that there are likely to be anomalies in this process; for example, there may be woodland sites that, for a variety of reasons, are more vulnerable to change, than certain grassland sites. These will need to be identified once the feasibility of delivering a biodiversity opportunity is being tested.

3.4 Biodiversity Opportunity Area Descriptions

BOA A – GAINSBOROUGH WOODLANDS

All of the 3,196ha of the Gainsborough Woodlands BOA lies within Central Lincolnshire. The opportunities explored within this BOA principally relate to the protection of, and increases in extent to, the woodlands surrounding Gainsborough.

Key Environmental Characteristics

- Heavy, poorly draining land
- Associated with base-rich loamy and clayey soils developed on soft clay and chalky till

General Description of Habitats

The dominant semi-natural habitat type within this 3,196ha opportunity area is woodland. This includes several Planted Ancient Woodland Sites (PAWS) and Ancient Semi-Natural Woodland sites (ASNW) which are of BAP quality. The next most common habitat type present is 'greenspace' managed as parks and gardens, including a large golf course to the north of the BOA. There are small areas of wetlands and neutral grasslands, mainly to the south of Gainsborough and where this BOA merges with BOA D.

BAP Habitats

- Lowland mixed deciduous woodland
- Lowland meadows
- Floodplain grazing marsh
- Wet woodland
- Traditional orchards

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- Creation of woodland corridors to link ancient woodland sites;
- Creation of woodland buffer zones around ancient woodland sites;
- Restoration of ancient woodland sites through selective felling of conifer plantations (restoration of ancient woodland on Plantation Ancient Woodland Sites (PAWS));
- Restoration and management of hedgerows by gapping up, laying, planting of new hedgerow trees and coppicing; and,
- Restoration of woodland habitats within 'greenspace' through sympathetic management.

BOA B – WOODLANDS EAST OF LINCOLN

Approximately 9,769ha (55%) of the Woodlands East of Lincoln BOA lies within Central Lincolnshire, whilst 7,992ha (45%), extends beyond the Central Lincolnshire boundary to the east. The opportunities explored within this BOA principally relate to increasing the connectivity between the woodlands that comprise the Lincolnshire Limewoods as a whole.

Key Environmental Characteristics

- Heavy, poorly draining land
- Associated with base-rich loamy and clayey soils developed on soft clay and chalky till
- Also includes variable small amounts of sandy drift and peat covered glacial till close to the River Witham

General Description of Habitats

The dominant semi-natural habitat type within this 17,761ha opportunity area is woodland. The woodlands include several Planted Ancient Woodland Sites (PAWS) and Ancient Semi-Natural Woodland sites (ASNW) which are of BAP quality. Neutral grassland, in particular linear lowland meadow sites are also common throughout the BOA. A small number of wetland habitats are found along the River Witham and Barlings Eau where this BOA merges with BOA G. Other habitats present include 'greenspace' managed as parks and gardens and one heathland site to the south of the BOA around Woodhall Spa.

BAP Habitats

- Lowland mixed deciduous woodland
- Lowland meadows
- Floodplain grazing marsh
- Wet woodland
- Traditional orchards
- Lowland fens
- Lowland heathland
- Purple moor grass and rush pastures

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- Creation of hedgerows (linear corridors) to connect the individual woodlands comprising the Bardney Limewoods SSSI with one another, as well as other (non-SSSI) woodland;
- Creation of field corner woodland copses to create woodland stepping stones;
- Creation of woodland buffers around each woodland unit of Bardney Limewoods and Wickenby Woods SSSIs;
- Creation of hedgerows, tree belts (linear corridors) and woodland blocks to connect the Bardney Limewoods SSSI woodlands with Wickenby Wood SSSI;
- Creation of hedgerows, tree belts (linear corridors) and woodland blocks to connect the Bardney Limewoods SSSI woodlands with the ancient woodlands to the south around Potterhanworth; and,
- Creation of hedgerows, tree belts (linear corridors) and woodland blocks to connect the ancient woodlands to the north and east of Woodhall Spa (lying outside the Central Lincolnshire boundary) with the Bardney Limewoods SSSI woodlands.

As identified from the Lincolnshire Limewoods Project[14]:

- Restoration of ancient woodland sites through selective felling of conifer plantations (restoration of ancient woodland on Plantation Ancient Woodland Sites (PAWS));
- Widening of narrow woodland rides;
- Retention of standing and lying dead wood in situ;
- Creation of woodland belts linking adjacent woods ;
- Creation of hedgerows with minimum 60% blackthorn adjacent to and linking woods with brown hairstreak colonies;
- Management of hedgerows by rotational flailing/laying/coppicing on a 2-5 year cycle with no more than 30% cut in any year in core brown hairstreak areas;
- Retention of existing mature trees;
- Planting of new oak, ash[15], elm, wild service, small-leaved lime, crab apple, wild cherry and holly trees within existing hedgerows;
- Creation of field corner woodlands (copses) and some planting of new trees around ponds, where this is appropriate; and,
- Creation of new woodland within 250m-500m of existing broad-leaved woodland.

For more information on the Lincolnshire Limewoods Project, including details of habitat creation and management projects visit http://microsites.lincolnshire.gov.uk/limewoods/about/

[14] ESL (Ecological Services) Ltd (2008) *Wildlife Corridors in the Lincolnshire Limewoods: Habitat Creation Opportunities and Constraints Map*.

[15] At the time of writing this report, it is not currently possible to plant ash due to the spread of *Chalara* (ash dieback disease) which has resulted in the imposition of a Plant Health Order prohibiting all imports of ash seeds, plants and trees, and all internal movement of ash seeds, plants and trees).

BOA C – RIVER ANCHOLME

The River Ancholme BOA within Central Lincolnshire is measured at some 374ha, however, this represents only a small fraction of the total catchment of the River Ancholme, which extends to the north before discharging to the Humber estuary. The opportunities explored within this BOA principally relate to upstream catchment management.

Key Environmental Characteristics

- Low-lying land
- Associated with fluvial (riverine/marine) drift
- Characteristic associated habitats: wetlands more or less permanently waterlogged, including swamp and fen
- Drained areas usually characterised by open ditches/drains with relic wetland vegetation such as reeds and lines of willow

General Description of Habitats

The dominant semi-natural habitat types within this 374ha opportunity area (within Central Lincolnshire) are small isolated woodland blocks scattered throughout the BOA and wetlands to the west of North Kelsey, within an otherwise intensively farmed landscape.

Outside the Central Lincolnshire boundary, to the north, fens, heathland and acid grassland habitats are found on Wrawby Moor, where this BOA merges with the northern extent of BOA J.

BAP Habitats

- Floodplain grazing marsh
- Lowland fens
- Lowland heathland
- Lowland dry acid grassland
- Purple moor grass and rush pastures
- Traditional orchards

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- Creation of a mosaic of wet grassland, reedbeds and wet woodland in the valley;
- Restoration of 'naturalised' channel characteristics through the removal of in-channel obstructions; and,
- Creation of buffers around wetland habitats, including the banks of the River Ancholme, using targeted environmental land management schemes, to ameliorate the effects of intensive agriculture.

BOA D – TRENT VALE

Of the 8,966ha comprising this BOA, only around 1,958ha (22%) of the Trent Vale BOA occurs within Central Lincolnshire, whilst the remaining 7,008ha (78%) lies outside, forming its western boundary. Opportunities explored within this BOA principally relate to strengthening connectivity between wetland habitats within western Central Lincolnshire and the Trent Vale as a whole.

Key Environmental Characteristics

- Low-lying land
- Associated with fluvial (riverine/marine) drift
- Some reddish/brown free-draining mineral soils developed on permeable rocks or drift at elevations below 180m
- Characteristic associated habitats: damp grassland and marshland that are seasonally or perennially wet
- Drained and intensively cultivated areas usually characterised by open ditches/drains with relic wetland vegetation such as reeds and lines of willow

General Description of Habitats

The dominant semi-natural habitat types within this 8,966ha opportunity area are wetlands and neutral grassland. Notable areas of neutral grassland include the Newton-on-Trent grasslands which are designated as an SNCI and the lowland meadows found scattered around the Gainsborough area.

Fens and floodplain grazing marsh and lowland meadow habitats are found scattered throughout the BOA, however, much of these habitat types occur outside the Central Lincolnshire boundary, particularly around Carlton-on-Trent and Besthorpe and reedbeds are present in the sand and gravel pits at Collingham. The next most common habitat type is woodland, found scattered throughout the BOA (much of it again occurring outside the Central Lincolnshire boundary), including some of BAP quality. Small areas of acid grassland are found to the east of the BOA, including where it merges with BOA K.

BAP Habitats

- Floodplain grazing marsh
- Lowland fens
- Lowland meadows
- Lowland mixed deciduous woodland
- Traditional orchards
- Reedbeds
- Lowland dry acid grassland
- Wood pasture and parkland

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- The potential creation of wet grassland in connection with the Lea Marsh SSSI if the currently submitted sand and gravel extraction sites around Lea receive approval;
- Creation of reedbeds at Dunham Lagoons through floodbank manipulation; and,

- Creation of buffers around wetland habitats, including the banks of the River Trent and its tributaries, using targeted environmental land management schemes, to ameliorate the effects of intensive agriculture.

  Outside the Central Lincolnshire boundary, opportunities improving the ecological connectivity include:

- Creation of wetland habitats as part of restoration plan for Rampton Quarry;
- Creation of wetland and grassland habitats as part of Sturton le Steeple Quarry restoration;
- Creation of new wet grassland/grazing marsh habitats to extend the existing resource at Beckingham Marshes; and,
- Creation of reedbed complexes around Sutton on Trent.

BOA E – RIVER TILL AND FOSSDYKE NAVIGATION

All 4,463ha of the River Till and Fossdyke Navigation falls within Central Lincolnshire. The opportunities explored within this BOA principally relate to water quality and flow regime enhancements, in line with WFD requirements to improve the ecological quality of the catchment. Additionally, opportunities to improve flood risk management through habitat enhancements are also considered.

Key Environmental Characteristics

- Reddish/brown, free-draining mineral soils developed on permeable rocks or drift at elevations below 180m
- Some areas have poor draining base-rich loamy and clayey soils developed on soft clay and chalky till
- Characteristic associated habitats: wet grassland and marshland which are seasonally or periodically inundated by water
- Seasonal waterlogging is the main constraint to agricultural production – however in most areas these soils will be intensively cultivated and used for cereal growing

General Description of Habitats

This 4,463ha opportunity area contains a mosaic of wetland, neutral grassland, woodland, acid grassland and heathland habitats, particularly to the south where it merges with BOA K. Reedbeds are present in the Swanpool area and standing water bodies include the Swanholme Lakes, Hartsholme Lake and Ballast Holes which are found occurring with wet woodland. Also present in the Lincoln area are large areas of 'greenspace' including parks and gardens, arable, scrub and tall ruderal habitats. Woodland is the main habitat type found north-west of Lincoln and along the length of the River Till, including a mixture of ancient and plantation woodland, some of which is BAP quality.

BAP Habitats

- Lowland mixed deciduous woodland
- Eutrophic standing water
- Wet woodland
- Traditional orchards
- Lowland dry acid grassland
- Lowland heathland
- Lowland meadows
- Reedbeds
- Floodplain grazing marsh
- Wood pasture and parkland
- Lowland fens

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- Restoration of 'naturalised' river channels where this is considered feasible and/or appropriate, through the removal of in-channel obstructions and the introduction of features that enhance flow heterogeneity;
- Partial restoration of pasture within the Till washland;

- Creation of a mosaic of wet woodland, reedbed and wet grassland in the upper reaches of the River Till;
- Restoration of water quality within the River Till and Fossdyke navigation using phosphate stripping at wastewater treatment works, where this may be applicable;
- Creation of new reedbeds to extend the existing resource at Swanpool and to aid flood risk management; and,
- Creation of buffers around wetland habitats, including the banks of the River Till and its tributaries, using targeted environmental land management schemes, to ameliorate the effects of intensive agriculture.

BOA F – RIVER BRANT AND UPPER WITHAM

Of the 5,478ha comprising the River Brant and Upper Witham BOA, approximately 78% (4,277ha) lies within Central Lincolnshire, with the remaining 22% (1201ha) lies to the south. The opportunities explored within this BOA principally relate to water quality and flow regime enhancements, in line with WFD requirements to improve the ecological quality of the catchment. Additionally, opportunities to improve flood risk management through habitat enhancements are also considered.

Key Environmental Characteristics

- Reddish/brown, free-draining mineral soils developed on permeable rocks or drift at elevations below 180m
- Some areas have poor draining base-rich loamy and clayey soils developed on soft clay and chalky till
- Characteristic associated habitats: wet grassland and marshland habitats which are seasonally or periodically inundated by water
- Seasonal waterlogging is the main constraint to agricultural production – however in most areas these soils will be intensively cultivated and used for cereal growing

General Description of Habitats

This 5,478ha opportunity area contains a mosaic of wetland, neutral grassland and woodland habitats. Woodland is found scattered throughout the BOA, including some likely to be of BAP quality in Boultham Park. Neutral grasslands found to the north of the BOA are mostly non-BAP quality with a few scattered lowland meadow sites. Also present to the north of the BOA is a large amount of 'greenspace' including allotments, amenity grassland, arable and improved grassland habitats.

A limited number of floodplain grazing marsh sites can be found along the River Witham, in particular east of Balderton (outside the Central Lincolnshire boundary).

BAP Habitats

- Lowland mixed deciduous woodland
- Lowland meadows
- Floodplain grazing marsh
- Traditional orchards
- Wet woodland
- Wood pasture and parkland

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- Restoration of floodplain grazing marsh near Haddington;
- Creation of wet woodland at suitable locations along both the River Brant and Upper Witham;
- Creation of riparian buffer strips of wet grassland or wet woodland along the channel of the River Brant;
- Restoration of 'naturalised' channel characteristics of the River Brant through removal of in-channel obstructions;
- Restoration of the River Brant through de-silting;

- Creation of in-channel features such as riffle-pool sequences and in-channel deflectors in the River Brant;
- Restoration of the River Brant using phosphate stripping at wastewater treatment works;
- Creation of wet woodland as a mechanism for controlling silt deposition into watercourses; and,
- Creation of new upstream washlands, as an extension of the existing Brant washland.

BOA G – LOWER WITHAM PEATLANDS AND BARLINGS EAU

Virtually all of the 7,199ha comprising the Lower Witham Peatlands and Barlings Eau BOA occurs within Central Lincolnshire. The opportunities explored within this BOA principally relate to the conservation of peatland soils and water quality and flow regime enhancements, in line with WFD requirements to improve the ecological quality of the catchment. Additionally, opportunities to improve flood risk management through habitat enhancements are also considered.

