National Character Area profile:

# 47. Southern Lincolnshire Edge



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# Introduction

As part of Natural England's responsibilities as set out in the Natural Environment White Paper,[1] Biodiversity 2020[2] and the European Landscape Convention,[3] we are revising profiles for England's 159 National Character Areas (NCAs). These are areas that share similar landscape characteristics, and which follow natural lines in the landscape rather than administrative boundaries, making them a good decision-making framework for the natural environment.

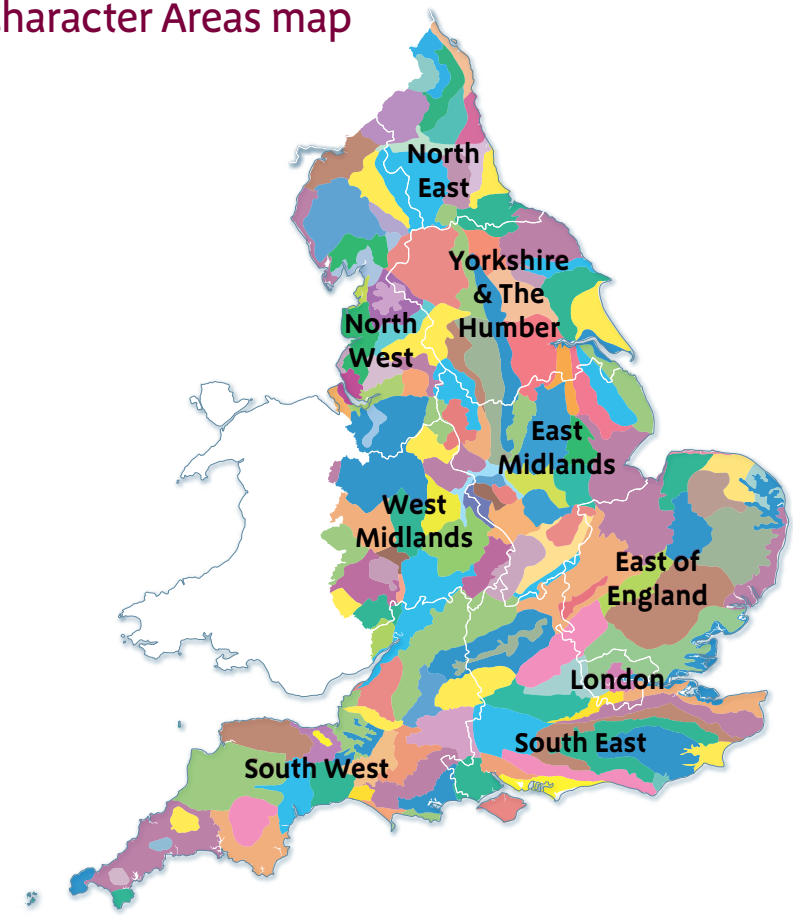
NCA profiles are guidance documents which can help communities to inform their decision-making about the places that they live in and care for. The information they contain will support the planning of conservation initiatives at a landscape scale, inform the delivery of Nature Improvement Areas and encourage broader partnership working through Local Nature Partnerships. The profiles will also help to inform choices about how land is managed and can change.

Each profile includes a description of the natural and cultural features that shape our landscapes, how the landscape has changed over time, the current key drivers for ongoing change, and a broad analysis of each area's characteristics and ecosystem services. Statements of Environmental Opportunity (SEOs) are suggested, which draw on this integrated information. The SEOs offer guidance on the critical issues, which could help to achieve sustainable growth and a more secure environmental future.

NCA profiles are working documents which draw on current evidence and knowledge. We will aim to refresh and update them periodically as new information becomes available to us.

We would like to hear how useful the NCA profiles are to you. You can contact the NCA team by emailing ncaprofiles@naturalengland.org.uk.

## National Character Areas map



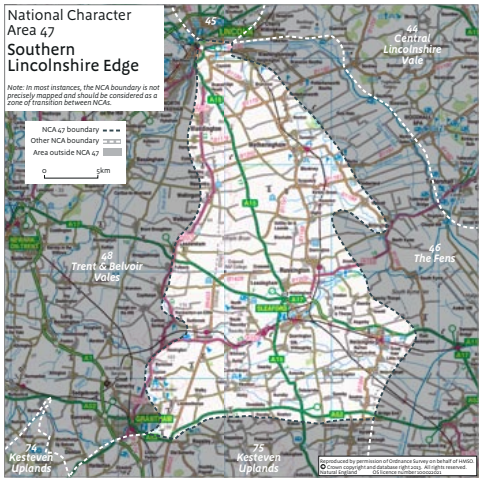

[1] The Natural Choice: Securing the Value of Nature, Defra (2011; URL: www.official-documents.gov.uk/document/cm80/8082/8082.pdf)
[2] Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services, Defra (2011; URL: www.defra.gov.uk/publications/files/pb13583-biodiversity-strategy-2020-111111.pdf)
[3] European Landscape Convention, Council of Europe (2000; URL: http://conventions.coe.int/Treaty/en/Treaties/Html/176.htm)

# Summary

The Southern Lincolnshire Edge is an area of clear character defined by the dramatic limestone cliff to the west and the dip slope that drops gently away to the edge of the fens in the east. It shares the cliff and the dip slope, and many landscape characteristics, with the Northern Lincolnshire Edge and Coversands National Character Area to the north. It is an open landscape with far-reaching views over the Trent and Belvoir Vales and up to Lincoln Cathedral. On the free-draining higher ground, landcover is primarily arable, in large geometric fields divided by limestone walls, with few trees or woodland. On the wetter, heavier clay soils to the east and south-west, pasture is more prevalent; hedgerows are the predominant boundary and the landscape has a more intimate, enclosed feel, with more trees, woodland and parkland.

The underlying Jurassic Limestone geology has a defining impact on the landscape, not just through the distinctive topography, but also through its widespread use for construction of walls and buildings and numerous limestone quarries, both active and disused. Semi-natural habitats – including calcareous and neutral grassland and broadleaved woodland – are fragmented and sparsely scattered. Wide verges along roads and tracks provide important refuges for unimproved flower-rich grassland. The farmland supports large numbers of arable birds such as skylark, lapwing, grey partridge and corn bunting. There are many visible reminders of early human activity in the form of Roman roads and canals, such as Ermine Street and Car Dyke, medieval ridge and furrow, deserted medieval villages and moated sites. The 20th-century heritage includes a number of airfields created during the World Wars and industrial buildings such as the Bass Maltings in Sleaford.

The primary ecosystem services provided by this area include food provision, biomass provision, water availability, sense of place and sense of history. Enhancements in management of soil, water, habitats and landscape features on agricultural land could help to strengthen the provision of many of these services. More efficient use, capture and re-use of water by industry and households could help to protect the major aquifer and water availability from rivers. The protection of archaeology, historic buildings and traditional villages is key to preserving sense of place and sense of history.




Click map to enlarge; click again to reduce

## Statements of Environmental Opportunities:

- **SEO 1:** Enhance the agricultural landscape and soils to increase efficiency of food production, conserve and connect fragmented patches of limestone grassland and woodland and maintain the traditional fabric of the rural landscape, to preserve sense of place and sense of history, protect water quality, enhance biodiversity and improve resilience to climate change.

- **SEO 2:** Protect and sympathetically manage geological features and historic features such as Ermine Street Roman road, medieval earthworks, industrial buildings, historic drystone wall networks and traditional villages, to sustain a sense of history and sense of place, providing interpretation to aid understanding of the landscape.

- **SEO 3:** Ensure that new development is planned and executed to preserve a sense of place, sense of history, tranquillity and biodiversity, while minimising water use and avoiding exacerbation of flooding and habitat fragmentation.