Key Environmental Characteristics

- Low-lying land
- Associated with fluvial (riverine/marine) drift
- To the north around Snelland the land is heavy and associated with base-rich loamy and clayey soils developed on soft clay and chalky till
- Characteristic associated habitats: permanently or seasonally waterlogged including swamp, fen, wet grassland and marshland
- Drained and intensively cultivated areas usually characterised by open ditches/drains with relic wetland vegetation such as reeds and lines of willow

General Description of Habitats

The dominant semi-natural habitat type within this 7,199ha opportunity area is wetland. Areas of floodplain grazing marsh are concentrated east of Lincoln along the River Witham and Barlings Eau, and along the embankments of the Metheringham Delph. Swamp and standing water bodies are found north and west of Canwick. Also present to the west of the BOA around Lincoln is a concentration of acid and neutral grassland habitats, mostly of non-BAP quality. A small amount of woodland is found scattered throughout the BOA, including some semi-natural ancient and BAP quality sites where this BOA merges with BOA B. Other notable habitats present include brownfield sites, cemeteries and parks and gardens broadly categorised as 'greenspace'.

BAP Habitats

- Floodplain grazing marsh
- Lowland mixed deciduous woodland
- Lowland meadows
- Lowland dry acid grassland
- Wet woodland
- Traditional orchards

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- Restoration of relic peatlands to provide landscape-scale mosaic of wetland habitats to connect with the Fens Waterway Link;
- Creation of a new washland between Cherry Willingham and Washingborough;
- Creation of reedbeds around Potterhanworth Booths;
- Creation of wet woodland (alder carr) in the upper reaches of the Barlings Eau to extend the existing resource;
- Restoration of 'naturalised' river channels along the River Witham and Barlings Eau through removal of in-channel obstructions;

- Restoration of the floodplain adjacent to Upper Langwith Beck;
- Restoration of floodplain adjacent to the Branston Delph;
- Creation of buffers around wetland habitats using targeted environmental land management schemes, to ameliorate the effects of intensive agriculture;
- Creation of grassland buffers adjacent to agricultural field drains to ameliorate the effects of agricultural run-off;
- Incorporation of surface water drainage attenuation ponds associated with the Lincoln Eastern Bypass, as a component of a mosaic of small waterbodies (pondscape);
- Restoration of fenland habitats where feasible; and,
- Creation of ponds on agricultural land to restore the pondscape through targeted environmental land management agreements.

BOA H – RIVER SLEA

Of the 3,799ha comprising the River Brant and Upper Witham BOA, approximately 93% (3,541ha) lies within Central Lincolnshire, with the remaining 7% (257ha) extending outside the Central Lincolnshire boundary to both the west and east The opportunities explored within this BOA principally relate to water quality and flow regime enhancements, in line with WFD requirements to improve the ecological quality of the catchment. Additionally, opportunities to improve flood risk management through habitat enhancements are also considered.

Key Environmental Characteristics

- Heavy, often poorly drained and associated with base-rich loamy and clayey soils developed on soft clay and chalky till
- To the east from Anwick to Dogdyke the land is better described as low-lying and associated with fluvial (riverine/marine) drift
- Characteristic associated habitats: permanently or seasonally waterlogged including swamp, fen, wet grassland and marshland
- Drained and intensively cultivated areas usually characterised by open ditches/drains with relic wetland vegetation such as reeds and lines of willow

General Description of Habitats

This 3,799ha opportunity area contains a mosaic of wetland, neutral grassland and woodland habitats. Small pockets of floodplain grazing marsh, fens, reedbeds and open water bodies are found scattered throughout the BOA. The woodland resource also mainly exists as small scattered fragments, and includes some habitats which are likely to be of BAP quality. The neutral grassland resource is concentrated west of Sleaford and is mainly non-BAP quality. Other habitats present include some fragments of calcareous grassland, mainly around the South Rauceby/Wilsford area where this BOA merges with BOA L.

BAP Habitats

- Floodplain grazing marsh
- Lowland calcareous grassland
- Lowland mixed deciduous woodland
- Lowland meadows
- Lowland fens
- Traditional orchards
- Wet woodland
- Purple moor grass and rush pastures
- Reedbeds
- Wood pasture and parkland

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- Creation of riparian wet woodland, where this is deemed feasible by specialist experts in this form of habitat creation;
- Creation of neutral grassland at Mareham Pastures to expand the existing resource, in connection with the Sleaford southern extension;
- Creation of wet meadows along the channel of the River Slea;

- Restoration of 'naturalised' channel characteristics of the River Slea through removal of in-channel obstructions;
- Restoration of the River Slea through de-silting;
- Creation of in-channel features such as riffle-pool sequences and in-channel deflectors in the River Slea;
- Creation of buffers around wetland habitats using targeted environmental land management schemes, to ameliorate the effects of intensive agriculture;
- Potential restoration of submitted minerals sites to the south of Sleaford to an open wetland habitat mosaic, if they receive approval; and,
- Creation of a mosaic of wetland habitats along the length of the River Slea to link the existing wetland habitat resource and restore naturalised floodplain characteristics.

BOA I – HEATHLAND/ACID GRASSLAND NORTH OF GAINSBOROUGH

Of the 19,672ha comprising the Heathland / Acid Grassland north of Gainsborough BOA, approximately 27% (5,400ha) lies within Central Lincolnshire, with the remaining 73% (14,272ha) extending to the north, towards Scunthorpe. The opportunities explored within this BOA principally relate to the protection, conservation and extension of heathland and acid grassland habitats within the vicinity of Gainsborough.

Key Environmental Characteristics

- Light land
- Coversands
- Associated with impoverished (podzolic) soils, reddish/brown free-draining soils and sandy/shallow acid brown soils developed on permeable rocks (mudstones, siltstones and sandstones) or sandy drift at elevations below 300m
- Characteristic associated habitats: dry acidic grassland and dwarf shrub habitats i.e. heathland and moor
- May be intensively cultivated
- Relic heathland habitats distinguished by an abundance of bracken and gorse, or planted with conifers

General Description of Habitats

The dominant semi-natural habitat types within this 19,672ha opportunity area are woodland, heathland and acid grassland. A large proportion of the woodland resource, particularly in the Laughton Forest, is coniferous plantation. Deciduous woodland (some likely to be of BAP quality) is also found scattered throughout the BOA. Concentrations of lowland dry acid grassland, heathland and purple moor grass and rush pastures are found at Greetwell, Scotton and Messingham. Also common in these areas are wetland habitats, particularly fens and reedbeds.

Outside the Central Lincolnshire boundary, other habitats present in the BOA include heathland and purple moor grass and rush pastures are found at Risby Warren, along with calcareous grassland, a small extent of scattered neutral grassland and some 'greenspace' areas managed as wood pasture and parkland.

BAP Habitats

- Lowland dry acid grassland
- Lowland heathland
- Purple moor grass and rush pastures
- Lowland mixed deciduous woodland
- Reedbeds
- Traditional orchards
- Lowland fens
- Lowland calcareous grassland
- Floodplain grazing marsh
- Lowland meadows
- Wood pasture and parkland
- Lowland raised bog

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- Restoration of heathland and/or acid grassland habitats through the selective felling of coniferous woodland plantations (where these are not PAWS plantations);
- Restoration of heathland and acid grassland habitats through a combination of techniques which may include: the maintenance of areas of bare ground, brash laying, seeding and control of self-sown tree seedlings;
- Potential restoration of submitted minerals sites to an open heathland/acid grassland habitat mosaic, if sites receive approval;
- Creation of a mosaic of open heathland, acid grassland and wetland (e.g. acidic bog) habitats to reinforce and extend the coverage of the existing resource; and,
- Creation of open habitat buffers around the existing extent of heathland and acid grassland habitats to protect them from the potential effects of agricultural spray drift.

BOA J – HEATHLAND/ACID GRASSLAND AROUND MARKET RASEN

Of the 16,385ha comprising the Heathland / Acid Grassland around Market Rasen BOA, approximately 78% (12,784ha) lies within Central Lincolnshire, with the remaining 12% (3,601ha) extending to the north and south. The opportunities explored within this BOA principally relate to the protection, conservation and extension of heathland and acid grassland habitats within the vicinity of Gainsborough.

Key Environmental Characteristics

- Light land
- Associated with impoverished (podzolic) soils, reddish/brown free-draining soils and sandy/shallow acid brown soils developed on permeable rocks (mudstones, siltstones and sandstones) or sandy drift at elevations below 300m
- Characteristic associated habitats: dry acidic grassland and dwarf shrub habitats i.e. heathland and moor
- May be intensively cultivated
- Relic heathland habitats distinguished by an abundance of bracken and gorse, or planted with conifers

General Description of Habitats

The dominant semi-natural habitat types within this 16,385ha opportunity area are woodland, heathland and acid grassland. A large proportion of the woodland resource, particularly around Market Rasen, is coniferous plantation. However there are also ancient semi-natural and BAP quality woodland sites concentrated in this area, as well as being scattered throughout the BOA. Concentrations of BAP quality acid grassland and heathland are found around Nettleton, Normanby le Wold and Market Rasen. Other habitats present include neutral and calcareous grassland, with the best quality sites concentrated around Nettleton and Normanby le Wold, and a limited number of wetland sites, parks and gardens.

BAP Habitats

- Lowland heathland
- Lowland dry acid grassland
- Lowland meadows
- Lowland mixed deciduous woodland
- Purple moor grass and rush pastures
- Lowland calcareous grassland
- Lowland fens
- Traditional orchards
- Wood pasture and parkland
- Floodplain grazing marsh

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- Restoration of heathland and/or acid grassland habitats through the selective felling of coniferous woodland plantations (where these are not PAWS plantations);
- Restoration of heathland and acid grassland habitats through a combination of techniques which may include: the maintenance of areas of bare ground, brash laying, seeding and control of self-sown tree seedlings;

- Potential restoration of submitted minerals sites to an open heathland/acid grassland habitat mosaic, if sites receive approval;
- Creation of a mosaic of open heathland, acid grassland and wetland (e.g. acidic bog) habitats to reinforce and extend the coverage of the existing resource; and,
- Creation of open habitat buffers around the existing extent of heathland and acid grassland habitats to protect them from the potential effects of agricultural spray drift.

BOA K – MOSAIC SOUTH-WEST OF LINCOLN

Of the 12,722ha comprising the mosaic habitat south-west of Lincoln BOA, approximately 82% (10,410ha) lies within Central Lincolnshire, with the remaining 18% (2,312ha) extending to the west. The opportunities explored within this BOA principally relate to the protection, conservation and extension of a mosaic of habitats around the periphery of Lincoln, the Witham Valley Country Park and potential for minerals sites restorations further to the west.

Key Environmental Characteristics

- Heavy, often poorly draining land associated with base-rich loamy and clayey soils developed on clay and chalky till, or reddish/brown free-draining soils developed on permeable rocks or drift at elevations below 180m
- Characteristic associated habitats: damp neutral grassland and marshland
- However, due to localised deposits of sand and gravel in this area the land is able to support acid grassland and heathland habitats more typical of free-draining acidic soils

General Description of Habitats

This 12,722ha opportunity area contains a mosaic of woodland, wetland, acid grassland and heathland habitats. Much of the woodland resource is likely to be of BAP quality, including ancient, wet and lowland mixed deciduous woodland. The coniferous plantation woodland resource is also quite large, but much has originated on ancient woodland sites- notably Stapleford Woods. Acid grassland and heathland sites are found scattered throughout the BOA, often occurring in a mosaic with woodland and wetland habitats in disused mineral extraction sites or on planted woodland sites. The majority of wetland habitats that occur are standing water, running water and swamp/reedbeds which are found concentrated in the Whisby Nature and Hartsholme Country Park, around Swanpool and West Common. Neutral grassland and 'greenspace' is abundant in and around Lincoln, and includes areas such as parks, gardens, allotments, cemeteries, scrub and meadows.

BAP Habitats

- Lowland mixed deciduous woodland
- Lowland dry acid grassland
- Lowland fens
- Lowland heathland
- Lowland meadows
- Eutrophic standing water
- Purple moor grass and rush pastures
- Reedbeds
- Wet woodland
- Traditional orchards
- Wood pasture and parkland
- Floodplain grazing marsh

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- Creation of heathland stepping stones (through a combination of heathland restoration, re-establishment on areas of current plantation woodland and new habitat creation) in the Spalford, North Scarle and Besthorpe area towards Whisby;

- Creation of new wetland habitat mosaics around Swanpool, as integral components for the development of the SUE and its associated flood risk management strategy;
- Restoration of PAWS through the selective felling of conifers;
- Creation of new open grassland and/or wetland habitats as key components of quarry restoration;
- Creation of buffers around existing habitat resource to reduce the effects of intensive agriculture; and,
- Creation of semi-natural habitats within the urban extent of North Hykeham to provide linkages between greenspaces and to increase permeability for wildlife.

BOA L – CALCAREOUS GRASSLAND SOUTH OF LINCOLN

Of the 37,856ha comprising the calcareous grassland south of Lincoln BOA, approximately 75% (28,360ha) lies within Central Lincolnshire, with the remaining 25% (9,496ha) extending south, towards Grantham (outside the Central Lincolnshire boundary). The opportunities explored within this BOA principally relate to the protection, conservation and extension of calcareous grassland habitats within the central southern swathe of Central Lincolnshire.

Key Environmental Characteristics

- Light land
- Associated with shallow, free-draining soils developed on limestone or chalk bedrock
- To the south from Wilsford to Humby (outside Central Lincolnshire) the land is heavier and associated with base-rich loamy and clayey soils developed on soft clay and chalky till
- Characteristic associated habitats: dry grassland, usually with an abundance of fine leafed grasses, low flowering herbs and/or bracken
- Stony soils with relic calcareous grassland may occur on steeper slopes in soft rock areas

General Description of Habitats

The dominant semi-natural habitat types within this 37,856ha opportunity area are woodland and calcareous grassland. Small fragments of woodland, mainly broadleaved, are found scattered throughout the BOA but do include some sites likely to be of BAP quality. There is also a number of large wood pasture and parkland sites, including those at Rauceby, Belton, Harmston and Branston (as well as at Belton, outside the Central Lincolnshire boundary). The calcareous grassland resource is mainly confined to a large number of road verges, which have been identified during the 'Life on the Verge' project and designated as Local Wildlife Sites. Besides that which is found on road verges, the largest extent of calcareous grassland on any one site is found at Greetwell quarry. A small number of neutral grassland and wetland sites are also present, concentrated mainly around Lincoln where this BOA merges with BOA G. Other habitats include a small extent of acid grassland and 'greenspace' – including brownfield sites, allotments, cemeteries, scrub, parks and gardens.

BAP Habitats

- Lowland calcareous grassland
- Lowland mixed deciduous woodland
- Wood pasture and parkland
- Lowland fens
- Lowland meadows
- Floodplain grazing marsh
- Wet woodland
- Lowland dry acid grassland
- Traditional orchards

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- Creation of calcareous grassland linear corridors extending northwards from the High Dyke corridor;
- Restoration of sub-optimal calcareous grassland habitats at RAF Barkston Heath and Cranwell;

- Restoration and management of road verges by introducing appropriate management e.g. cut and bale, scrub removal;
- Creation and extension of calcareous grassland roadside verges through seeding and plug planting to aid colonisation and habitat contiguity;
- Creation of calcareous grassland in connection with the Sleaford Sustainable Urban Extensions;
- Creation of buffers adjacent to calcareous grassland habitats using targeted environmental land management schemes, to ameliorate the effects of intensive agriculture; and,
- Restoration of relic calcareous grasslands through the creation of buffers to reduce to effects of spray drift and the introduction of appropriate grazing regimes.