- **SEO 4:** Enhance the provision for access and recreation while maintaining the tranquillity of undisturbed areas and providing educational opportunities and interpretation.

**Productive arable land occupies higher ground on the Southern Lincolnshire Edge, with large fields and low boundaries giving an open feel and far-reaching views.**

# Description

## Physical and functional links to other National Character Areas

To the north, the high, arable, limestone plateau continues through the Northern Lincolnshire Edge and Coversands National Character Area (NCA). There are many similarities between the two NCAs. The ridge of Jurassic Limestone that runs through them is part of a belt that runs from the Dorset Coast to the Humber Estuary. The Trent and Belvoir Vales NCA lies to the west, while the flat, drained land of The Fens NCA can be found to the east.

The River Witham rises south of Grantham, passes through Lincoln and drains to The Wash at Boston. The River Slea rises in this NCA at West Willoughby near Ancaster, and drains north-east into The Fens NCA to join the River Witham and eventually drain into The Wash. The Witham catchment features the Trent Witham Ancholme River Transfer Scheme. The limestone holds a regionally important aquifer and supplies water for industry, agriculture and domestic consumption.

There are a number of long-distance routes linking this to other NCAs: historic routes such as Ermine Street, a Roman road linking London to Lincoln and York; and walking routes such as the Viking Way, between Rutland Water and the Humber Bridge, which although created in the 1970s reflects the historic influence of Danelaw in the area.

Major road routes include the A15 linking Sleaford to Lincoln. Railways run east–west linking Sleaford to Boston and Nottingham, and north–south linking Sleaford to Lincoln and Spalding.

## Key characteristics

- Elevated arable escarpment with a distinct cliff running north–south along the western boundary, providing far-reaching views over the Trent and Belvoir Vales NCA.
- Productive loamy soils on the limestone plateau, giving rise to a large-scale open landscape of arable cultivation with large, regular fields and few boundaries of tightly cut hedgerows or rubble limestone walls.
- Heavy clay soils in the east and south-west of the area, which support more grazing land in smaller, less regular fields, along with small areas of woodland and parkland.
- Semi-natural habitats in small, isolated fragments, with pockets of woodland on clay soils, fen at the foot of the dip slope and flower-rich limestone grassland, particularly along road verges.
- Sparse settlement on higher land, with springline villages along the foot of the cliff, parklands and country estates such as Rauceby and Belton on lower ground, and larger settlements – including Sleaford, Ruskington and Metheringham – to the east of the dip slope.
- Active and re-used airfields prominent on the ridgetop.
- Long, straight roads and tracks, often with wide verges, including Ermine Street, which follows the route of a key Roman north–south route.
- Vernacular architecture and walling, especially in villages, of local warm-coloured limestone with dark brown pantiles.

## The Southern Lincolnshire Edge today

The landscape of the Southern Lincolnshire Edge National Character Area is one of an elevated, gently sloping plateau with a sharply defined western boundary in the form of a north–south cliff of Jurassic Limestone. The cliff is a dramatic linear feature, with a two-tier section in the south between Leadenham and Grantham. This is made up of a lower tier of ironstone, Lower Jurassic Marlstone Rock, separated from a higher tier of Middle Jurassic Lincolnshire Limestone by the softer Whitby Mudstone Formation. The higher land has fertile soils that support productive, largely arable agriculture in large, regular fields bounded by drystone walls. The landscape is an open one with relatively few trees and woodland and far-reaching views into the Trent and Belvoir Vales to the west and down the dip slope to the fens in the east. Cropping is predominantly cereals, but also sugar beet and potatoes. On lower land to the south-west and the eastern edge, where the dip slope falls to meet the fens, deposits of glacial till result in heavier land that is slower draining and prone to waterlogging in winter. This landscape has a more enclosed, wooded feel, with smaller, less regular fields and more hedgerows, hedgerow trees, parkland and woodland. The heavier land supports more livestock grazing pastures and more mixed farms than on the higher, more freely draining plateau.

Watercourses occur along the cliff edge where the porous limestone meets seams of less permeable clay. Streams also rise on the dip slope and drain into the fenland to the east, the River Slea being the biggest of these. The River Witham cuts through the limestone cliff just south of Lincoln. Dry valleys indicate the free-draining nature of the underlying geology. The agricultural land has a dense network of ditches, particularly on the heavier land, and many have farm reservoirs. There are no water company reservoirs in the area and few natural ponds or lakes, due to the permeable nature of the soils across much of the area. However, the limestone holds a regionally important aquifer and supplies water for industry, agriculture and domestic consumption

Semi-natural habitats are fragmented and sparsely scattered within the Southern Lincolnshire Edge NCA. Verges along roads, tracks and Roman roads provide a valuable refuge for flower-rich limestone and neutral grassland. These habitats support many species of rare plants and in turn provide valuable habitats, food sources and movement corridors for butterflies, insects and other wildlife. Some of the arable land is of great value for arable birds, particularly skylark, lapwing, corn bunting, grey partridge, yellow wagtail, tree sparrow and turtle dove, which use it for nesting and feeding. The River Witham supports white-clawed crayfish. Woodland is primarily composed of oak and ash, interspersed with wild service tree, cherry, aspen and field maple. There are important areas of ancient limewoods on the north-east fringe, along the border with The Fens NCA.

The cliff and the high land to the east of it retain numerous prehistoric and Roman sites, such as the bronze-age triple ditch system at Honington and Ermine Street Roman road. Ridge and furrow is well preserved in some places to the east, under uncultivated grassland. This lower-lying, wetter landscape on the margins of the fens also preserves archaeological features such as Car Dyke Roman drainage channel and several medieval moated sites and fish ponds. The high incidence of medieval defensive sites suggests this area was once regarded as a frontier. The south-west corner of the NCA between Sleaford and Grantham includes several parklands, including Belton Park and Rauceby Park.

Settlement is concentrated around the perimeter of the NCA, along the cliff foot, where villages have been founded on springlines, and at the foot of the dip slope, where the larger conurbations such as Sleaford lie. Many of the villages retain their traditional character, with buildings of local limestone and pantile roofs. Villages to the east of the dip slope tend to be in elongated parishes that stretch between the wetter lowlands suitable for grazing and the higher, drier land better suited for arable cropping. Some manor houses and estates occupy sheltered locations looking up at the cliff, such as Leadenham.

Industry in the area, both historically and today, focuses on limestone and aggregate quarrying and agriculture. Major transport links include busy A roads, such as the A15 between Lincoln and Sleaford, and railway lines running north–south and east–west. Publicly accessible routes and areas are less prolific than in some NCAs; there are only 0.9 km per km2 of public rights of way and no country parks or National Nature Reserves. However, there are long-distance routes such as the Viking Way, 311 ha of publicly accessible land, and a number of parklands – such as Belton – that are open to the public. The area is moderately tranquil; less-disturbed areas include the more remote parts of the sparsely settled areas, the open landscape of the dip slope and the more sheltered, enclosed, traditional landscapes of the claylands, with the area around Sleaford being the most disturbed.

**Sleaford's Bass Maltings is the largest industrial building on English Heritage's 'at risk' register and it is thought to be the largest malting house ever built in Europe.**

## The landscape through time

The limestone that so dramatically defines this area in terms of landform, vegetation and building materials was part of a succession of limestones and mudstones that were laid down across the area during the Jurassic Period, 195-145 million years ago. These rocks and the fossils that they contain provide evidence that they were deposited in shallow tropical seas with reefs, sandbars, tidal lagoons and coastal swamps. During the Pleistocene (1.8-0.01 million years ago) the area was affected repeatedly by glaciation. The ice sheets left tills (boulder clay) that are particularly evident in the southern and eastern parts of the NCA, forming the heavy clay soils of those areas. Meltwater released from the glaciers carried sand and gravel that was deposited in channels below the glaciers or in outwash plains in front of them.

It is thought that the higher land of the dip slope would have been cleared of trees in the early Neolithic. Its free-draining nature would have been attractive to early settlers and would have provided a valuable dry overland route away from the marshy and densely wooded lowlands on either side.[4] Visible reminders of early settlement are widespread, including prehistoric burial mounds, linear boundary features and trackways. Roman activity is visible in structures such as Car Dyke Roman canal, the marching camp at Sudbrook and Ermine Street.

Placenames suggest that villages were of Scandinavian or Saxon origin. Saxon and medieval settlement developed in a series of small villages along the springlines on the western scarp, and on the lower claylands of the dip slope to the east. Archaeological and placename evidence suggests that the area was substantially cleared of woodland by the 11th century and, on higher land, largely unsettled heath was used as common grazing until it was enclosed for farmland from the late 18th century. Medieval and Tudor estates testify to the wealth derived from wool production, the heathlands providing common pastures for sheep, as well as rabbit warrens.

The marginal nature of the soils before improvement and enclosure in the 18th and 19th centuries meant they would have been of limited agricultural productivity, which perhaps contributed to the abandonment of some of the medieval villages in the area, combined with the devastating effect of the Black Death. Enclosure of fields from the common land under the Parliamentary Enclosures Acts of the 18th and 19th centuries resulted in a large-scale regular field boundary network away from the villages. Ermine Street continued to play an important role and influenced the layout of enclosures. Scattered farmsteads were built at this time, typically with combination barns serving cattle courts, although some may have originated as monastic granges or specialist sheep farms in the medieval period. Parklands associated with the country houses of major landowners are found on both sides of the Edge (Lincolnshire Cliff) along its entire length, and in the 19th century estates were responsible for the development of estate villages as well as farmsteads.

The open, reasonably flat ground near the escarpment, with strong prevailing winds to aid take-offs and landings, meant this landscape was well-suited to the selection of sites for airfields, most famously at Cranwell, which was developed from its origins in the First World War to the Royal Air Force's

[4] East Midlands Regional Landscape Character Assessment, East Midlands Landscape Partnership (2010; URL: www.naturalengland.org.uk/regions/east_midlands/ourwork/characterassessment.aspx)

(RAF's) main officer training school. Waddington and other bomber bases were established after 1934 and expanded during the Second World War and the Cold War. Many of the airfields are no longer in use, but some retain runways, hardstandings, bomb dumps and buildings.

The latter half of the 20th century saw widespread agricultural intensification, involving comprehensive drainage schemes, removal of drystone walls and hedgerows to create bigger fields, and an increase in arable production. It also saw an increase in the size of the major settlements and the upgrading of major transport routes. All of these served to reduce and fragment semi-natural habitats. In the 21st century agri-environment schemes have helped to fund the maintenance, enhancement and restoration of traditional field boundaries, semi-natural habitats and historic features such as archaeological earthworks and traditional farm buildings.

**The landscape was well suited to the selection of sites for airfields, most famously at Cranwell, which was developed from its origins in the First World War to the RAF's main officer training school.**

## Ecosystem services

The Southern Lincolnshire Edge NCA provides a wide range of benefits to society. Each is derived from the attributes and processes (both natural and cultural features) within the area. These benefits are known collectively as 'ecosystem services'. The predominant services are summarised below. Further information on ecosystem services provided in the Southern Lincolnshire Edge NCA is contained in the 'Analysis' section of this document.

### Provisioning services (food, fibre and water supply)

- **Food provision:** This is a productive agricultural area, producing arable crops (particularly cereals and oilseeds) and meat from pigs, poultry and sheep. Farms are generally medium to large in size, with most holdings more than 100 ha. Economies of scale mean that many of the businesses could be well-placed to invest in new and innovative machinery and techniques that help to maximise production while minimising environmental impact, such as precision farming, controlled farm traffic and minimum tillage. Farms on the free-draining soils on higher ground may be particularly vulnerable to the effects of drought, so measures to improve soil quality and increase water-use efficiency and water storage will be particularly important in a changing climate.

- **Biomass energy:** Low woodland cover means there is currently limited production of woody biomass. The area has generally medium potential for short rotation coppice and some areas of high potential for miscanthus. A straw-fired power plant has opened in Sleaford, with contracts for supply of surplus straw from farms within a 50-kilometre radius. Greater levels of woody biomass could be provided through the management of existing woodland, where compatible with nature conservation objectives, and through the planting of new woodland in appropriate locations, particularly where it will help to reduce soil erosion and flooding, link isolated woodlands and screen new development.

- **Water availability:** There is water available for abstraction from certain stretches at high and medium flows, and from parts of the Slea only at very high flows. The limestone holds a regionally important aquifer and supplies water for industry, agriculture and domestic consumption. The Witham catchment benefits from the Trent Witham Ancholme River Transfer Scheme, which can transfer water between rivers to maintain minimum flows and meet abstraction needs. Many farms have farm reservoirs to provide water for irrigation. Measures to improve the structure of agricultural soils should help to maximise infiltration rates and aquifer recharge. Opportunities should be sought to incorporate water-saving features and sustainable urban drainage systems into new developments and retrofit into existing buildings and infrastructure. Support should be provided to help businesses and householders to reduce water consumption and increase rain and greywater capture and recycling.

### Regulating services (water purification, air quality maintenance and climate regulation)

- **Regulating water quality:** Water resources are potentially vulnerable to pollution from agriculture and water treatment plants. Support should be provided for farmers and agricultural contractors to encourage best practice in soil and water management, efficient and appropriate use of nutrients and agricultural chemicals, and creation of features to limit run-off of pollutants and sediment such as buffer strips, riparian habitats and settlement ponds. Water companies should be encouraged to make further investment to reduce discharges to rivers.

- **Regulating water flow:** Sleaford is susceptible to both groundwater and surface water flooding, but in general flooding is not a major issue in this area. The Witham and Slea rivers suffer from low flows at times, but these can be moderated using the Trent Witham Ancholme River Transfer Scheme. Measures to reduce speed of rainwater run-off from agricultural land could help to reduce flooding intensity. These could include enhancing soil structure and organic matter, maintaining vegetation cover over winter and creating features such as buffer strips and storage ponds. New development should be planned, and existing development modified, to incorporate sustainable urban drainage systems, to reduce surface water run-off and stagger release of storm water into watercourses.

- **Regulating soil erosion:** Erosion of soil by wind and water is a potentially serious issue in this open arable landscape that has large areas of light soil under cultivation. The shallow, lime-rich soils over limestone (covering 41 per cent) and light textured and shallow variants of the freely draining, lime-rich loamy soils (covering 23 per cent) are at greatest risk of erosion, particularly on sloping, cultivated ground or where soil is exposed. Climate change is likely to bring more frequent extreme weather events that could increase both wind and water erosion of soils. Measures to limit soil erosion could help to increase food production, improve water quality and benefit biodiversity both within the NCA and downstream.

- **Pollination:** Farms in the area grow large quantities of insect-pollinated crops, particularly oilseed rape, so pollination is a potentially important service in this area. The existing fragments of flower-rich grasslands, especially verges along tracks and roadsides, will be important as a source of nectar and overwintering habitat to support pollinator populations, as will hedgerows and field margins. Securing appropriate management of these areas to allow maximum flowering and to extend and link them would benefit pollinators. Helping farmers and agricultural contractors to minimise insecticide use and ensure best practice could help to protect pollinator populations.

- **Pest regulation:** With large areas of contiguous arable land, this is a potentially important service. Measures that could help to increase populations of beneficial predator species include: strengthening networks of flower-rich and rough grassland, particularly in buffer strips around field edges; sympathetic management of hedgerows; and creation of features such as beetle banks and pollen and nectar mix. Evidence on the impact and value of this service is still lacking, and this could be an appropriate area in which to support research.