BOA M – LINCOLNSHIRE WOLDS CALCAREOUS GRASSLAND

Of the 27,928ha comprising the calcareous grassland south of Lincoln BOA, approximately 61% (17,025ha) lies within Central Lincolnshire, with the remaining 39% (10,903ha) extending outside Central Lincolnshire to both north and south. The opportunities explored within this BOA principally relate to the protection, conservation and extension of calcareous grassland habitats within the central southern swathe of Central Lincolnshire.

Key Environmental Characteristics

- Light land
- Associated with shallow, free-draining drift soils developed on chalk bedrock
- Characteristic associated habitats: dry grassland, usually with an abundance of fine leafed grasses, low flowering herbs and/or bracken
- Stony soils with relic calcareous grassland may occur on steeper slopes in soft rock areas

General Description of Habitats

The dominant semi-natural habitat types within this 27,928ha opportunity area are woodland, wood pasture and parkland, neutral grassland and calcareous grassland. Most noticeable is the series of woodlands, wood pasture and parklands running southwards from Habrough (outside the Central Lincolnshire boundary) to just north of Caistor. Very few of these woodlands are ancient and some are planted with conifers, but some may also be of BAP quality. The best quality grassland sites are concentrated around Nettleton, Risby and Normanby le Wold and there are also a number of important road verges. A small number of wetland sites are also present scattered throughout the BOA and a limited extent of acid grassland around Nettleton and Normanby le Wold where this BOA merges with BOA J.

BAP Habitats

- Lowland mixed deciduous woodland
- Lowland calcareous grassland
- Lowland meadows
- Wood pasture and parkland
- Traditional orchards
- Lowland dry acid grassland
- Wet woodland
- Purple moor grass and rush pastures

For a detailed description of the UK BAP habitats see http://jncc.defra.gov.uk/page-5706

Ecological Network Enhancement Opportunities

Opportunities for improving the ecological connectivity of existing 'core sites' (BAP/other habitats and designated sites) to reduce habitat fragmentation and reverse species decline within this BOA include:

- Creation of a mosaic of open habitat types that connect the existing semi-natural calcareous, neutral and acid grassland habitats, particularly south east of Caister, towards Walesby;
- Restoration and management of road verges by introducing appropriate management e.g. cut and bale, scrub removal;
- Creation and extension of calcareous grassland roadside verges through seeding and plug planting to aid colonisation and habitat contiguity;
- Creation of buffers adjacent to calcareous grassland habitats using targeted environmental land management schemes, to ameliorate the effects of intensive agriculture; and,

- Restoration of relic calcareous grasslands through the creation of buffers to reduce to effects of spray drift and the introduction of appropriate grazing regimes, particularly around Thorganby, Croxby and north of Swallow.

3.5 Schedule of Proposed Strategic Projects

3.5.1 Informed by the stakeholder consultation, a list of strategic projects considered to have potential to contribute to the delivery of Biodiversity Opportunities has been identified and presented in **Table 3.1** and illustrated in **Figure 3.6**.

3.5.2 **Figure 3.6** illustrates the extent of each of the identified strategic projects within the BOAs. These areas identified are indicative and endeavour to show the broad area within which practical, project-based, interventions should be focused in the first instance. In some circumstances the project area aligns to the extent of the BOA (e.g. the River Till and Fossdyke Navigation BOA and Project Area), whilst others focus on a specific area within the BOA (e.g. the Market Rasen Heathlands Project Area is one area within the Heathland/Acid Grassland around Market Rasen BOA. The extent of the project areas is based on a number of criteria including:

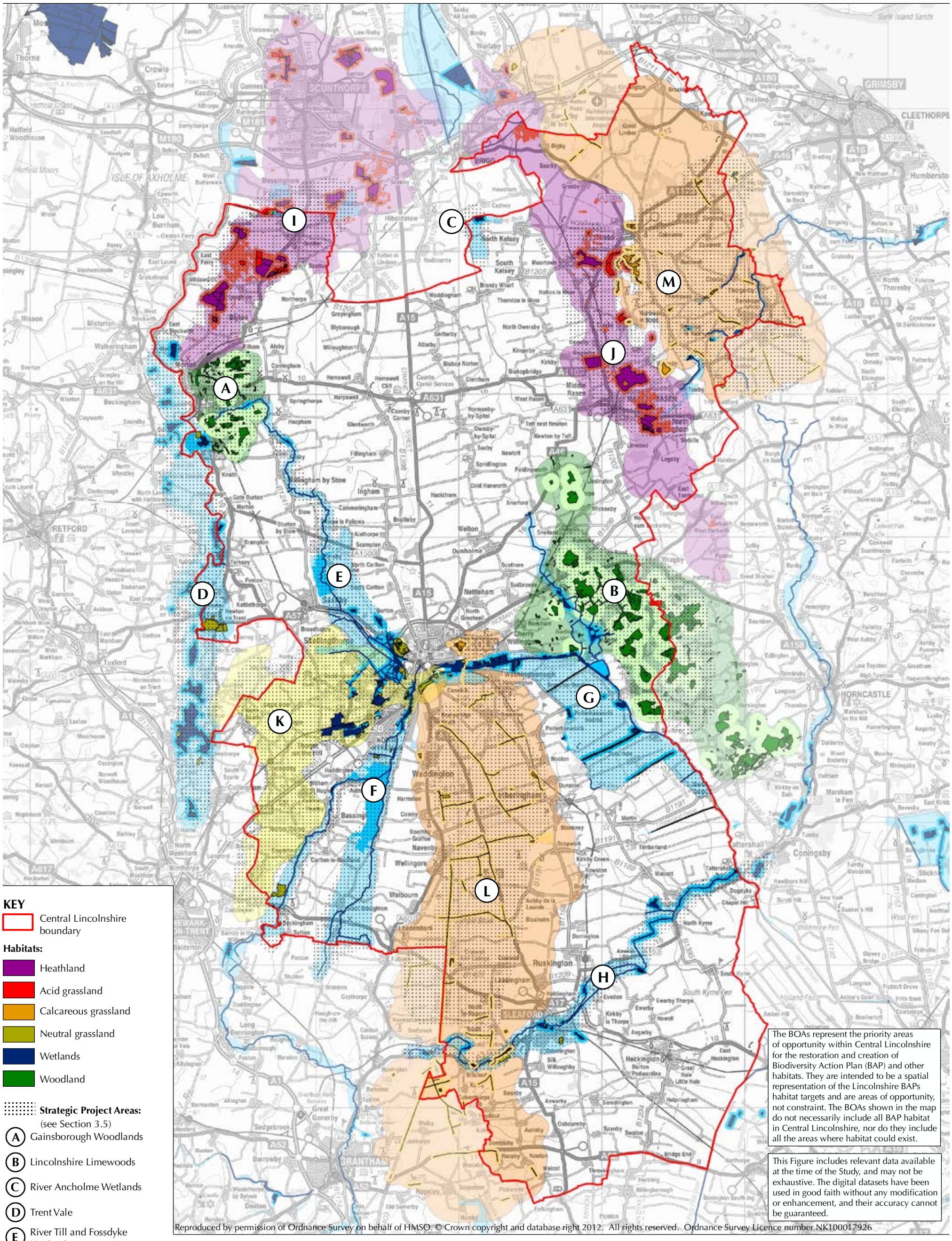
- The extent and relative fragility of the known habitat resource;
- The scope of existing projects;
- The area required to address specific ecological issues (e.g. addressing poor water quality within a given catchment, or the protection of existing ecological resources in relation to planned growth); and,
- The magnified influence that the delivery of small projects may have in relation to the protection and enhancement of the resource as a whole (i.e. large gains for relatively small input effort).

3.5.3 For the purposes of this Study, a 'strategic' project is one that is clearly of value to more than a part of Central Lincolnshire and facilitates a landscape-scale approach to enhancing the ecological network. The areas should, however, be considered as guidance intended to help focus and scope feasibility studies and detailed project development. They should not result in the exclusion of individual projects or initiatives that may arise outside these areas.

3.5.4 The Strategic Projects include both existing (e.g. the Lincolnshire Limewoods Project), as well as proposed projects identified through the BOM process. **Table 3.1** provides a broad rationale and suite of objectives for each of the strategic projects, the delivery of which could be achieved through the implementation of the relevant ecological enhancement opportunities set out under each BOA in **Section 3.4**.

3.5.5 'Indicative Costs' have been identified on the basis of estimated capital costs for the delivery of the project objectives using cost bandings as follows:

- Low - < £50k
- Medium - £50 - £500k
- High - £500k +



KEY

Central Lincolnshire boundary

Habitats:

- Heathland
- Acid grassland
- Calcareous grassland
- Neutral grassland
- Wetlands
- Woodland

Strategic Project Areas: (see Section 3.5)

- (A) Gainsborough Woodlands
- (B) Lincolnshire Limewoods
- (C) River Ancholme Wetlands
- (D) Trent Vale
- (E) River Till and Fossdyke Navigation
- (F) River Brant and Upper Witham Wetlands
- (G) Lower Witham Peatlands
- (H) River Slea Wetlands
- (I) North Gainsborough Heathlands
- (J) Market Rasen Heathlands
- (K) South-West Lincoln Wetlands and Heathlands
- (L) South of Lincoln Calcareous Grasslands
- (M) Lincolnshire Wolds Calcareous Grasslands

The BOAs represent the priority areas of opportunity within Central Lincolnshire for the restoration and creation of Biodiversity Action Plan (BAP) and other habitats. They are intended to be a spatial representation of the Lincolnshire BAPs habitat targets and are areas of opportunity, not constraint. The BOAs shown in the map do not necessarily include all BAP habitat in Central Lincolnshire, nor do they include all the areas where habitat could exist.

This Figure includes relevant data available at the time of the Study, and may not be exhaustive. The digital datasets have been used in good faith without any modification or enhancement, and their accuracy cannot be guaranteed.

Biodiversity Opportunity Areas (see Secton 3.4):

- Gainsborough Woodlands
- Woodlands East of Lincoln
- River Ancholme
- Trent Vale
- River Till and Fossdyke Navigation
- River Brant and Upper Witham
- Lower Witham Peatlands and Barlings Eau
- River Slea
- Heathland/Acid Grassland North of Gainsborough
- Heathland/Acid Grassland around Market Rasen
- Mosaic South-West of Lincoln
- Calcareous Grassland South of Lincoln
- Lincolnshire Wolds Calcareous Grassland

0 5 10 km

N

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BIODIVERSITY OPPORTUNITY MAPPING STUDY FOR CENTRAL LINCOLNSHIRE

FIGURE 3.6
Strategic Project Areas for Central Lincolnshire

Table 3.1 Schedule of Proposed Strategic Projects

Proposed Strategic Project	Scope / Objectives	Indicative Cost	Priority
A. Gainsborough Woodlands Project	The Gainsborough Woodlands project recognises the important woodland resource surrounding Gainsborough and the protection that they require in light of proposed growth around the town. Objectives: • To protect the existing woodlands • To strengthen and extend the woodlands by creating woodland linkages and strengthening the hedgerow network	Medium	Medium. To be considered in relation to the effects that future housing allocation and projected population growth may have on the woodland resource
B. Lincolnshire Limewoods Project (existing)	The Lincolnshire Limewoods Project has existed since 2005, delivering a Heritage Lottery funded programme of works until 2012. Project partners continue to work on a variety of projects including forestry and woodland management, grassland management, woodland creation, hedgerow management and species monitoring. The proposal seeks to reinforce and build on the work already achieved in this area. Objectives: • Promote sympathetic woodland management, restoration and expansion • Strengthening linkages between existing woodlands and associated habitats through the creation of appropriate habitats • Maintaining, strengthening and extending the hedgerow network.	Medium	Medium. Structures and programmes of work are already in place to continue the management of existing, as well as the creation of new woodlands. Continuation of the works programme required in the longer term to ensure the quality of the woodlands and associated habitats are maintained.
C. River Ancholme Wetlands Project	The River Ancholme is currently graded as having 'Moderate' (approx. 80%) to 'Poor' (approx. 20%) ecological status within Central Lincolnshire, as assessed under WFD criteria. Given the rural nature of the catchment, this status may be due to diffuse agricultural pollution (surface water run-off from surrounding fields). Other issues include the use of the river by boat traffic and potential pollution from boat maintenance (although any objectives to deal with this are outside the scope of this study). Objective: • The creation of wet grassland or reedbed habitats adjacent to, and in direct continuity with, the river to provide filtration and aid water quality.	Medium	Low. The opportunity to significantly contribute towards WFD assessment criteria for the Ancholme as a whole is limited due to the very small sections of the river located within Central Lincolnshire.
D. Trent Vale Wetland Project (existing)	The River Trent valley has been the source of aggregates for the construction industries for many years. The results of these excavations leave a ribbon of old mineral workings throughout the Trent valley. Sympathetic restoration of former minerals workings and sympathetic land management practices adjacent to the River Trent provides the opportunity to achieve the following objective:	Medium	Low. The extent of the Trent Vale within Central Lincolnshire is small in comparison with the whole of the project area and therefore the scale of the interventions practically achievable would be limited within the wider context of the Trent Vale project.