### Cultural services (inspiration, education and wellbeing)

- **Sense of place/inspiration:** Key components contributing to the sense of place include: the dramatic limestone cliff in the east; the springline villages at the foot of the cliff; the open arable landscape on higher land with large, geometric fields and far-reaching views; the more enclosed landscape with hedgerows, trees, woodland and parkland to the east and south-west that support grazing livestock; the rich Roman, medieval and 20th-century archaeology, particularly straight Roman roads such as Ermine Street, military airfields and the impact of estates in designed landscapes, regular enclosed fieldscapes, farmsteads and estate housing; scattered fragments of flower-rich calcareous grassland, particularly along verges; and widespread use of local limestone in drystone walls and buildings. Protection and positive management of these features should be encouraged.

- **Sense of history:** The Roman, medieval and 20th-century archaeology of the area is particularly rich, with Roman routeways and canals, deserted medieval villages and moated sites, and many abandoned airfields still highly visible in the landscape. The traditional character of villages has been maintained and the historic routeways and what remain of traditional field boundaries serve as a reminder of historic land use. Placenames are largely of Scandinavian and Saxon origin. Designated and important historic features should be protected and sympathetically maintained and managed. New development, including of airfield sites and industrial buildings, should consider this historic character and context.

- **Biodiversity:** Although semi-natural habitats are highly fragmented in this landscape, there are some sites of great value for biodiversity, particularly calcareous and neutral grassland and ancient woodland. Road and track verges offer important refuge for flower-rich grassland but need appropriate management and protection from vehicular damage to realise their wildlife potential. Farmland can be of great value for arable and wading birds, with this NCA being ranked as one of the top five in England for skylark. Opportunities to increase the extent and connectivity of existing sites should be sought while taking care to avoid any impact on food production. Restoration of mineral extraction sites provides opportunities to create new priority habitats.

- **Geodiversity:** The dramatic limestone cliff and disused quarry sites provide some valuable exposures of limestone and ironstone which illustrate the geological history of the area. Geological sites should be protected and positively managed, and access and high-quality interpretation provided, to make the most of this educational and scientific resource. Quarry restoration schemes should be encouraged to retain geological exposures and provide public access to them.

# Statements of Environmental Opportunity

**SEO 1: Enhance the agricultural landscape and soils to increase efficiency of food production, conserve and connect fragmented patches of limestone grassland and woodland and maintain the traditional fabric of the rural landscape, to preserve sense of place and sense of history, protect water quality, enhance biodiversity and improve resilience to climate change.**

**For example, by:**

- Providing information, advice, training and other support to help farmers use new technology, such as precision farming, that reduces the negative environmental impacts of food production.
- Providing information, advice, training and support to farmers to promote best practice and help farmers to: enhance soil structure and organic matter (through measures such as minimum tillage, controlled farm traffic and green manures); reduce soil erosion (through measures such as tree and hedgerow planting, buffer strips, infield grass strips and beetle banks, and establishing vegetative cover and/or green manures over winter); reduce diffuse and point-source water pollution (through measures such as updating infrastructure and creating features such as buffer strips, settlement ponds or silt traps, and riparian woodland); minimise water use; and increase capture and re-use of greywater and rainwater.
- Providing training for agricultural contractors and sprayer operators on protection of watercourses and groundwater and on best practice in insecticide use to avoid harm to pollinator and beneficial predator populations.
- Encouraging farmers, particularly in primarily arable areas, to provide or leave flower-rich habitats as a nectar-source for pollinators and areas of rough grass for over-wintering, and to use alternative measures for insect pest management and control.
- Supporting research into the potential for and value of natural pest control services in this National Character Area (NCA) and disseminating useful findings to local farmers and agricultural contractors.
- Encouraging less frequent cutting of hedgerows and creation of features to benefit farmland birds, such as overwintered stubbles, fallow nest plots and wild birdseed mix.
- Encouraging appropriate management and restoration of species-rich roadside verges to maintain and enhance their wildlife and landscape value, and the creation of species-rich grassland on adjacent land to increase their value as wildlife corridors.
- Exploring opportunities for production of timber and woody biomass from existing woodlands, where this is compatible with or beneficial to nature conservation objectives, and new tree planting in locations where it will help to reduce wind erosion of agricultural soil, intercept run-off from agricultural land, provide shade for livestock and buildings, connect isolated fragments of woodland and/or provide stepping stones for woodland species.

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- Seeking opportunities to restore, buffer and connect existing priority habitats, particularly calcareous and neutral grassland, woodland, heathland and riparian habitats, where they will help to protect water quality, reduce flooding and benefit biodiversity.
- Providing information, advice, training and other support to help farmers reduce the carbon dioxide emissions associated with farming.
- Supporting research into the benefits and impacts of applying ash from straw-fired power plants to agricultural land, and disseminating this to the agriculture industry.
- Encouraging the creation of priority habitats during restoration of disused quarry sites.

**Lower ground supports more mixed farming, with grazing land, hedges and trees, and the escarpment offers distant views over the Trent and Belvoir Vales.**

**SEO 2: Protect and sympathetically manage geological features and historic features such as Ermine Street Roman road, medieval earthworks, industrial buildings, historic drystone wall networks and traditional villages, to sustain a sense of history and sense of place, providing interpretation to aid understanding of the landscape.**

**For example, by:**

- Encouraging and supporting positive management and protection of characteristic features of rural landscapes such as drystone walls, hedgerows, woodlands and archaeological earthworks.
- Protecting historic linear routes and seeking ways to minimise vehicular damage and secure positive management to maintain flower-rich grassland.
- Providing information, advice and training to property owners and tradespeople in maintenance and restoration of old buildings using appropriate materials and techniques.
- Encouraging the use of local stone in building, walling and restoration work.
- Facilitating the recording and sampling of temporary sections and excavations to expose geological features.
- Providing high-quality interpretation material using a range of media to increase understanding and appreciation of the landscape and its evolution.
- Protecting and managing key prehistoric, Roman and medieval archaeological sites, particularly Ermine Street, Car Dyke, deserted medieval villages, ridge and furrow and moated sites.
- Encouraging developers to plan and execute redevelopment of disused airfields in ways that retain the historic essence and some of the features of the original airfield and enhance their wildlife value, for example through creation of limestone grassland.
- Facilitating sympathetic restoration and future use of key disused historic buildings such as Bass Maltings.
- Improving access to key geological sites, particularly for educational visits, where appropriate.
- Ensuring that the restoration of disused mineral extraction sites retains exposures that illustrate geological processes.

**Ermine Street Roman route provides a distinctive feature in the landscape contributing to access and recreation and sense of place as well as biodiversity due to the wide flower-rich verges.**

**SEO 3: Ensure that new development is planned and executed to preserve a sense of place, sense of history, tranquillity and biodiversity, while minimising water use and avoiding exacerbation of flooding and habitat fragmentation.**

**For example, by:**

- Continuing to work with quarry operators, agricultural contractors, farmers and other businesses to support the implementation of water-saving measures and the capture and re-use of greywater and rainwater, to reduce demand for abstraction.
- Planning new development and adapting existing development to incorporate sustainable urban drainage systems and water-saving features.
- Providing information and advice for householders on how to minimise water consumption.
- Working with water companies to reduce discharge of pollutants from water treatment works.
- Protecting the scarp slope from inappropriate development, increasing woodland cover where possible.
- Protecting stone-built vernacular architecture including farmhouses and farmsteads, and using appropriate materials and techniques when restoring them.
- Ensuring that new irrigation reservoirs are constructed so that they contribute to biodiversity and fit in to local landform and landscape.
- Maintaining the low rate of urbanisation and development outside urban and fringe areas and ensuring that any in-fill development in the small settlements is appropriately sited and designed.
- Exploring opportunities to incorporate tree planting into new developments, where appropriate, to provide a local source of fuel while also screening new development and providing shade to help regulate temperatures inside buildings.
- Ensuring that any new developments incorporate accessible greenspace, offering residents opportunities for recreation and to benefit from contact with the natural environment.

Welbourn and other villages occur along spring lines at the foot of the escarpment.

**SEO 4: Enhance the provision for access and recreation while maintaining the tranquillity of undisturbed areas and providing educational opportunities and interpretation.**

**For example, by:**

- Managing and enhancing the rights-of-way network and long-distance routes, such as the Viking Way, and improving the rights-of-way network by creating permissive and definitive access routes, increasing the opportunities for recreation and enabling people to visit the area in a sustainable way.
- Protecting historic linear routes and seeking ways to minimise vehicular damage.
- Ensuring that restoration of disused extraction sites incorporates open access and opportunities for quiet recreation where possible.
- Providing high-quality interpretation, using a range of media, to explain the context and significance of paths along historic routeways.
- Creating more links between urban populations and the surrounding countryside, finding links between existing accessible sites and semi-natural habitats, especially woodlands, for use by walkers, cyclists and horse riders.
- Restoring and managing historic parklands and estates by retaining veteran trees, restoring wood pasture, restoring vistas and bringing woodlands into appropriate management, enhancing opportunities for sustainable recreational access and contributing to the creation of ecological networks.
- Protecting the open nature of the landscape and far-reaching views from the limestone escarpment.
- Preserving the tranquillity of existing undisturbed areas and seeking opportunities to use hedgerow and tree planting to screen new developments and transport routes. Protect hedgerows and trees where these serve to reduce noise pollution.

**Wide verges along roads and historic routes provide important refuges for flower-rich limestone grassland.**

# Supporting document 1: Key facts and data

**Southern Lincolnshire Edge National Character Area (NCA): 57,041 ha**

## 1. Landscape and nature conservation designations

There are no National Parks or Areas of Outstanding Natural Beauty (AONB) within this NCA.

**Source: Natural England (2011)**

### 1.1 Designated nature conservation sites

The NCA includes the following statutory nature conservation designations:

| Tier | Designation | Designated site(s) | Area (ha) | % of NCA |
|---|---|---|---|---|
| **International** | n/a | n/a | 0 | 0 |
| **European** | Special Protection Area (SPA) | n/a | 0 | 0 |
| | Special Area of Conservation (SAC) | n/a | 0 | 0 |
| **National** | National Nature Reserve (NNR) | n/a | 0 | 0 |
| **National** | Site of Special Scientific Interest (SSSI) | A total of 8 sites wholly or partly within the NCA | 118 | <1 |

**Source: Natural England (2011)**

*Please note: (i) Designated areas may overlap (ii) all figures are cut to Mean High Water Line, designations that span coastal areas/views below this line will not be included.*

There are 152 local sites in the Southern Lincolnshire Edge NCA covering 2,130 ha which is 4 per cent of the NCA.

**Source: Natural England (2011)**

- Details of individual Sites of Special Scientific Interest can be searched at: **http://www.sssi.naturalengland.org.uk/Special/sssi/search.cfm**
- Details of Local Nature Reserves (LNR) can be searched at: **http://www.lnr.naturalengland.org.uk/Special/lnr/lnr_search.asp**
- Maps showing locations of Statutory sites can be found at: **http://magic.defra.gov.uk/website/magic/** – select 'Rural Designations Statutory'

#### 1.1.1 Condition of designated sites

| Condition category | Area (ha) | % of SSSI land in category condition |
|---|---|---|
| **Unfavourable declining** | 0 | 0 |
| **Favourable** | 35 | 30 |
| **Unfavourable no change** | 57 | 49 |
| **Unfavourable recovering** | 24 | 21 |

**Source: Natural England (March 2011)**

- Details of SSSI condition can be searched at: **http://www.sssi.naturalengland.org.uk/Special/sssi/reportIndex.cfm**

## 2. Landform, geology and soils

### 2.1 Elevation

The lowest elevation in this NCA is <1 m; the highest point is 135 m. The mean elevation across the NCA is 42 m.

**Source: Natural England (2010)**

### 2.2 Landform and process

The Lincolnshire Edge forms the distinctive limestone backbone running through this NCA.

**Source: Northern Lincolnshire Edge with Coversands/Southern Lincolnshire Edge Countryside Character Area Description**

### 2.3 Bedrock geology

The Lincolnshire Edge is formed by the Middle Jurassic Lincolnshire Limestone which runs along the high ground from Grantham north to the Humber.

**Source: Northern Lincolnshire Edge with Coversands/Southern Lincolnshire Edge Countryside Character Area Description**

### 2.4 Superficial deposits

Glacial boulder clay drift and small deposits of sands and gravels.

**Source: Northern Lincolnshire Edge with Coversands/Southern Lincolnshire Edge Countryside Character Area Description**

### 2.5 Designated geological sites

| Designation | Number |
|---|---|
| Geological Site of Special Scientific Interest (SSSI) | 1 |
| Mixed interest SSSI | 1 |

There are 13 Local Geological Sites within the NCA.

**Source: Natural England 2011**

- Details of individual Sites of Special Scientific Interest can be searched at: http://www.sssi.naturalengland.org.uk/Special/sssi/search.cfm

### 2.6 Soils and Agricultural Land Classification

Soils include shallow lime-rich and freely draining soils over much of the higher ground. There is some clay with associated poorer drainage on lower ground.

**Source: Northern Lincolnshire Edge with Coversands/Southern Lincolnshire Edge Countryside Character Area Description**

The main grades of agricultural land in the NCA are broken down as follows (as a proportion of total land area):

| Agricultural Land Classification | Area (ha) | % of NCA |
|---|---|---|
| Grade 1 | 0 | 0 |
| Grade 2 | 20,401 | 36 |
| Grade 3 | 33,503 | 59 |
| Grade 4 | 717 | 1 |
| Grade 5 | 0 | 0 |
| Non-agricultural | 1,799 | 3 |
| Urban | 620 | 1 |

**Source: Natural England (2010)**

- Maps showing locations of statutory sites can be found at: http://magic.defra.gov.uk/website/magic/ - Select 'Landscape' (shows ALC and 27 types of soils)

## 3. Key water bodies and catchments

### 3.1 Major rivers/canals

The following major rivers/canals (by length) have been identified in this NCA.

| Name | Length in NCA (km) |
|---|---|
| River Slea | 25 |
| River Witham | 6 |

**Source: Natural England (2010)**

**Please note: other significant rivers (by volume) may also occur. These are not listed where the length within the NCA is short.**