Proposed Strategic Project	Scope / Objectives	Indicative Cost	Priority
	• The creation of wetland habitats adjacent to and in direct continuity with the river • The restoration of low intensity wet grassland grazing regimes adjacent to the river These objectives are aligned with the aims and vision of the Trent Vale Landscape Partnership project		
E. River Till and Fossdyke Navigation Wetland Project	Approximately 70% of the River Till and Fossdyke Navigation catchment is graded as 'Moderate', with the remaining 30% graded as 'Poor' ecological quality, under WFD assessment criteria. Diffuse agricultural pollution from adjacent arable cultivation is likely to be a significant contributing factor in relation to water quality. The watercourses converge upstream of Lincoln and are therefore also important for flood risk management. Objectives: • The creation of wet grassland or reedbed habitats adjacent to, and in direct continuity with, the river to provide filtration and aid water quality. • Build resilience into riparian habitats to help improve water quality and to provide erosion control • Restore natural characteristics of the river channel which could aid aeration and dissolved oxygen concentrations within the river Provide flood alleviation upstream of Lincoln through the creation of appropriate habitats as a component of future planning and development of the SUE proposed in the Swanpool area.	High	Medium-High. To meet the requirements of WFD. To put in safeguards to protect existing properties and future growth in the Swanpool area and around Lincoln from potential flood risk
F. River Brant and Upper Witham Wetland Project	Approximately 85% of the River Brant within Central Lincolnshire is graded as 'Bad', with the remaining 15% (and all of the Upper Witham) graded as 'Moderate' ecological quality, under WFD assessment criteria. The River Brant is the only watercourse in Central Lincolnshire graded as 'Bad'. Diffuse agricultural pollution from adjacent arable cultivation is likely to be a significant contributing factor in relation to water quality. The watercourses converge upstream of Lincoln and are therefore also important for flood risk management. Objectives: • Implement the creation of buffers on land adjacent to the river to absorb / reduce the discharge of water which may exacerbate poor water quality • Build resilience into riparian habitats to help improve water quality and to provide erosion control • Restore natural characteristics of the river channel which could aid	High	High. To meet the requirements of WFD. To put in safeguards to protect existing properties and future growth around Lincoln from potential flood risk

Proposed Strategic Project	Scope / Objectives	Indicative Cost	Priority
	aeration and dissolved oxygen concentrations within the river • Provide flood alleviation upstream of Lincoln through the creation of appropriate habitats.		
G. Lower Witham Peatlands	The Lower Witham Peatlands support significant deposits of peat soils, characteristic of fen habitat that has seen a significant decline, particularly within the last 100 years. This highly ambitious project would significantly contribute towards the conservation of peatland soils through the creation of habitats associated with peat to control fluvial flooding, maintain water resources and improve water quality. They also support a rare and in some cases, unique, species assemblages. Objectives: • Restore peatland soils where feasible • Reinstate the natural functioning of the floodplain, where this may be feasible • Provide riparian habitats to improve water quality and reduce erosion of topsoils • Restore the natural flow characteristics of the river channel to help improve water quality	Medium / High	Medium / High. To meet WFD requirements. To aid the conservation of peatland soils.
H. River Slea Wetlands Project	Approximately 70% of the River Slea within Central Lincolnshire is graded as 'Poor', with the remaining 30% graded as 'Moderate' ecological quality, under WFD assessment criteria. Diffuse agricultural pollution from adjacent arable cultivation is likely to be a significant contributing factor in relation to water quality. Objectives: • Create buffers on land adjacent to the river to absorb / reduce discharges which may exacerbate poor water quality • Build resilience into riparian habitats to help improve water quality and to provide erosion control • Restore the natural flow characteristics of the river channel to help improve water quality • Provide flood alleviation upstream of Sleaford through the creation of appropriate habitats.	High	High. To meet the requirements of WFD. To put in safeguards to protect existing properties and future growth around Sleaford from potential flood risk
I. North of Gainsborough Heathlands Restoration Project (existing)	The heathlands in north west Lincolnshire represent the remaining fragments of what was probably around 60,000ha. of coversands heathland. This strategic project seeks to build on work already commenced as part of The Coversands Project, developed by a broad partnership of organisations. Objectives:	Medium / High	Medium / High. Medium. Structures and programmes of work are already in place to continue the management of existing, as well as the creation of new woodlands. Continuation of the works programme required in the longer term to ensure the quality of the heathlands/acid grasslands is maintained.

Proposed Strategic Project	Scope / Objectives	Indicative Cost	Priority
	• Protect the existing extent of heathland / acid grasslands through sympathetic management and creating buffers around them • Extend and link areas of existing heathland / acid grassland through buffering and the creation of new habitat • Restore the historic extent of heathland / acid grassland, where possible, through land conversion such as the removal of coniferous woodland plantation		
J. Market Rasen environs Heathlands Restoration Project	Heathlands are a highly fragmented habitat within the landscape. They are also high susceptible to a range of external factors including: atmospheric pollution, unsympathetic land management, agricultural intensification and development. Objectives: • Protect the existing extent of heathland / acid grasslands through sympathetic management and creating buffers around them • Extend and link areas of existing heathland / acid grassland through buffering and the creation of new habitat • Restore the historic extent of heathland / acid grassland, where possible, through land conversion such as the removal of coniferous woodland plantation	High	High. Heathlands/acid grasslands are vulnerable to a range of external influences. Work required to protect, restore and enhance these habitats, to ensure their long term resilience to these factors.
K. South-West of Lincoln Wetlands and Heathlands Project	The area to the south-west of Lincoln, designated as the Witham Valley Country Park, provides a wide range of opportunities for creating a mosaic of semi-natural habitats. These opportunities are explored in detail in **Section 4.0.** Objectives: • Protect the existing extent of semi-natural habitats in relation to planned growth in and around Lincoln through buffering adjacent land use • Provide flood protection to Lincoln through the creation of habitats suitable for absorbing and ameliorating high volumes of water • Improve water quality through the natural filtering processes provided by a mosaic of semi-natural habitats • Extension of existing, and creation of new, habitats through the creation of linkages and buffers	High	High. WVCP will experience increased use resulting from the anticipated increase in Lincoln's population. Establishment of a coherent and resilient habitat network is required to enable absorption of the additional pressures.
L. South of Lincoln Calcareous Grasslands Project	The extent of calcareous grassland in Central Lincolnshire is small and fragmented, restricted to a number of small sites and a network of roadside verges. It is considered that the habitat is highly vulnerable to a range of	Low / Medium	Low / Medium. Calcareous grasslands are vulnerable to external influences similar to heathlands / acid grassland. This project should help to support works already being undertaken by the

Proposed Strategic Project	Scope / Objectives	Indicative Cost	Priority
(existing)	external factors including: agricultural spray drift, poor management of roadside verges, the laying of services in roadside verges and a lack of appropriate management such as grazing. This project seeks to build on and complement the work already commenced through the 'Life on the Verge' project. Objectives: • Protect the existing calcareous grassland resource by buffering adjacent agricultural land by creating conservation headlands • Enhance calcareous grasslands currently in poor condition through the reintroduction of sympathetic management • Increase the extent of calcareous grassland through the restoration of (limestone) minerals sites and poor quality roadside verges		'Life on the Verge' project.
M. Lincolnshire Wolds Calcareous Grasslands Project	The extent of calcareous grassland in Central Lincolnshire is small and fragmented, restricted to a number of small sites and a network of roadside verges. It is considered that the habitat is highly vulnerable to a range of external factors including: agricultural spray drift, poor management of roadside verges, the laying of services in roadside verges and a lack of appropriate management such as grazing. This project seeks to build on and complement the work already commenced through the 'Life on the Verge' project. Objectives: • Protect the existing calcareous grassland resource by buffering adjacent agricultural land by creating conservation headlands; • Enhance calcareous grasslands currently in poor condition through the reintroduction of sympathetic management; and, • Increase the extent of calcareous grassland through the restoration of (chalk) minerals sites and poor quality roadside verges.	Low	Low / Medium. Calcareous grasslands are vulnerable to external influences similar to heathlands / acid grassland. This project should help to support works already being undertaken by the 'Life on the Verge' project.

4.0 PART 2: BIODIVERSITY OPPORTUNITY MAPPING FOR LINCOLN PRINCIPAL URBAN AREA/SUSTAINABLE URBAN EXTENSIONS/WITHAM VALLEY COUNTRY PARK

4.1 General

4.1.1 The principals for Biodiversity Opportunity Mapping set out in **Sections 3.1**, **3.2**[16] and **3.3** apply to the Lincoln PUA/SUEs/WVCP scale. The BOAs identified at the Central Lincolnshire scale are also applied at the Lincoln PUA/SUEs/WVCP scale to provide a broad context and further refined to identify BOAs at the 'field scale', to provide fine grained opportunity mapping.

4.1.2 The Lincoln PUA/SUEs/WVCP is identified as an opportunity area for a mosaic of habitats. There is no clearly defined dominant habitat type within this area and, because of the scale of the mapping, the identification of opportunity priorities can be more refined on a site-by-site or field scale.

Urban Biodiversity Opportunity Mapping

4.1.3 Biodiversity Opportunity Mapping can sometimes be interpreted as applying to predominantly rural locations, or the restoration of old industrial sites. However, opportunities also present themselves within cities such as Lincoln (as well as smaller towns), which can help to make urban conurbations permeable to wildlife (i.e. greenspace that enables wildlife to disperse and migrate through urban areas) and provide a suite of ecosystem services that enhances the quality of life for the people who live there.

4.1.4 The implementation of biodiversity opportunities within urban areas requires an understanding of localised conditions. For Lincoln, this is characterised by the range of relic habitats which are the product of the confluence of varied geologies and landscape character types that occur within the City. The limestone ridge that runs roughly north-south through the centre of the City broadly influences the habitat characteristics to the east and west of the ridge line. To the east, on the higher ground, habitats that favour calcareous conditions predominate. To the west and within the floodplain of the River Witham, low lying land overlaying sand and gravel deposits tends to favour habitats that prefer wet, neutral and more acidic conditions. Urban biodiversity opportunities may be considered in two distinct ways:

[16] The exception to this is that, as discussed in Section 2.2.11, buffer zones were not applied to open habitats at the Lincoln PUA/SUEs/WVCP scale.

(i) Retro-fitting biodiversity within the existing urban fabric of the City

4.1.5 Concepts relating to sustainable urban living (urban 'liveability'), green infrastructure, ecosystem services embrace the notion of enhancing urban areas to achieve a range of goals that include:

- Improvements to the quality of life experienced by those living in cities;
- Making cities more permeable for wildlife (i.e. enabling species to migrate and disperse through urban landscapes);
- Supporting species of nature conservation concern including, for example, pollinators such as bees and certain bird species; and,
- The delivery of ecosystem services such as flood risk management, improving air quality, management of the 'heat island' effect and providing space for access to nature.

4.1.6 The implementation of biodiversity opportunities can achieve these goals through a range of interventions that include:

- New planting, such as street trees, to provide shade and shelter, improve air quality and to reduce the heat island effect;
- New planting such as swales and rain gardens, to help manage surface run-off and aid flood risk management;
- Planting new parks and gardens to provide access to nature;
- Enhancing the management of existing greenspaces (e.g. allotments, parks, churchyards) for the benefit of wildlife;
- Retrofitting green walls and green roofs on existing built structures, to increase the buildings' energy efficiency, reduce storm water run-off, support birds and pollinators and, where feasible, provide access to nature for people; and,
- Desealing (the removal of impermeable concrete, tarmac, hardstanding) to enable new planting to provide shade and help the control of storm water run-off by increasing permeability.

(ii) Incorporating biodiversity into new urban extensions and new build

4.1.7 All of the biodiversity opportunities described above, with their associated benefits, can be incorporated into new build schemes, prior to any works being carried out. The opportunity to ensure that appropriate natural greenspace (habitats for wildlife) are incorporated into new scheme layouts is available at the planning stage. This will help to ensure that existing areas of habitat are not further fragmented as the result of new development, but also ensure that linkages between these habitats can be strengthened or created. Moreover, the incorporation of biodiversity opportunities into the fabric of the developments will help to fulfil the broad aims of sustainable development.

4.1.8 By way of example, the SUE to the east of the City, as with the proposed Lincoln Eastern Bypass, provide opportunities for the creation and expansion of calcareous grasslands to link Greetwell Quarry with existing extents of calcareous grassland around Greetwell Hollow, wetlands (SuDS) with the Lower Witham and woodland planting comprising of limes and ash

as dominant species, in a variety of locations. Similar opportunities exist for the SUE to the south of the City. By contrast the SUE around Swanpool would benefit more readily by the incorporation of wetland habitats focusing around the River Till and Fossdyke Navigation, as well as grasslands with acidic characteristics further to the west, towards Hartsholme Country Park and its environs.

4.1.9 **Sections 4.2** to **4.5** below describe detailed opportunities for biodiversity protection, enhancement and creation in the context of broad habitat types. Opportunities for integrating biodiversity within the urban fabric of Lincoln are signposted within each of the following Sections. The implementation of such opportunities will require an understanding of very localised conditions, characterised by the range of relic habitats that occur within Lincoln and which are the product of the confluence of varied geologies and landscape character types that occurs within the City.

4.2 Woodland Habitat Opportunity Mapping

4.2.1 The Woodland Habitat Opportunity Mapping for the Lincoln PUA/SUEs/WVCP is shown on **Figure 4.1**. Opportunities for enhancing the ecological network, including the connectivity of existing woodland sites to reduce habitat fragmentation and reverse species decline within the area are identified on the following schedule:

Table 4.1: Woodland Opportunities (**Figure 4.1**)

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
1	City of Lincoln Principal Urban Area (PUA)	• Restoration of semi-natural habitats within 'greenspaces' • Creation of 'urban woodland' comprising street trees to increase permeability for wildlife, amenity and to manage the heat island effect	K. South-West of Lincoln Wetlands and Heathlands
4	Sustainable Urban Extensions (SUE) East of Lincoln	• Creation of 'urban woodland' comprising street trees to increase permeability for wildlife, amenity and to manage the heat island effect	-
7	Lincoln Eastern Bypass (LEB)	• Restoration of hedgerows along farm boundaries and adjacent to the LEB • Creation of woodland habitat in association with the LEB scheme	L. South of Lincoln Calcareous Grasslands G. Lower Witham Peatlands
8	Canwick SUE	• Extension of the existing local community orchard; • Creation of woodland/woodland corridors to increase permeability of the SUE	-
9	Swanpool SUE	• Creation of woodland/woodland corridors to increase permeability of the SUE	K. South-West of Lincoln Wetlands and Heathlands E. River Till & Fossdyke Navigation Wetlands
11	North of Burton Waters	• Creation of wet woodland habitat to reduce silt deposition in associated watercourses	E. River Till & Fossdyke Navigation Wetlands

This Figure includes relevant data available at the time of the Study, and may not be exhaustive. The digital datasets have been used in good faith without any modification or enhancement, and their accuracy cannot be guaranteed.

KEY

- Witham Valley Country Park boundary
- Sustainable Urban Extensions

Habitats:

- Coniferous plantation woodland
- Woodland (other)
- Ancient woodland

Targeted opportunity areas for the creation and restoration of a woodland habitat network:

- Permitted minerals and waste sites
- Submitted minerals and waste sites
- Proposed Lincoln Eastern Bypass
- Greenspace
- 500m ancient woodland buffer
- Species-poor hedges

(30) Opportunity Number (see Habitat Opportunity Mapping Schedule - Table 4.5)

0 1 2 km

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FIGURE 4.1
Woodland Habitat Opportunity Mapping
Lincoln PUA/SUEs/WVCP

OCTOBER 2013

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
14	Hartsholme Country Park	• Restoration of semi-natural habitats through the management and control of *Rhododendron* • Restoration and enhancement of existing woodland habitat through active management (selective felling; coppicing; ride creation; glade creation)	K. South-West of Lincoln Wetlands and Heathlands
15	Skellingthorpe Moor	• Creation of heathland/acid grassland/open woodland /open space	K. South-West of Lincoln Wetlands and Heathlands
16	North of Skellingthorpe	• Creation of wet woodland habitat to aid silt reduction and flood risk management	K. South-West of Lincoln Wetlands and Heathlands E. River Till & Fossdyke Navigation Wetlands
17	West of Skellingthorpe	• Creation of a woodland habitat corridor linking Ash Lound to Old Wood	K. South-West of Lincoln Wetlands and Heathlands E. River Till & Fossdyke Navigation Wetlands
25	South-east of Doddington	• Restoration of broadleaved woodland habitats through suitable management and/or new planting	K. South-West of Lincoln Wetlands and Heathlands
26	West of Skellingthorpe to Thorney	• Creation of woodland corridors/stepping stones to link existing habitats of high value	K. South-West of Lincoln Wetlands and Heathlands
29	Minerals sites West of Whisby	• Potential for the creation of wet woodland habitat as a component of minerals site restorations, if sites are allocated	K. South-West of Lincoln Wetlands and Heathlands E. River Till & Fossdyke Navigation Wetlands
30	Tunman Wood	• Creation of wet woodland habitat to aid the control of surface water run-off into adjacent water courses	K. South-West of Lincoln Wetlands and Heathlands
31	River Brant and Washlands	• Creation of riparian buffer strips of wet grassland or wet woodland to help improve water quality of the River Brant • Creation of woodland stepping stones to link isolated woodlands	F. River Brant and Upper Witham Wetlands
32	Morton Hall	• Creation of woodland habitat on prison land to link to Tunman Wood	K. South-West of Lincoln Wetlands and Heathlands

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
39	Stapleford Woods	• Restoration of ancient woodland sites through selective felling of conifer plantations (restoration of ancient woodland on Plantation Ancient Woodland Sites (PAWS))	K. South-West of Lincoln Wetlands and Heathlands

4.3 Wetland Habitat Opportunity Mapping

4.3.1 The Wetland Habitat Opportunity Mapping for the Lincoln PUA/SUEs/WVCP is shown on **Figure 4.2**. As discussed in **Section 3.2.7**, lowland meadows are mapped on **Figure 4.2** for convenience; however, no specific opportunities for the enhancement, extension or creation of this habitat type have been identified in **Table 4.2**. Opportunities for enhancing the ecological network, including the connectivity of existing wetland sites to reduce habitat fragmentation and reverse species decline within the area are identified in **Table 4.2** below:

Table 4.2: Wetland Opportunities (**Figure 4.2**)

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
1	City of Lincoln PUA	• Creation of SuDs schemes to manage surface water drainage • Creation of rain gardens to manage surface water drainage • Restoration of semi-natural habitats within 'greenspaces' • Creation of green roofs and living walls as part of new build or on existing buildings to increase permeability for wildlife, manage surface water drainage and to improve the energy efficiency of buildings	K. South-West of Lincoln Wetlands and Heathlands

This Figure includes relevant data available at the time of the Study, and may not be exhaustive. The digital datasets have been used in good faith without any modification or enhancement, and their accuracy cannot be guaranteed.

KEY

- Witham Valley Country Park boundary
- Sustainable Urban Extensions
- MOD Airbase (constraint)

Habitats:

- Wetlands
- Neutral grassland

Ecological Status of Rivers:

- Good
- Moderate
- Bad

Opportunity Areas:

- Wetland Biodiversity Opportunity Areas
- 30 Opportunity Number (see Habitat Opportunity Mapping Schedule - Table 4.5)

Targeted opportunity areas for the creation and restoration of a wetland habitat network:

- Proposed Lincoln Eastern Bypass
- Permitted minerals and waste sites
- Submitted minerals and waste sites
- The Brant and Till Washlands

0 1 2 km

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FIGURE 4.2
Wetland Habitat Opportunity Mapping
Lincoln PUA/SUEs/WVCP

OCTOBER 2013

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
4	SUE East of Lincoln	• Creation of SuDs schemes to manage surface water drainage • Creation of green roofs and living walls as part of new build or on existing buildings to increase permeability for wildlife, manage surface water drainage and to improve the energy efficiency of buildings	G. Lower Witham Peatlands
5	Sincil Dyke	• Restoration of the dyke through 'decanalisation', in-channel and riparian enhancements • Re-establishment of marginal and in-channel vegetation cover • Planting occasional tree and shrub cover • Creation of backwaters and bays for still-water habitat and high-flow refuge	G. Lower Witham Peatlands
6	North of Canwick	• Creation of wetland habitat/wet grazing meadow for SE growth area	G. Lower Witham Peatlands
7	Lincoln Eastern Bypass	• Creation of SuDs schemes to provide 'naturalised' open water habitats	G. Lower Witham Peatlands
8	Canwick SUE	• Creation of SuDs schemes to manage surface water drainage • Creation of wetland habitat/wet grazing marsh to increase the extent of the existing resource and to aid flood risk management • Creation of green roofs and living walls as part of new build or on existing buildings to increase permeability for wildlife, manage surface water drainage and to improve the energy efficiency of buildings	G. Lower Witham Peatlands

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
9	Swanpool SUE	• Creation of new, or extensions to, existing reedbeds • Creation of SuDs schemes to manage surface water drainage • Creation of new 'greenspace' comprising a mosaic of wetland, heathland and acid grassland habitats • Creation of a blue corridor between Hartsholme Lake and Ballast Holes to increase the permeability of the SUE for wildlife and to aid flood risk management • Creation of green roofs and living walls as part of new build or on existing buildings to increase permeability for wildlife, manage surface water drainage and to improve the energy efficiency of buildings	E. River Till & Fossdyke Navigation Wetlands
10	Fossdyke Navigation	• Restoration of 'naturalised' channel characteristics through the removal of in-channel obstructions • Restoration of habitat suitable for water voles / eels • Re-establishment of marginal and in-channel vegetation cover • Channel narrowing to improve the flow regime • Planting occasional tree and shrub cover • Creation of backwaters and bays for still-water habitat and high-flow refuge	E. River Till & Fossdyke Navigation Wetlands
11	North of Burton Waters	• Creation of a wet grassland and reedbed habitat mosaic to aid flood risk management • Creation of wet woodland habitat to reduce silt deposition in associated watercourses	E. River Till & Fossdyke Navigation Wetlands

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
13	Pike Drain	• Creation of eel passes to aid migration • Re-establishment of marginal and in-channel vegetation cover • Channel narrowing to improve the flow regime • Creation of backwaters and bays for still-water habitat and high-flow refuge • Planting of occasional tree and shrub cover	F. River Brant and Upper Witham Wetlands
14	Hartsholme Country Park & Swanholme Lakes LNR	• Restoration of the small area of remnant bog through suitable management - only location of this habitat in the city • Restoration of remnant open wetland habitats through the selective clearance of woodland • Creation of open water habitats within the woodland area to avoid the need for increasing size of the outfall from Hartsholme Lake	E. River Till & Fossdyke Navigation Wetlands
16	North of Skellingthorpe	• Creation of wet woodland habitat to aid silt reduction and flood risk management	E. River Till & Fossdyke Navigation Wetlands
19	Prial Drain	• Restoration of the drain through 'decanalisation', in-channel and riparian enhancements • Re-establishment of marginal and in-channel vegetation cover • Channel narrowing to improve the flow regime • Creation of backwaters and bays for still-water habitat and high-flow refuge	E. River Till & Fossdyke Navigation Wetlands

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
21	East of North Hykeham	• Creation of new reedbeds to help improve water quality of the River Brant and its tributaries • Creation of wetland habitats / wet meadows to aid flood risk management • Restoration of neutral grassland habitat on the river banks • Restoration of semi-natural habitats through targeting of environmental land management schemes • Restoration of wet grassland / floodplain habitats through suitable management	F. River Brant and Upper Witham Wetlands
22	North-west of Waddington	• Creation of wetland habitats/wet meadows to aid flood risk management • Re-establishment of marginal and in-channel vegetation cover • Channel narrowing to improve the flow regime • Creation of a multi-stage channel with a low-flow sediment berm • Creation of backwaters and bays for still-water habitat and high-flow refuge	F. River Brant and Upper Witham Wetlands
24	Minerals sites East of Whisby	• Potential restoration to a mosaic of open waterbody and wetland habitat types, dependent upon submitted sites receiving approval	K. South-West of Lincoln Wetlands and Heathlands
28	Lincoln Edge/Cliff (including the Viking Way)	• Protection of important spring-fed habitats/calcareous flushes, if identified as being present	F. River Brant and Upper Witham Wetlands L. South of Lincoln Calcareous Grasslands
29	Minerals sites West of Whisby	• Potential creation of new reedbeds as a component of minerals site restorations, if sites are allocated • Potential creation of wet woodland habitat as a component of minerals site restorations, if sites are allocated	K. South-West of Lincoln Wetlands and Heathlands
30	Tunman Wood	• Creation of wet woodland habitat to aid the control of surface water run-off into adjacent water courses	K. South-West of Lincoln Wetlands and Heathlands

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
31	River Brant and Washlands	• Creation of riparian buffer strips of wet grassland or wet woodland to help improve water quality of the River Brant • Restoration of 'naturalised' channel characteristics through the removal of in-channel obstructions; • Maintenance, enhancement and expansion of current wetland site at Blackmoor Bridge • Assess requirements for de-silting, and undertake if considered necessary • Creation of in-channel features such as riffle-pool sequences and in-channel deflectors to enhance flow characteristics • Restoration of pasture through arable reversion within washland, where feasible	F. River Brant and Upper Witham Wetlands
37	North of Brant Broughton	• Creation of a new washland - preferably grassland/pasture, rather than arable to aid flood risk management • Re-establishment of marginal and in-channel vegetation cover • Channel narrowing to improve the flow regime • Creation of a multi-stage channel with a low-flow sediment berm • Creation of backwaters and bays for still-water habitat and high-flow refuge	F. River Brant and Upper Witham Wetlands

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
40	Beckingham and downstream towards Lincoln	• Restoration of semi-natural habitats at Beckingham Ranges through suitable management • Re-establishment of marginal and in-channel vegetation cover • Channel narrowing to improve the flow regime • Creation of a multi-stage channel with a low-flow sediment berm • Creation of backwaters and bays for still-water habitat and high-flow refuge • Creation of bank-side and in-channel woody material • Planting occasional tree and shrub cover • Creation of channel-floodplain habitat connectivity	F. River Brant and Upper Witham Wetlands

4.4 Heathland & Acid Grassland Habitat Opportunity Mapping

4.4.1 The Heathland & Acid Grassland Habitat Opportunity Mapping for the Lincoln PUA/SUEs/WVCP is shown on **Figure 4.3**. As discussed in **Section 3.2.7**, dry neutral grasslands, such as lowland meadows, are mapped on **Figure 4.2** for convenience; however, opportunities for the extension or creation of this habitat type have been identified in **Table 4.3**, where these opportunities are considered appropriate. Opportunities for enhancing the ecological network, including the connectivity of existing heathland/acid grassland sites to reduce habitat fragmentation and reverse species decline within the area are identified in **Table 4.3** below:

Table 4.3: Heathland / Acid Grassland Opportunities (**Figure 4.3**)

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
1	City of Lincoln PUA	• Restoration of acid grassland habitats within greenspaces'	K. South-West of Lincoln Wetlands and Heathlands
8	Canwick SUE	• Creation of a grassland buffer around the neutral grassland on South Common	K. South-West of Lincoln Wetlands and Heathlands

This Figure includes relevant data available at the time of the Study, and may not be exhaustive. The digital datasets have been used in good faith without any modification or enhancement, and their accuracy cannot be guaranteed.

KEY

- Witham Valley Country Park boundary
- Sustainable Urban Extensions

Habitats:

- Sites including heathland
- Acid grassland

Targeted opportunity areas for the creation and restoration of a heathland/acid grassland habitat network:

- Permitted sand and gravel extraction sites
- Coniferous (non-ancient) plantation woodland
- Submitted sand and gravel extraction sites
- Greenspace
- Soil most likely suitable for heathland and acid grassland habitat creation
- (30) Opportunity Number (see Habitat Opportunity Mapping Schedule - Table 4.5)

0 1 2 km

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FIGURE 4.3
Heathland & Acid Grassland Habitat Opportunity Mapping
Lincoln PUA/SUEs/WVCP

OCTOBER 2013

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
9	Swanpool SUE	• Creation of new 'greenspace' comprising a mosaic of wetland, heathland, acid and neutral grassland habitats	K. South-West of Lincoln Wetlands and Heathlands
10	Fossdyke Navigation	• Creation of neutral grassland habitat corridor adjacent to the canal	K. South-West of Lincoln Wetlands and Heathlands
12	South of Swanpool	• Restoration of remnant heathland through the removal of trees and the introduction of a suitable management regime	K. South-West of Lincoln Wetlands and Heathlands
14	Hartsholme Country Park	• Protection of acid grassland habitat beside the lakes through suitable management. Where feasible create a buffer zone with the intention of creating and extending this habitat type	K. South-West of Lincoln Wetlands and Heathlands
15	Skellingthorpe Moor	• Creation of heathland / acid grassland / open woodland open space	K. South-West of Lincoln Wetlands and Heathlands
18	Hospital Plantation	• Restoration of existing areas of heathland through suitable management • Restoration of semi-natural habitats through the management and control of *Rhododendron*, to create heathland 'stepping stones' through the woodland	K. South-West of Lincoln Wetlands and Heathlands
20	Railway Line	• Creation of a heathland habitat corridor adjacent to the railway line	K. South-West of Lincoln Wetlands and Heathlands
24	Mineral sites East of Whisby	• Creation of heathland / acid grassland habitats as a component of the restoration of minerals sites (or potential creation, if submitted sites receive approval) • Creation of heathland / acid grassland habitats around the margins and boundaries of minerals sites already restored to lakes	K. South-West of Lincoln Wetlands and Heathlands

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
25	South-east of Doddington	• Restoration of heathland / acid grassland through the selective felling of coniferous woodland plantations (where these are not PAWS plantations)	K. South-West of Lincoln Wetlands and Heathlands
27	Whisby Nature Park	• Restoration of relic heathland through appropriate management	K. South-West of Lincoln Wetlands and Heathlands
29	Minerals sites West of Whisby	• Potential creation of heathland / acid grassland habitats as a component of minerals site restorations, if sites receive approval	K. South-West of Lincoln Wetlands and Heathlands
30	Tunman Wood	• Restoration of heathland and / or acid grassland through the selective felling of coniferous woodland plantations (where these are not PAWS plantations)	K. South-West of Lincoln Wetlands and Heathlands
33	Spalford Warren	• Creation of new heathland habitats to buffer the existing rare habitat (blown sand heath)	K. South-West of Lincoln Wetlands and Heathlands
34	Besthorpe Warren	• Restoration and extension of existing heathland / acid grassland habitats	K. South-West of Lincoln Wetlands and Heathlands
35	Minerals sites Swinderby to Stapleford	• Potential creation of heathland and acid grassland to expand on existing areas of these habitats at Stapleford Moor, dependent upon submitted sites receiving approval	K. South-West of Lincoln Wetlands and Heathlands
36	North-West of Stapleford	• Restoration of heathland and/or acid grassland through the selective felling of coniferous woodland plantations (where these are not PAWS plantations) • Restoration of open areas through selective felling, pulling seedlings; prevent reversion to woodland through suitable management, potentially including grazing as well as physical removal of tree seedlings	K. South-West of Lincoln Wetlands and Heathlands

4.5 Calcareous Grassland Habitat Opportunity Mapping

4.5.1 The Calcareous Grassland Habitat Opportunity Mapping for the Lincoln PUA/SUEs/WVCP is shown on **Figure 4.4**. As discussed in **Section 3.2.7**, dry neutral grasslands, such as lowland meadows, are mapped on **Figure 4.2** for convenience; however, opportunities for the extension or creation of this habitat type have been identified in **Table 4.4**, where these opportunities are considered appropriate. Opportunities for enhancing the ecological network, including the connectivity of existing calcareous grassland sites to reduce habitat fragmentation and reverse species decline within the area are identified on the following schedule:

Table 4.4: Calcareous Grassland Opportunities (**Figure 4.4**)

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
1	City of Lincoln PUA	• Restoration of calcareous grassland habitats within 'greenspaces'	-
2	Ermine Quarry	• Creation of calcareous grassland habitat as a component of quarry restoration	-
3	Greetwell Quarry	• Restoration and extension of relic calcareous grasslands in quarry	-
4	SUE East of Lincoln	• Creation of a calcareous grassland habitat buffer around Greetwell Quarry, including adjacent to Greetwell Hollow	-
7	Lincoln Eastern Bypass	• Creation of calcareous grassland linear corridors along road verges – linking grassland from Bracebridge Heath to Greetwell Quarry	L. South of Lincoln Calcareous Grasslands
8	Canwick SUE	• Creation of species-rich calcareous grassland and neutral grasslands	L. South of Lincoln Calcareous Grasslands
23	Roadside verges South of Lincoln	• Creation of grassland habitat buffers using targeted environmental land management schemes to aid the protection of the calcareous grassland roadside verges	L. South of Lincoln Calcareous Grasslands

This Figure includes relevant data available at the time of the Study, and may not be exhaustive.
The digital datasets have been used in good faith without any modification or enhancement, and their accuracy cannot be guaranteed.