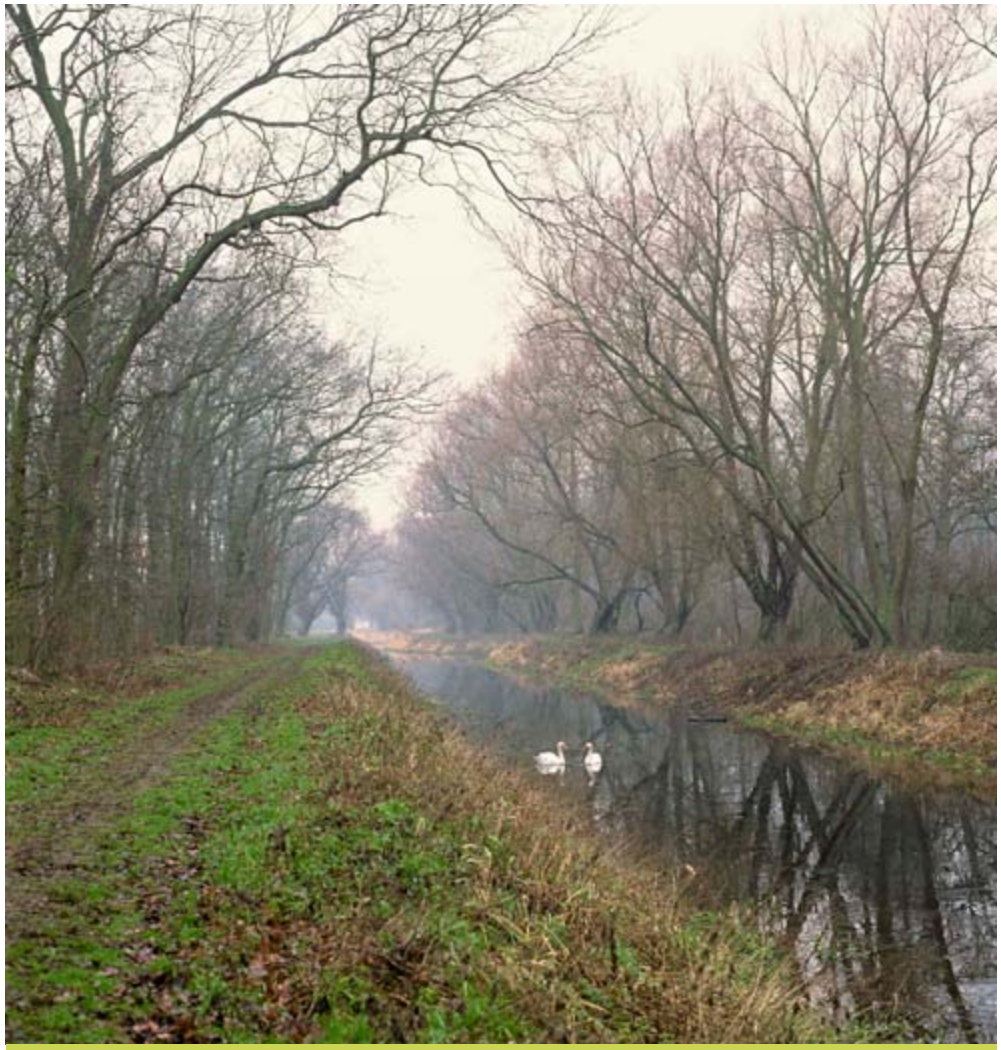
### 3.2 Water quality

The total area of Nitrate Vulnerable Zone is 57,041 ha, 100 per cent of the NCA.

**Source: Natural England (2010)**

### 3.3 Water Framework Directive

Maps are available from the Environment Agency showing current and projected future status of water bodies at: http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e



**The River Slea is one of the area's major rivers and drains into the Fens. It was historically important for navigation and was canalised along stretches.**

## 4. Trees and woodlands

### 4.1 Total woodland cover

The NCA contains 2,136 ha of woodland (4 per cent of the total area), of which 196 ha is ancient woodland.

**Source: Natural England (2010), Forestry Commission (2011)**

**Roman features unclude Car Dyke Canal in the east of the area.**

### 4.2 Distribution and size of woodland and trees in the landscape

Most of the woodland is found on the poorly drained boulder clay that covers the limestone between Sleaford and Grantham. North of the boulder clay there are very few types of woodland, mainly copses and plantations. However, there are a couple of ancient woodlands around Nocton at the foot of the limestone where it descends down into the fen edge clays and gravels.

**Source: Northern Lincolnshire Edge with Coversands/Southern Lincolnshire Edge Countryside Character Area Description**

### 4.3 Woodland types

A statistical breakdown of the area and type of woodland found across the NCA is detailed below.

Area and proportion of different woodland types in the NCA (over 2 ha).

| Woodland type | Area (ha) | % of NCA |
|---|---|---|
| Broadleaved | 1,711 | 3 |
| Coniferous | 245 | <1 |
| Mixed | 37 | <1 |
| Other | 143 | <1 |

**Source: Forestry Commission (2011)**

Area and proportion of Ancient Woodland and Planted Ancient Woodland within the NCA:

| Type | Area (ha) | % of NCA |
|---|---|---|
| Ancient semi-natural woodland | 148 | <1 |
| Ancient re-planted woodland (PAWS) | 48 | <1 |

**Source: Natural England (2004)**

## 5. Boundary features and patterns

### 5.1 Boundary features

Boundaries marked with either stone walls or hedges are mostly remnants of the Enclosures Acts between 1760 and 1830.

**Source: Northern Lincolnshire Edge with Coversands/Southern Lincolnshire Edge Countryside Character Area Description; Countryside Quality Counts (2003)**

### 5.2 Field patterns

Large fields bordered by small trimmed hedges and limestone walls are characteristic of farmland on higher ground, with smaller fields and bigger hedges to the south west and east.

**Source: Northern Lincolnshire Edge with Coversands/Southern Lincolnshire Edge Countryside Character Area Description; Countryside Quality Counts (2003)**

**The view towards Fulbeck, one of the villages along springlines on the scarp edge.**

## 6. Agriculture

The following data has been taken from the Agricultural Census linked to this NCA.

### 6.1 Farm type

68 per cent of the area's farms were arable (48 per cent cereals, 19 per cent general cropping). 17 per cent of farms were mainly livestock units (grazing livestock 10 per cent, specialist poultry 6 per cent).

**Source: Agricultural Census, Defra (2010)**

### 6.2 Farm size

38 per cent of farms (112 of 293 holdings) were greater than 100 hectares, and this category of farm accounted for 86 per cent of the agricultural area in 2009. There was a fairly equal spread of sizes among the remaining farms. The broad pattern was similar to that in 2000, although there were significantly more farms between 20 ha and 50 ha (up from 33 in 2000 to 41 in 2009) and fewer farms greater than 100 hectares (from 143 to 112).

**Source: Agricultural Census, Defra (2010)**

### 6.3 Farm ownership

2009: Total farm area = 45,924 ha; owned land = 31,133 ha
2000: Total farm area = 53,364 ha; owned land = 35,146 ha

**Source: Agricultural Census, Defra (2010)**

### 6.4 Land use

In 2009, almost half the agricultural area was under cereals, 17 per cent was grass and uncropped land, 12 per cent oilseeds and 9 per cent cash roots. Land with oilseeds had increased by 88 per cent since 2000, cash roots had decreased by 33 per cent and grass and uncropped land had decreased by 26 per cent.

**Source: Agricultural Census, Defra (2010)**

### 6.5 Livestock numbers

Sheep accounted for the majority of livestock (15,100), followed by pigs (9,200) and cattle (3,300).

**Source: Agricultural Census, Defra (2010)**

### 6.6 Farm labour

There were 921 agricultural workers in this area in 2009 (down from 1,105 in 2000). Of these, 44 per cent were principal farmers, 31 per cent full-time workers, 9 per cent part-time workers, 7 per cent salaried managers and 10 per cent casual/gang workers.

**Source: Agricultural Census, Defra (2010)**

**Please note: (i) Some of the Census data is estimated by Defra so will not be accurate for every holding (ii) Data refers to Commercial Holdings only (iii) Data includes land outside of the NCA belonging to holdings whose centre point is within the NCA listed.**

## 7. Key habitats and species

### 7.1 Habitat distribution/coverage

Fields in the Ancaster Valley, Ryhall Pasture and Porter's Lodge meadows all contain good examples of limestone grassland. Road verges in this NCA have some of the best surviving grassland habitats. Oak and ash are the dominant species in the woodland, with wild service tree, wild cherry, aspen and field maple. The NCA also contains important arable habitats which support nationally important assemblages of arable birds.