KEY

Witham Valley Country Park boundary

Sustainable Urban Extensions

Habitats:

Calcareous grassland

Targeted opportunity areas for the creation and restoration of a calcareous grassland habitat network:

Permitted limestone extraction site

Submitted mineral extraction site - building stone

Proposed Lincoln Eastern Bypass

Greenspace

Soil most likely suitable for calcareous grassland habitat creation

(28) Opportunity Number (see Habitat Opportunity Mapping Schedule - Table 4.5)

0 1 2 km

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FIGURE 4.4
Calcareous Grassland Habitat Opportunity Mapping
Lincoln PUA/SUEs/WVCP

OCTOBER 2013

Opportunity No.	Area	Opportunities	Contribution to Central Lincolnshire Strategic Projects
28	Lincoln Edge/Cliff (including the Viking Way)	• Protection and restoration important spring-fed habitats / calcareous flushes • Restoration of grassland habitats (including calcareous) and corridors through favourable management using agri-environment funding	L. South of Lincoln Calcareous Grasslands
38	South of Harmston Heath to Webourn Heath	• Restoration of road verges through suitable management e.g. cutting and baling, removing scrub	L. South of Lincoln Calcareous Grasslands

4.6 Biodiversity Opportunity Mapping Schedule

4.6.1 The Biodiversity Opportunity Mapping Schedule for the Lincoln PUA/SUEs/WVCP (**Table 4.5**) below combines all of the opportunities described above in **Sections 4.1- 4.4**, listing them by geographical location and ranking them in terms of their priority for delivery.

The BOAs represent the priority areas of opportunity within Central Lincolnshire for the restoration and creation of Biodiversity Action Plan (BAP) and other habitats. They are intended to be a spatial representation of the Lincolnshire BAP's habitat targets and are areas of opportunity, not constraint. The BOAs shown in the map do not necessarily include all BAP habitat in Central Lincolnshire, nor do they include all the areas where habitat could exist.

This Figure includes relevant data available at the time of the Study, and may not be exhaustive. The digital datasets have been used in good faith without any modification or enhancement, and their accuracy cannot be guaranteed.

KEY

Witham Valley Country Park Boundary

Sustainable Urban Extensions

Habitats:

(See Figs 4.1 - 4.4)

Biodiversity Opportunity Areas:

I Lincoln Calcareous Grasslands

II Upper Witham and Brant Wetlands

III South-West Lincoln Mosaic

IV Lincoln Heathland

V Till and Fossdyke Wetlands

Targeted opportunity areas for habitat creation and restoration (see Section 4.6):

39 Woodland

38 Heathland

40 Wetland

36 Calcareous Grassland

0 2 4 km

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FIGURE 4.5

Biodiversity Opportunity Map for Lincoln PUA/SUEs/WVCP

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Table 4.5. Biodiversity Opportunity Mapping Schedule for the Lincoln PUA/SUEs/WVCP

Opportunity No.	BOA	Figure No.	Area	Opportunities for Enhancing the Ecological Habitat Network	Sensitivity
1	-	4.1 4.2 4.3 4.4	City of Lincoln Principal Urban Area (PUA)	Creation of SuDs schemes to manage surface water drainage Creation of rain gardens to manage surface water drainage Restoration of acid grassland habitats within 'greenspaces' Restoration of calcareous grasslands within 'greenspaces'	High
				• Restoration of semi-natural habitats within 'greenspaces' • Creation of 'urban woodland' comprising street trees to increase permeability for wildlife, amenity and to manage the heat island effect Creation of green roofs and living walls as part of new build or on existing buildings to increase permeability for wildlife, manage surface water drainage and to improve the energy efficiency of buildings	Medium
				Restoration of cemeteries and allotments to benefit wildlife through sympathetic management	Low
2	I	4.4	Ermine Quarry	Creation of calcareous grassland habitat as a component of quarry restoration	High
3	I	4.4	Greetwell Hollow Quarry	Restoration and extension of relic calcareous grasslands in quarry	High
4	I	4.1 4.2 4.4	Sustainable Urban Extension (SUE) East of Lincoln	Creation of a calcareous grassland habitat buffer around Greetwell Quarry including adjacent to Greetwell Hollow • Creation of SuDs schemes to manage surface water drainage	High
				• Creation of 'urban woodland' comprising street trees to increase permeability for wildlife, amenity and to manage the heat island effect • Creation of green roofs and living walls as part of new build or on existing buildings to increase permeability for wildlife, manage surface water drainage and to improve the energy efficiency of buildings	Medium
				• Creation of 'urban woodland' comprising street trees to increase permeability for wildlife, amenity and to manage the heat island effect	Low
5	-	4.2	Sincil Dyke	• Restoration of the dyke through 'decanalisation', in-channel and riparian enhancements	High
				• Re-establishment of marginal and in-channel vegetation cover	
				• Planting occasional tree and shrub cover	
				• Creation of backwaters and bays for still-water habitat and high-flow refuge	
6	-	4.2	North of Canwick	• Creation of wetland habitat/wet grazing meadow for SE growth area	High
7	I	4.1 4.2 4.4	Lincoln Eastern Bypass (LEB)	• Creation of calcareous grassland linear corridors along road verges – linking grassland from Bracebridge Heath to Greetwell Quarry • Creation of SuDs schemes to provide 'naturalised' open water habitats	High
				• Restoration of hedgerows along farm boundaries and adjacent to the LEB	Medium
				• Creation of woodland habitat in association with the LEB scheme	Low
8	I	4.1 4.2 4.3 4.4	Canwick SUE	• Creation of species-rich calcareous and neutral grasslands • Creation of a grassland buffer around the acid/neutral grassland on South Common • Creation of SuDs schemes to manage surface water drainage	High
				• Creation of wetland habitat/wet grazing meadow to increase the extent of the existing resource and to aid flood risk management	Medium
				• Extension of the existing local community orchard • Creation of woodland/woodland corridors to increase permeability of the SUE • Creation of green roofs and living walls as part of new build or on existing buildings to increase permeability for wildlife, manage surface water drainage and to improve the energy efficiency of buildings	Low
9	V	4.1 4.2 4.3	Swanpool SUE	• Creation of new, or extensions to existing reedbeds • Creation of SuDs schemes to manage surface water drainage • Creation of new 'greenspace' comprising a mosaic of wetland, heathland and acid grassland habitats • Creation of a blue corridor between Hartsholme Lake and Ballast Holes to increase the permeability of the SUE for wildlife and to aid flood risk management	High

Opportunity No.	BOA	Figure No.	Area	Opportunities for Enhancing the Ecological Habitat Network	Sensitivity
				• Creation of green roofs and living walls as part of new build or on existing buildings to increase permeability for wildlife, manage surface water drainage and to improve the energy efficiency of buildings	Medium
				• Creation of woodland/woodland corridors to increase permeability of the SUE	Low
10	V	4.2 4.3	Fossdyke Navigation	• Restoration of 'naturalised' channel characteristics through the removal of in-channel obstructions • Restoration of habitat suitable for water voles/eels • Re-establishment of marginal and in-channel vegetation cover • Channel narrowing to improve the flow regime • Planting occasional tree and shrub cover • Creation of backwaters and bays for still-water habitat and high-flow refuge • Creation of neutral grassland habitat corridor adjacent to the canal	High
				• Creation of a heathland/acid grassland habitat corridor adjacent to the canal	Low
11	V	4.1 4.2	North of Burton Waters	• Creation of a wet grassland and reedbed habitat mosaic to aid flood risk management	High
				• Creation of wet woodland habitat to reduce silt deposition in associated watercourses	Low
12	III	4.3	South of Swanpool	• Restoration of remnant heathland through the removal of trees and the introduction of a suitable management regime	High
13	III	4.2	Pike Drain	• Creation of eel passes to aid migration • Re-establishment of marginal and in-channel vegetation cover • Channel narrowing to improve the flow regime • Planting occasional tree and shrub cover • Creation of backwaters and bays for still-water habitat and high-flow refuge	High
14	III	4.1 4.2 4.3	Hartsholme Country Park	• Restoration of the small area of remnant bog through suitable management - only location of this habitat in the city • Protection of acid grassland habitat beside the lakes through suitable management. Where feasible create a buffer zone with the intention of creating and extending this habitat type • Restoration of remnant open wetland habitats through the selective clearance of woodland	High
				• Restoration of semi-natural habitats through the management and control of *Rhododendron* • Creation of open water habitats within the woodland area to avoid the need for increasing size of the outfall from Hartsholme Lake	Medium
				• Restoration and enhancement of existing woodland habitat through active management (selective felling; coppicing; ride creation; glade creation)	Low
15	IV	4.1 4.3	Skellingthorpe Moor	• Creation of heathland/acid grassland/open woodland open space	Medium
16	V	4.1 4.2	North of Skellingthorpe	• Creation of wet woodland habitat to aid silt reduction and flood risk management	High
17	-	4.1	West of Skellingthorpe	• Creation of a woodland habitat corridor linking Ash Lound to Old Wood	Medium
18	IV	4.3	Hospital Plantation	• Creation of a robust baseline habitat dataset by reviewing the mapping of heathland • Restoration of existing areas of heathland through suitable management • Restoration of semi-natural habitats through the management and control of *Rhododendron*	High
19	III	4.2	Prial Drain	• Restoration of the drain through 'decanalisation', in-channel and riparian enhancements • Re-establishment of marginal and in-channel vegetation cover • Channel narrowing to improve the flow regime • Creation of backwaters and bays for still-water habitat and high-flow refuge	High
20	III	4.3	Railway Line	• Creation of a heathland habitat corridor adjacent to the railway line	High

Opportunity No.	BOA	Figure No.	Area	Opportunities for Enhancing the Ecological Habitat Network	Sensitivity
21	II	4.2	East of North Hykeham	• Creation of new reedbeds to help improve water quality of the River Brant and its tributaries • Creation of wetland habitats/wet meadows to aid flood risk management • Restoration of netural grassland habitat on the river banks • Restoration of semi-natural habitats through targeting of agri-environment schemes • Restoration of wet grassland/floodplain habitats through suitable management	High
22	II	4.2	North-west of Waddington	• Creation of wetland habitats/wet meadows to aid flood risk management • Re-establishment of marginal and in-channel vegetation cover • Channel narrowing to improve the flow regime • Creation of multi-stage channel with a low-flow sediment berm • Creation of backwaters and bays for still-water habitat and high-flow refuge	High
23	I	4.4	Roadside verges South of Lincoln	• Creation of grassland habitat buffers using targeted environmental land management schemes to aid the protection of the calcareous grassland roadside verges	High
24	III	4.2 4.3	Mineral sites East of Whisby	• Creation of heathland/acid grassland habitats as a component of the restoration of mineral sites	High
				• Creation of heathland/acid grassland habitats around the edges of minerals sites already restored to lakes • Restoration to a mosaic of open waterbody and wetland habitats, dependent on submitted sites receiving approval	Medium
25	IV	4.1 4.3	South-east of Doddington	• Restoration of heathland habitats through selective felling of coniferous woodland plantations (where these are not PAWS)	High
				• Restoration of broadleaved woodland habitats through suitable management and/or new planting	Medium
26	-	4.1	West of Skellingthorpe to Thorney	• Creation of woodland corridors/stepping stones to link existing habitats of high value	Medium
27	III	4.3	Whisby Nature Park	• Restoration of relic heathland through appropriate management	High
28	I	4.2 4.4	Lincoln Edge/Cliff (including the Viking Way)	• Protection and restoration of important spring-fed habitats/calcareous flushes, if identified as being present • Restoration of grassland habitats (including calcareous) and corridors through favourable management using agri-environment funding	High
29	III	4.1 4.2 4.3	Minerals sites west of Whisby	• Creation of heathland/acid grassland habitats as a component of mineral site restorations	High
				• Creation of new reedbeds as a component of mineral site restorations • Creation of wet woodland habitat as a component of mineral site restorations, if sites are allocated	Medium
30	III	4.1 4.2 4.3	Tunman Wood	• Restoration of heathland habitats through selective felling of coniferous woodland plantations (where these are not PAWS)	High
				• Creation of wet woodland habitat to aid the control of surface water run-off into adjacent water courses	Low
31	II	4.1 4.2	River Brant and Washlands	• Creation of riparian buffer strips of wet grassland or wet woodland to help improve water quality of the River Brant • Restoration of 'naturalised' channel characteristics through the removal of in-channel obstructions • Maintenance, enhancement and expansion of current wetland site at Blackmoor Bridge	High
				• Assess requirements for de-silting • Creation of in-channel features such as riffle-pool sequences and in-channel deflectors to enhance flow characteristics • Restoration of pasture within washland where feasible	Medium
				• Creation of woodland stepping stones to link isolated woodlands	Low
32	III	4.1	Morton Hall	• Creation of woodland habitat on prison land to link to Tunman Wood	Low
33	-	4.3	Spalford Warren	• Creation of new heathland habitats to buffer the existing rare habitat (blown sand heath)	High
34	-	4.3	Besthorpe Warren	• Restoration and extension of existing heathland/acid grassland habitats	High
35	III	4.3	Minerals sites Swinderby to Stapleford	• Creation of heathland and acid grassland to expand on existing areas of these habitats at Stapleford Moor, dependent on submitted sites receiving approval	High
36	III	4.3	North-West of Stapleford	• Restoration of heathland habitats through selective felling of coniferous woodland plantations (where these are not PAWS) • Restoration of open areas through selective felling, pulling seedlings; prevent reversion to woodland through suitable management, potentially including grazing as well as physical removal of tree seedlings	High

Opportunity No.	BOA	Figure No.	Area	Opportunities for Enhancing the Ecological Habitat Network	Sensitivity
37	II	4.2	North of Brant Broughton	• Creation of a new washland - preferably grassland/pasture, rather than arable to aid flood risk management • Re-establishment of marginal and in-channel vegetation cover • Creation of a multi-stage channel with a low-flow sediment berm • Creation of backwaters and bays for still-water habitat and high-flow refuge	Medium
38	I	4.4	South of Harmston Heath to Webourn Heath	• Restoration of road verges through suitable management e.g. cutting and baling, removing scrub	High
39	III	4.1	Stapleford Woods	• Restoration of ancient woodland sites through selective felling of conifer plantations (restoration of ancient woodland on Plantation Ancient Woodland Sites (PAWS))	High
40	II	4.2	Beckingham	• Restoration of semi-natural habitats at Beckingham Ranges through suitable management • Re-establishment of marginal and in-channel vegetation cover • Channel narrowing to improve the flow regime • Creation of a multi-stage channel with a low-flow sediment berm • Planting occasional tree and shrub cover • Creation of backwaters and bays for still-water habitat and high-flow refuge • Creation of bankside and in-channel woody material deposits • Creation of channel-floodplain habitat connectivity	Medium

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Biodiversity Opportunity Mapping for Central Lincolnshire

5.1.1 The Biodiversity Opportunity Mapping Study for Central Lincolnshire has taken forward the GI Study by providing spatial biodiversity opportunity evidence in support of Local Plan making in accordance with the National Planning Policy Framework objectives.

5.1.2 The Study has created a GIS-based map showing broad proposals for Biodiversity Opportunity Areas across Central Lincolnshire (**Figure 3.5**), which represent areas in which resources should be targeted to maintain, restore, buffer, link and expand wildlife habitats at a landscape scale. Strategic biodiversity enhancement projects, including cost estimates for consideration in the development of the Infrastructure Delivery Plan for Central Lincolnshire, have been identified in relation to the Biodiversity Opportunity Areas. In addition, the Study has produced detailed GIS-based maps showing specific biodiversity opportunities for the Lincoln PUA/SUEs/WVCP (**Figures 4.1 – 4.4**).

5.1.3 For the first time, Biodiversity Opportunity Mapping for the whole of Central Lincolnshire now exists to inform a range of applications in relation to land use planning and environmental land management. Taken together with the more detailed opportunity mapping within the Lincoln PUA/SUEs/WVCP, the Study is considered to provide a useful tool to assist decision-making in Central Lincolnshire.

5.1.4 The Biodiversity Opportunity Mapping Study provides an overview of the broad spatial characteristics for the protection, recreation and expansion of Central Lincolnshire's ecological network. The information contained within the BOM Study should be viewed as a starting point, rather than an end in itself, for planning biodiversity enhancement initiatives. Specifically, the BOM Study provides the basis for the development of Central Lincolnshire's Ecological Network Strategy, as described in the Green Infrastructure Study for Central Lincolnshire[17].

5.1.5 The BOM Study currently identifies a range of suitable habitat types which could be created at some locations. The Ecological Network Strategy will therefore be required to make informed choices regarding preferences for the selection of one habitat type in favour of another, dependent on the detail of a given scenario (e.g. minerals restorations, requirements for flood risk management, growth and development).

[17] CBA (2011). Green Infrastructure Study for Central Lincolnshire. Volume 1 – Strategy. Table 4.1 Long List of Strategic Initiatives and Projects No.15, page 40. For and on behalf of Central Lincolnshire Joint Planning Unit.

5.2 Constraints and Limitations within the mapping process

5.2.1 The principal constraint to the Study relates to the limited application of soils data in defining BOAs due to the complexity and high costs of these data, particularly with respect to calcareous grassland mapping. 'Bedrock' data was used to provide some guidance in defining the calcareous grassland opportunity area. However, this dataset lacks the refinement of soils data, which is capable of providing a greater level of accuracy in predicting exact locations where establishing calcareous grasslands is likely to be successful. Similarly, bedrock data cannot identify anomalies such as overlying superficial soil deposits necessary for the refinement of priority areas.

5.2.2 Whilst every reasonable effort has been made to source and use relevant and up to date digital data for the Study, the Biodiversity Opportunity Mapping reflects the current coverage and quality of digital habitat data available within the timescale constraints of the project. In particular, there is a notable lack of consistency in the recording and classification of habitat types within metadata provided in some datasets. In these cases, it would be prudent to exercise a degree of caution in the interpretation of site-specific opportunities without further checking and validation of the data.

5.3 Endorsement and Communication

5.3.1 It is recommended that the Central Lincolnshire Joint Planning Unit, its associated Local Planning Authorities (City of Lincoln Council, North Kesteven District Council and West Lindsey District Council) and the Greater Lincolnshire Nature Partnership considers formally endorsing the findings of the Biodiversity Opportunity Mapping Study as a basis for informing decision-making across Central Lincolnshire. Consideration should also be given to promoting awareness of the key findings of the study through appropriate methods of communication, and it is recommended that the report is made available to download from the Central Lincolnshire Joint Planning Unit and Greater Lincolnshire Nature Partnership website following endorsement.

5.4 Biodiversity Action Plan Delivery

5.4.1 The Lincolnshire Biodiversity Action Plan, administered by the Greater Lincolnshire Nature Partnership[18], sets out the quantitative targets for increasing and enhancing the biodiversity resource of Lincolnshire. It is recommended that the Central Lincolnshire Biodiversity

[18] http://www.glnp.org.uk/

Opportunity Maps should be used as the spatial framework for identifying opportunities to deliver the BAP targets summarised in Table 6.1 below.

Table 6.1: Summary of Lincolnshire's BAP Habitat Targets

Habitat Type	Action	Quantity
Arable Field Margins	Creation	700ha
Grazing Marsh	Restoration Creation	800ha 1200ha
Hedgerows	Creation	75km
Calcareous grassland	Restore / increase	275ha
Lowland meadows	Restore / increase	65ha
Heathland	Restore / increase	100ha
Lowland dry acid grassland	Restore / increase	70ha
Chalk Streams	Restore	90km
Fen	Expand	1000ha
Ponds	Create	200
Ponds, lakes and rivers	Reduce diffuse input of nutrients & fertilizers to stillwaters	-
Reedbed	Increase	500ha
Rivers, canals and drains	Restore degraded riparian habitat	150km
Springs & Flushes	Enhance	30 non-chalk springs

5.4.2 It should be noted, however, that these targets relate to the whole county. Therefore assessing the contribution made through the delivery of BOM projects and initiatives for Central Lincolnshire should be considered as a proportion of the whole target.

5.5 Green Infrastructure and Biodiversity Planning

Policy Context

5.5.1 The Biodiversity Opportunity Mapping provides the local planning authorities in Central Lincolnshire with spatial evidence to support local green infrastructure and biodiversity planning work.

5.5.2 The Government's National Planning Policy Framework (NPPF) states that: *'The planning system should contribute to and enhance the natural and local environment by: minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures…'* (109). NPPF 114 requires local planning authorities to *'set out a strategic approach in their Local Plans, planning positively for the creation, protection, enhancement and management of networks of biodiversity and green infrastructure…'*.

5.5.3 NPPF 117 goes on to state that: *'To minimise impacts on biodiversity and geodiversity, planning policies should:*

- *Plan for biodiversity at a landscape-scale across local authority boundaries;*
- *Identify and map components of the local ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity, wildlife corridors and stepping stones that connect them and areas identified by local partnerships for habitat restoration or creation;*
- *Promote the preservation, restoration and re-creation of priority habitats, ecological networks and the protection and recovery of priority species populations, linked to national and local targets, and identify suitable indicators for monitoring biodiversity in the plan.'*

5.5.4 In accordance with the NPPF, it is recommended that the Central Lincolnshire Biodiversity Opportunity Areas set out in **Section 3.0** should be used as spatial evidence to support Policy CL24 (Green Infrastructure & Biodiversity) of the emerging Central Lincolnshire Local Plan Core Strategy[19]. Policy CL24 states:

The Central Lincolnshire Authorities will work with partners, stakeholders and others to conserve, restore and enhance the green infrastructure, biodiversity and geodiversity of Central Lincolnshire for the benefit of residents, visitors and wildlife. In doing so, the Local Plan will support the creation of a high quality, accessible and multi-functional network of green infrastructure across the area, which contributes to healthy and active lifestyles and delivers the benefits of rich and diverse natural environments and ecosystems for Central Lincolnshire.

The Local Plan, other strategies, development, and local investment will:

Green Infrastructure

- *Maximise the potential of existing and new green infrastructure, including public and other open spaces, by promoting proposals that benefit:*
- *… biodiversity; geodiversity; flood and water management; the conservation of landscape character … carbon reduction and resilience to climate change. Improvements to links between green infrastructure assets within and extending beyond the area should be considered;*
- *Support the implementation of the Green Infrastructure Strategy for Central Lincolnshire, including the Green Infrastructure Network … This includes linking larger areas of … biodiversity value across Central Lincolnshire. Development proposals crossing or adjacent to the Network should make provision for its implementation and/or enhancement;*

Biodiversity & Geodiversity

- *Safeguard nature conservation, biodiversity and geodiversity assets within and outside of Central Lincolnshire from adverse effects of development by:*
- *Pursuing opportunities to conserve and enhance biodiversity and ecological networks, having regard to priority biodiversity habitats and species and the restoration of declining habitat assets;*

Proposals for development will be required to accord with these policy principles and requirements and not adversely affect any designated site or any important habitat, species, geological feature or green infrastructure asset. Adequate information must be submitted with planning applications that may affect such assets to allow the likely impacts to be fully assessed.

[19] Central Lincolnshire Local Plan Core Strategy (Publication Version, July 2013)

Without this there will be a presumption against granting permission. Where, exceptionally, the benefits of a development outweigh the importance of a local nature conservation site, species, habitat or green infrastructure feature, the adverse impacts must be minimised and mitigated as far as possible and any losses offset either off-site or as an integral part of the development, to achieve a net gain for green infrastructure and biodiversity.

5.5.5 In addition, it is recommended that the Biodiversity Opportunity Mapping for the Lincoln PUA/SUEs/WVCP set out in **Section 4.0** should be used as spatial evidence to support Policy L1 (Strategy for Growth in the Lincoln Area), L3 (Green Wedges and Green Infrastructure in the Lincoln Area) and Policy L8 (Lincoln Western Growth Corridor (Land at Swanpool, Fen Farm and Decoy Farm)[20]. Policy L1 states:

Protect, nurture and enhance Lincoln's natural … environment and assets as a key component of the strategy for growth by:

- *Respecting Lincoln's unique character and setting, including its … biodiversity, geodiversity, views and corridors that contribute to these;*

Policy L3 states:

The Central Lincolnshire Authorities will work with partners and stakeholders to protect, enhance and deliver an integrated green infrastructure network for the Lincoln area. In addition to meeting the general principles for green infrastructure and biodiversity in Policy CL24, this network will meet the specific requirements for the Lincoln area, and will be achieved through development management, investment and appropriate management of land. In relation to growth and development in the Lincoln area, the Local Plan will:

- *Protect and enhance the existing network of green spaces, including Green Wedges and wildlife sites … together with any future revisions to the network;*
- *Undertake a review of the existing Green Wedge network as part of the Central Lincolnshire Local Plan to consolidate, enhance and, where appropriate, extend the network, including revised or additional designation of land if required, taking account of:*
  - *The opportunities identified in the Green Infrastructure Study for Central Lincolnshire;*
  - *the proposed locational priorities for development in the Lincoln area, including the Sustainable Urban Extensions …*
- *Maintain, enhance and develop a comprehensive local Green Infrastructure Network based on the Green Infrastructure Network Concept Plan for the Lincoln area, by:*
  - *The protection, enhancement and creation of Local Green Links to connect the Lincoln Urban Green Grid to the Strategic Green Access Links, greenspace and habitats in the countryside around the city,*
  - *including the Witham Valley, and also to the surrounding satellite villages;*
- *Support the delivery of the Witham Valley Country Park …;*
- *Protect the Lincoln Edge escarpment and its natural character from inappropriate development;*
- *Protect and enhance the environmental quality of landscapes that contribute to the character and setting of Lincoln and its setting, including the key access corridors, Green Wedges and woodlands;*
- *Retain existing important natural green spaces, including woodland, and provide significant levels of habitat re-creation to form stepping stones to link existing wildlife habitats;*
- *Provide extensive levels of new accessible natural green space to meet the needs of the expanding population for outdoor recreational space, and to act as ecological buffer zones to protect sensitive wildlife habitats;*
- *Promote the use of green roofs and walls to provide wildlife linkages between green spaces.*

[20] *Ibid.*

Policy L8 states:

To ensure that the development contributes positively to the conservation and enhancement of the environmental quality and character of the Lincoln area, and that adverse impacts are minimised and mitigated, the masterplan and development should:

- *protect and, where appropriate, enhance sites within and adjoining the development that are designated for … nature conservation purposes, including Critical Natural Assets, Basic Natural Stock and Green Wedges …;*
- *satisfactorily resolve any issues of public access or visitor management in relation to designated sites and biodiversity arising from the development;*

5.5.6 Additionally, it is recommended that the BOM Study be extended to provide detailed opportunity mapping to support Core Strategy policies that relate to other towns within Central Lincolnshire. In particular, the BOM Study can help and supplement the overarching aims of policies promoting the protection and enhancement of land for nature conservation purposes (A Quality Environment) for the following:

- Area Policies:
  - Gainsborough Area Policy G6 (Green Infrastructure and Settlement Breaks in the Gainsborough Area)
  - Sleaford Area Policy S6 (Green Infrastructure in the Sleaford Area)

- Sustainable Urban Area Policies:
  - Gainsborough Policy G7 (Southern Neighbourhood SUE)
  - Gainsborough Policy G8 (Southern Neighbourhood SUE)
  - Seaford Policy S7 (Sleaford South SUE)
  - Sleaford Policy S8 (Sleaford West SUE).

5.5.7 Similar exercises in mapping detailed biodiversity opportunities for Caistor and Market Rasen should also be considered.