**Source: Lincolnshire and Rutland Limestone Natural Area Profile**

**The scarp slope, although not very steep or high, is a defining landscape feature that is highly visible along the length of the NCA.**

### 7.2 Priority habitats

The Government's new strategy for biodiversity in England, Biodiversity 2020, replaces the previous Biodiversity Action Plan (BAP) led approach. Priority habitats and species are identified in Biodiversity 2020, but references to BAP priority habitats and species, and previous national targets have been removed. Biodiversity Action Plans remain a useful source of guidance and information. More information about Biodiversity 2020 can be found at; http://www.naturalengland.org.uk/ourwork/conservation/biodiversity/protectandmanage/englandsbiodiversitystrategy2011.aspx

The NCA contains the following areas of mapped priority habitats (as mapped by National Inventories). Footnotes denote local/expert interpretation. This will be used to inform future national inventory updates.

| Priority habitat | Area (ha) | % of NCA |
|---|---|---|
| Broadleaved mixed and yew woodland (broad habitat) | 770 | 1 |
| Lowland meadows | 85 | <1 |
| Lowland calcareous grassland | 49 | <1 |
| Reedbeds | 49 | <1 |
| Lowland heathland | 2 | <1 |

**Source: Natural England (2011)**

Maps showing locations of priority habitats are available at

- http://magic.defra.gov.uk/website/magic/ select 'Habitat Inventories'

### 7.3 Key species and assemblages of species

- Maps showing locations of priority habitats are available at: http://magic.defra.gov.uk/website/magic/
- Maps showing locations of S41 species are available at: http://data.nbn.org.uk/

## 8. Settlement and development patterns

### 8.1 Settlement pattern

The majority of settlements are gathered around the edges of the scarp, where there are numerous villages built on spring lines and the foot of the dip slope. Settlement on the higher land on the plateau consists largely of individual farmsteads.

**Source: Northern Lincolnshire Edge with Coversands/Southern Lincolnshire Edge Countryside Character Area Description; Countryside Quality Counts (2003)**

### 8.2 Main settlements

The main settlements are Sleaford, Waddington, Branston, Ruskington, Metheringham and Heckington. The total estimated population for this NCA (derived from ONS 2001 census data) is 75,288.

**Source: Northern Lincolnshire Edge with Coversands/Southern Lincolnshire Edge Countryside Character Area Description; Countryside Quality Counts (2003)**

### 8.3 Local vernacular and building materials

Small villages built in traditional honey-coloured limestone, warm brick and pantiles cluster by springs.

**Source: Northern Lincolnshire Edge with Coversands/Southern Lincolnshire Edge Countryside Character Area Description; Countryside Quality Counts (2003)**

## 9. Key historic sites and features

### 9.1 Origin of historic features

Evidence of a triple ditch system dating to the Bronze Age has been found at Honington. The scattered woodland that has survived today is largely on the boulder clay, the soils of which would have been difficult to plough for the early settlers. Medieval and Tudor estates provide evidence of the major source of wealth from wool. A large number of deserted villages attributed to the depopulation event caused by the Black Death in the 14th century. 20th century development of airfields, including Waddington and Cranwell with its RAF College.

**Source: Draft Historic Profile, Countryside Quality Counts, Countryside Character Area description**

### 9.2 Designated historic assets

This NCA has the following historic designations:

- 7 Registered Parks and Gardens covering 649 ha.
- 0 Registered Battlefields.
- 56 Scheduled Monuments.
- 927 Listed Buildings.

**Source: Natural England (2010)**

- More information is available at the following address: www.english-heritage.org.uk/caring/heritage-at-risk/
- www.english-heritage.org.uk/professional/protection/process/national-heritage-list-for-england/

## 10. Recreation and access

### 10.1 Public access

- <1 per cent of the NCA 311 ha is classified as being publically accessible.
- There are 522 km of public rights of way at a density of 0.9 km per km2.
- There are no National Trails within the NCA.

**Source: Natural England (2010)**

The following table shows the breakdown of land which is publically accessible in perpetuity:

| Access designation | Area (ha) | % of NCA |
|---|---|---|
| National Trust (accessible all year) | 0 | 0 |
| Common Land | 73 | <1 |
| Country Parks | 0 | <1 |
| CROW Access Land (Section 4 and 16) | 107 | <1 |
| CROW Section 15 | 164 | <1 |
| Village Greens | 1 | <1 |
| Doorstep Greens | 1 | <1 |
| Forestry Commission Walkers Welcome Grants | 72 | <1 |
| Local Nature Reserves (LNR) | 14 | <1 |
| Millennium Greens | <1 | <1 |
| Accessible National Nature Reserves (NNR) | 0 | 0 |
| Agri-environment Scheme Access | 14 | <1 |
| Woods for People | 186 | <1 |

**Sources: Natural England (2011)**

**Please note: Common Land refers to land included in the 1965 commons register; CROW = Countryside and Rights of Way Act 2000; OC and RCL = Open Country and Registered Common Land.**

**Historic parklands contribute to sense of history, sense of place, recreation opportunities and biodiversity.**

## 11. Experiential qualities

### 11.1 Tranquillity

Based on the CPRE map of Tranquillity (2006) areas particularly around Sleaford and other settlements, are less tranquil.

A breakdown of tranquillity values for this NCA are detailed in the table below:

| Category of tranquillity | Score |
|---|---|
| Highest | 42 |
| Lowest | -66 |
| Mean | 3 |

**Sources: CPRE (2006)**

More information is available at the following address: **www.cpre.org.uk/what-we-do/countryside/tranquil-places/in-depth/item/1688-how-we-mapped-tranquillity**

### 11.2 Intrusion

The 2007 Intrusion Map (CPRE) shows the extent to which rural landscapes are 'intruded on' from urban development, noise (primarily traffic noise), and other sources of visual and auditory intrusion. This shows that 94 per cent of the area is undisturbed, highlighting the rural nature of this NCA. A breakdown of intrusion values for this NCA is detailed in the following table.

| Intrusion category | 1960s (%) | 1990s (%) | 2007 (%) | Percentage change (1960s-2007) |
|---|---|---|---|---|
| Disturbed | 12 | 28 | 45 | 33 |
| Undisturbed | 87 | 72 | 52 | -35 |
| Urban | 1 | 1 | 2 | 1 |

**Sources: CPRE (2007)**

Notable trends from the 1960s to 2007 are that the percentage of disturbed land had increased, matched by a decrease in the percentage of undisturbed land. Although the percentage of urban intrusion has doubled it is still relatively low compared to other NCAs.

- More information is available at the following address: **www.cpre.org.uk/resources/countryside/tranquil-places**

**The heavier soils in the south of the NCA support more mixed agriculture than other parts, with grazing land for sheep and cattle.**

## 12. Data sources

- British Geological Survey (2006)
- Natural Area Profiles, Natural England (published by English Nature 1993-1998 )
- Countryside Character Descriptions, Natural England (regional volumes published by Countryside Commission/Countryside Agency 1998/1999)
- Joint Character Area GIS boundaries, Natural England (data created 2001)
- National Parks and AONBs GIS boundaries, Natural England (2006)
- Heritage Coast Boundaries, Natural England (2006)
- Agricultural Census June Survey, Defra (2000,2009)
- National Forest Inventory, Forestry Commission (2011)
- Countryside Quality Counts Draft Historic Profiles, English Heritage (2004)*
- Ancient Woodland Inventory, Natural England (2003)
- Priority Habitats GIS data, Natural England (March 2011)
- Special Areas of Conservation data, Natural England (data accessed in March 2011)
- Special Protection Areas data, Natural England (data accessed in March 2011)
- Ramsar sites data, Natural England (data accessed in March 2011)
- Sites of Special Scientific Interest, Natural England (data accessed in March 2011)
- Detailed River Network, Environment Agency (2008)
- Source protection zones, Environment Agency (2005)
- Registered Common Land GIS data, Natural England (2004)
- Open Country GIS data, Natural England (2004)
- Public Rights of Way Density, Defra (2011)
- National Trails, Natural England (2006)
- National Tranquillity Mapping data, CPRE (2007)
- Intrusion map data, CPRE (2007)
- Registered Battlefields, English Heritage (2005)
- Record of Scheduled Monuments, English Heritage (2006)
- Registered Parks and Gardens, English Heritage (2006)
- World Heritage Sites, English Heritage (2006)
- Incorporates Historic Landscape Characterisation and work for preliminary Historic Farmstead Character Statements (English Heritage/Countryside Agency 2006)

Please note all figures contained within the report have been rounded to the nearest unit. For this reason proportion figures will not (in all) cases add up to 100 per cent. The convention <1 has been used to denote values less than a whole unit.