Planning and Delivery

5.5.8 It is recommended that the BOM Study is used to inform **site allocations** by identifying the need to:

- Avoid sensitive habitats and/or their buffers;
- Prevent the fragmentation of the ecological network through inappropriate location selection;
- Prevent the creation of barriers to species dispersal and habitat connectivity;
- Protect vulnerable or sensitive habitats;
- Restore degraded habitats;
- Enhance habitats; and,
- Extend habitats to restore or enhance the ecological network.

5.5.9 The following principles should be used in assessing the potential of a site allocation (and planning application) to helping create a coherent and resilient ecological network for Central Lincolnshire:

Biodiversity Opportunity Planning Principles

1. **Habitats that contribute towards the protection and enhancement of the ecological network should be embedded into the selection of land allocations and incorporated into the layout of new development.**

2. **Development should retain, enhance and/or create habitats that positively contribute to the ecological network and support connectivity with the town centre, urban fringe areas and the wider countryside.**

3. **Development that will cause significant harm to the functioning of the ecological network, particularly in relation to reducing the impacts of and adapting to climate change, should be discouraged.**

4. **Where an adverse impact on the ecological network (or its components) is unavoidable, development should provide suitable mitigation measures to ensure the overall multi-functionality and connectivity of the ecological network is maintained.**

5. **Development should provide or contribute towards the provision of on- or off-site habitats as appropriate in locations with identified deficiencies, including arrangements for on-going management and maintenance of the ecological network.**

6. **Development should deliver a net increase in biodiversity by incorporating opportunities to enhance biodiversity and improve ecological connectivity, including contributing to local Biodiversity Action Plan targets.**

7. **Development should incorporate measures for adapting to and mitigating against the effects of climate change through innovative ecological design solutions, including sustainable water management/drainage systems and urban cooling measures.**

5.5.10 Funding for delivery of biodiversity enhancements and habitat creation to secure and protect the ecological network, related to individual developments may be secured from developer contributions. This enables the Council to require developers to provide (or make financial contributions towards) infrastructure and community benefits which the Council considers necessary in conjunction with development, secured either through a planning obligation or payment of a **Community Infrastructure Levy** (CIL) charge. The types of biodiversity enhancements and habitat creation related community benefits which the Council may pursue through planning obligations include the restoration, expansion and/or creation of new habitats that positively contribute towards the ecological network. This may be particularly relevant in situations where it may be particularly difficult to avoid habitats associated with the proposed development site.

5.5.11 **Biodiversity offsetting** is a new approach (within the UK) to addressing the residual ecological impacts of planned development which is currently being tested as a pilot scheme in a number

of local authority areas. Defra has recently released a consultation paper on how biodiversity offsetting could be applied to the planning system. It is recommended that the CLJPU reviews the progress of the pilot schemes and consultation process to monitor how biodiversity offsetting may applied in Central Lincolnshire, and how it may contribute towards delivery of the ecological network.

5.5.12 Furthermore, it is recommended that consideration should be given to incorporating the strategic biodiversity enhancement projects set out in **Section 3.4**, into the Central Lincolnshire Infrastructure Delivery Plan.

5.5.13 It is recommended that the Biodiversity Opportunity Mapping is used to update and inform the delivery of the Green Infrastructure Strategy set out in the Central Lincolnshire Green Infrastructure Study, including providing the basis for developing the proposed Central Lincolnshire Ecological Network Strategy and Local Green Infrastructure Delivery Plans.

5.6 Minerals and Waste Local Plan

5.6.1 It is recommended that the opportunity mapping is used as a tool for identifying appropriate end-use restorations for existing and future minerals sites in Central Lincolnshire. The Minerals and Waste Development Framework Sustainability Appraisal / Strategic Environmental Assessment Scoping Report [21] states: *"Over much of the twentieth century, active and closed mineral workings provided considerable opportunity for biodiversity through natural colonisation or designed restoration leading to increases in biodiversity. Restoration of mineral works can contribute significantly to habitat creation, adaptation to climate change and improving access to the countryside"*.

5.6.2 In recognition of this, the Preferred Minerals and Waste Strategy[22] recognises the value that minerals sites restoration can play in:

- Developing the Witham Valley Country Park's assets;
- The significant contribution that woodland creation and management can make to adaptation strategies both for floodplain management and for biodiversity, particularly through the creation of Forest Habitat Networks; and,
- Large scale habitat creation schemes … which … include the creation of grazing marsh, fenland habitats and heathland areas.

5.6.3 With respect to biodiversity, the Strategic Objectives of the Core Strategy states that: "*At the cessation of mineral working, after-uses will be identified which best meet local circumstances.*

[21] Scott Wilson (2008). *The Minerals and Waste Development Framework Sustainability Appraisal / Strategic Environmental Assessment Scoping Report*. on behalf of Lincolnshire County Council

[22] *Preferred Minerals and Waste Strategies*. Lincolnshire County Council. June 2010.

The enhancement of existing, and the creation of new biodiversity habitats, and green infrastructure will be key objectives";

5.6.4 The Biodiversity Opportunity Mapping also provides spatial evidence to support the Lincolnshire Minerals and Waste Local Plan. It is recommended that the Biodiversity Opportunity Mapping information is used to inform reviews of the Lincolnshire Minerals and Waste Local Plan with respect to identifying opportunities for the after-use of minerals sites within Central Lincolnshire to contribute to the restoration, linking and expansion of wildlife habitats at a landscape-scale.

5.6.5 The precise selection of the most appropriate and sustainable restoration programme for a given site will need to be considered on a case-by-case basis. The BOM Study does, however, provide guidance on the selection of the most appropriate habitats to which a given site could be restored (based on the priorities set out in the Lincolnshire BAP), for example:

- Sites to the north of Gainsborough, in the Coversands area (BOA I), should preferentially be restored to heathland and acid grassland habitats;
- Sites within the Trent Valley, particularly to the south and south-west of Gainsborough (BOA D), should preferentially be restored to wet woodland, wet grassland, open waterbody habitats;
- Sites on the sand and gravel deposits to the south west of Lincoln (BOA K), should preferentially be restored to heathland, acid grassland and open waterbodies; and,
- Sites in the major river valleys (BOAs E, F, G, H), should preferentially be restored to open waterbodies, wet and neutral grassland.

5.6.6 The exact selection of preferred habitat restoration for a given site will require detailed discussion and investigation, to determine the likelihood of success. For example, identifying the height of the water table will determine whether open water or a terrestrial habitat may be more achievable. Or, soil conservation may be the priority, in which case the creation of dry and/or wet grassland habitats may be the most suitable approach. Similarly, the location of a site may influence the design to the restoration. For example, open water habitats in combination with reedbeds and/or wet woodland and which exclude the creation of wet grassland (which could attract geese and other flocking birds), may be a suitable approach to restoring sites in close proximity to airfields where the threat of bird strikes needs to be taken into account.

5.6.7 It should also be borne in mind that the type of restoration will depend on the previous use of the land prior to extraction. This may not always favour habitat creation for enhancing Central Lincolnshire's ecological network, particularly where the restoration of high quality agricultural land (ALC Grades 1, 2 and 3a) and soil conservation may provide greater benefit.

5.6.8 Overall, the opportunities presented through the restoration of minerals and waste sites could provide a 'step change' in the delivery of BAP targets, particularly through the creation of wetlands, grasslands and heathlands.

5.7 Water Framework Directive Delivery

5.7.1 It is recommended that the opportunity mapping is used as a tool for identifying biodiversity opportunities that contribute towards delivering interventions that will improve the chemical and ecological quality of Central Lincolnshire's watercourses and wetlands. This is a key component for meeting water quality and water resources obligations as required by the Water Framework Directive (WFD).

5.8 Environmental Land Management Targeting

5.8.1 The recent reform of the Common Agricultural Policy will result in considerable changes to funding for agri-environment measures and woodland planting. There will also be a suite of 'greening' measures and encouragement of voluntary initiatives. Proposals will be firmed up during 2014, ready for implementation from 2015. It is recommended that the opportunity mapping is used to inform targeting of funding and advice to farmers and landowners.

5.9 Data Management

5.9.1 The digital datasets used and presented on the report figures within this Study reflects the current availability, coverage and quality of digital habitat data within Central Lincolnshire. In order to ensure that the partners have access to the most up to date biodiversity data, it is important that the Lincolnshire Environmental Records Centre develops appropriate standardised protocols for data recording, storage, management and access. It is recommended that the data management protocol is based on the key principles set out in Section 4.10 of the Central Lincolnshire Green Infrastructure Study.

5.9.2 With regards to the Biodiversity Opportunity Areas identified and mapped by this Study, the boundaries of these areas should be kept under review in light of the future availability of additional/enhanced digital habitat datasets (see below), and updated as necessary.

5.10 Recommendations for Further Work

5.10.1 Recommendations for further work include:

- The acquisition of soils data as resources allow to further refine the habitat opportunity mapping, particularly in relation to calcareous grassland;
- Developing a programme for checking and validating existing digital habitat data to ensure consistency in the recording and classification of habitat types within metadata;
- Undertaking an audit of all non-digitised habitat data and develop a programme validating and digitising these datasets for incorporation into the BOM maps;
- Targeting future survey effort to map habitats in areas where there is currently limited knowledge / information (e.g. the A15 corridor north of Lincoln);
- Using the model for detailed Biodiversity Opportunity Mapping developed at the Lincoln PUA/SUEs/WVCP scale for the other growth area locations within Central Lincolnshire (i.e. the Gainsborough Area and the Sleaford Area);
- Developing a web-based interactive Central Lincolnshire Biodiversity Opportunity Areas mapping to facilitate easy access to, and use of, the Study's outputs.

5.10.2 In order to ensure the longevity of the BOM Study and to ensure it remains current and relevant to all those who use it, it is recommended that the strategic projects set out in Table 3.1 undergo feasibility testing. The purpose of the testing is to ensure that the findings of the BOM Study can be translated into action on the ground.

GLOSSARY

Ancient Woodland: refers specifically to woodland that has existed continuously since 1600 or before in England and Wales. Prior to 1600, planting of new woodland was uncommon, so a wood present in 1600 was likely to have developed naturally and therefore has the potentially to be of significant biodiversity value.

Biodiversity Action Plans (BAPs): programmes to address issues affecting threatened species and habitats and are designed to protect and restore biological systems. Typically, Biodiversity Action Plans include: data relating to selected species or habitats; an assessment of current conservation status; targets to aid the conservation and restoration of the selected species or habitats; and, a programme of works for delivering conservation initiatives.

Biodiversity Offsetting: an approach currently being explored in England and Wales, to addressing the residual ecological impacts of planned development, once the legal and regulatory hierarchy for the protection and conservation of biodiversity, has been applied. The introduction of the biodiversity offsetting concept is in response to the findings set out in the Lawton Review (Making Space for Nature) and subsequently enshrined in Defra's Natural Environment (The Natural Choice: securing the value of nature) White Paper, published June 2011.

Biodiversity Opportunity Mapping (BOM): a process for identifying a spatial framework at varying scales for targeting resources to protect, manage, enhance, extend and create semi-natural habitats.

Biodiversity Opportunity Areas (BOAs): areas defined through the Biodiversity Opportunity Mapping process, usually within distinct geographical (e.g. landscape and/or topographical) locations. BOAs may relate to predominantly one or a mosaic of different habitat types, for which opportunities to protect, manage, enhance, extend and create have been identified.

Brownfield sites: a jargon term that describes land previously used for industrial purposes or some commercial uses. The land may be contaminated by low concentrations of hazardous waste or pollution, and has the potential to be reused once it is cleaned up.

Central Lincolnshire (C Lincs): The Central Lincolnshire Joint Planning Unit and the Central Lincolnshire Joint Strategic Planning Committee, a local partnership of City of Lincoln, North Kesteven, and West Lindsey councils together with Lincolnshire County Council, are working together to create an overall plan for Central Lincolnshire.

Community Infrastructure Levy (CIL): allows local authorities in England and Wales to raise funds from developers undertaking new building projects in their area. The money can be used to fund a wide range of infrastructure that is needed as a result of development. This includes transport schemes, flood defences, schools, hospitals and other health and social care facilities, parks, green spaces and leisure centres.

Geographical Information Systems (GIS): a computer based system designed to capture, store, manipulate, analyse, manage, and present all types of geographical data.

Greenspace: a vegetated area within an otherwise urban context that may be used for a variety of purposes. Examples include: parks, gardens, cemeteries and allotments.

Planted Ancient Woodland Sites (PAWS): woodlands which exhibit evidence of former ancient woodland, or for which there is recorded evidence of former ancient woodland, and which have subsequently been planted with coniferous or broadleaved trees.

Principal Urban Area (PUA) (Lincoln): the existing built-up area of the administrative City of Lincoln plus the existing built-up areas of Bracebridge Heath, North Hykeham and Waddington parishes in North Kesteven.

Riparian: of, or pertaining to, river banks

Section 106 agreements (S106): a mechanism for securing planning matters arising from a development proposal. They are commonly used to bring development in line with the objectives of sustainable development as articulated through the relevant planning policies.

Strategic Housing Land Availability Assessment (SHLAA): is an evidence base to inform the Local Development Framework. This assessment provides a comprehensive review of potential housing sites to ensure there is sufficient land for housing to meet Central Lincolnshire's future needs. In particular, it informs the preparation of the CLJPU's Core Strategy and associated supporting documents.

Sustainable Urban Drainage (SUDS): widely used in urban areas to control water flow and help reduce the risk of floods. SUDS use natural processes to purify urban run off before it is finally discharged to the receiving watercourse, and are designed to slow down and retain any water flows on site.

Sustainable Urban Extensions (SUEs): locations identified for future development that encompass and address sustainability issues relating to transport, green infrastructure and employment through large-scale masterplanning.

Washlands: an area of flood plain that is allowed to flood or is deliberately flooded for flood management purposes.

Water Framework Directive (WFD): is a European Union directive which commits European Union member states to achieve good qualitative and quantitative status of all water bodies by 2015. The Directive aims for 'good status' for all ground and surface waters (rivers, lakes, transitional waters, and coastal waters) in the EU.

The ecological and chemical status of surface waters are assessed according to the following criteria:

- Biological quality (fish, benthic invertebrates, aquatic flora);
- Hydromorphological quality such as river bank structure, river continuity or substrate of the river bed;
- Physical-chemical quality such as temperature, oxygenation and nutrient conditions; and,
- Chemical quality that refers to environmental quality standards for river basin specific pollutants. These standards specify maximum concentrations for specific water pollutants. If even one such concentration is exceeded, the water body will not be classed as having a "good ecological status".

Witham Valley Country Park (WVCP): North Kesteven District Council, West Lindsey District Council, City of Lincoln Council and others are working together on the development of the sub-regional Witham Valley Country Park on the south western side of Lincoln. The Park is centered on Hartsholme Country Park and Whisby Nature Park and incorporates a number of other green spaces in the area, including Lincoln's Commons, Skellingthorpe Old Wood and Tunman Wood. The aims of the Park are to improve access to and connectivity between these green spaces, develop opportunities for sustainable tourism and conserve local biodiversity.