# Supporting document 2: Landscape change

## Recent changes and trends

### Trees and woodlands

- At the end of 1998 young trees accounted for about 2 per cent of the mature woodland stock. Between 1999 and 2003 an area equivalent to 8 per cent of the 1999 total stock was planted (105 ha). New planting is mostly in scattered blocks and appears to strengthen the existing pattern of shelterbelts and strips, although some on the ridgetops may be less consistent with character.

- The proportion of ancient woodland sites covered by a Woodland Grant Scheme agreement increased from 38 per cent to 61 per cent between 1999 and 2003.

### Boundary features

- Between 1999 and 2003 Countryside Stewardship agreements for linear features included fencing (25 km), hedgerow management (33 km), hedgerow planting and restoration (67 km) and restored boundary protection (6 km). These options covered about 4 per cent of the field boundary stock. None of the Countryside Stewardship agreements during this time included options for stone wall restoration or maintenance.

- Between 2005 and 2013 Environmental Stewardship agreements in the area included options for 1,039 km of hedgerow management, 4.4 km of hedgerow restoration, 3.8 km of hedgerow planting, 145.9 km of combined hedgerow and ditch management, 193.5 km of ditch management, 2.4 km of ditch creation, 1 km of stone wall protection and maintenance, 1.7 km of stone wall restoration and 0.4 km of earth bank management. In total 1,392 km of options for maintenance, restoration and creation of traditional boundary features. The estimated total length of boundaries in the area is 3,242 km (including fences) so this represents positive management or restoration of a large proportion of traditional boundaries.

### Agriculture

- Countryside Stewardship uptake for annual area features was consistently below national average, until 2003. Countryside Stewardship agreements for margins >6 m has been significant (804 km), but despite the importance of the area for arable birds there was limited uptake of Countryside Stewardship agreements for management of stubbles or wild bird seed mixture.

- After boundary maintenance, the most popular Environmental Stewardship options between 2005 and 2014 included: 6-metre buffer strips on cultivated land (135.8 ha over 43 agreements); 4-metre buffer strips on cultivated land (125.2 ha over 38 agreements); overwintered stubbles (886.4 ha over 33 agreements); low-input grassland (316.5 ha over 27 agreements); wild bird seed mix (50.4 ha over 24 agreements).

### Settlement and development

- Development pressure is having an impact on the character of the NCA with moderately high rates of change in urban areas and development outside urban areas and fringe areas. Expansion of Sleaford and Lincoln is evident, together with expansion of residential and commercial development in smaller settlements such as Ruskington, Heckington, Cranwell and Metherington.

- Increased development and traffic pressure, particularly around Sleaford, has resulted in a reduction in tranquillity, with the percentage of the NCA classed as 'undisturbed' falling from 87 per cent in the 1960s to 52 per cent in 2007; a 35 per cent reduction.

### Semi-natural habitat

- The most popular Countryside Stewardship management options in 2003 were for lowland pastures on neutral/acid soils (521 ha) and regeneration of grassland/semi-natural vegetation (348 ha).

- Environmental Stewardship agreements between 2005 and 2014 included options to: manage 89.8 ha and restore 49.6 ha of wet grassland for breeding waders; and create 55.2 ha, restore 34.3 ha and maintain 23.4 ha of species-rich grassland.

- Species-rich grassland on wide road verges and alongside historic routes have suffered declines in condition and species diversity in recent years due to a lack of appropriate management, with many being either cut too frequently, or at the wrong times of year.

### Historic features

- In 2003 approximately 65 per cent of historic farm buildings remained unconverted and most were structurally intact.

- There seems to have been a continued loss of military archaeology (buildings, plan-forms, key installations) related to the airfields and related bases along the Edge (Lincolnshire Cliff), either through reversion to farmland or change of use (e.g. retail outlets).

- Environmental Stewardship agreements in the area between 2005 and 2014 included options to: take 90.6 ha of archaeological features out of cultivation; maintain 14,807 m2 of traditional farm buildings; manage 109.5 ha of grassland for archaeological features; restore 197.7 ha of wood pasture and parkland.

### Rivers

- In 1995 the biological water quality was predominantly excellent and chemical water quality predominantly very good. Both of these were maintained until 2003.

### Minerals

- Active quarries include Brauncewell and Longwood Quarry at Blankney (both of which supply limestone, aggregates and lime) and Goldholme Stone's quarry at Ancaster (supplying limestone for building and stone masonry). The quarry at Ancaster was re-opened in 1999 and recently granted a 5 hectare extension.[5]

[5] URL: www.goldholme.com/stone.html (accessed 20 February 2014)

## Drivers of change

### Climate change

Potential impacts of climate change in the NCA, and the East Midlands as a whole, could include:

- An increase in the number of flood events and an increase in drought events compounding existing occasional problems with low flows in the Slea and Witham rivers and threatening availability of water from rivers and the limestone aquifer.
- More frequent and more intense storm events may increase the amount of surface water run-off from agricultural land, increasing diffuse pollution from sediment and nutrient run-off.
- Increasingly stormy weather may bring stronger winds which have the potential to increase wind erosion in the spring dry weather, particularly on the lighter soils on the free-draining plateau.
- An increase in droughts, especially in the summer, could affect productivity of the farmed land, and increase demand for water for irrigation, especially on the free draining soils on the plateau.
- Increased frequency and severity of droughts could lower the water table and have negative effects on a range of habitats and species, particularly aquatic, riparian and wetland ones.
- There may be a move towards new crops or increased yields from traditional crops, due to warmer conditions.
- New conditions may favour generalist species, pests, diseases and invasive non-native species, leading to a reduction in biodiversity and/or disruption of habitats.
- Phenological mismatch may lead to a disruption of food species, putting species and ecosystem services at risk.[6]
- Heavy clay soils to the east of the area are likely to be most vulnerable to extreme weather events as they are easily waterlogged and drought stressed.

[6] A Summary of Climate Change Risks for the East Midlands, Climate East Midlands (2012; URL: www.climate-em.org.uk/images/uploads/EastMidlands-NewText-2Apdf.pdf)

## Other key drivers

- The main areas of development are centred on Lincoln, Sleaford and Grantham.
- Villages are under increasing pressure from development, both in-fill among existing buildings and expansion on the periphery.
- Due to the elevated and windswept nature of the escarpment and much of the dip slope there is likely to be pressure to accommodate wind energy schemes.
- There is likely to be continued demand for aggregate and limestone extraction.
- Restoration of disused quarries will present potential to create new wildlife habitat and access and educational opportunities.
- Combined demand for food and economic pressure on agriculture is likely to drive continuing intensification of agriculture.
- There will be opportunities to improve the environmental impact of agriculture through use of new and innovative technology and techniques that improve resource-use efficiency and soil quality.

**Although the Southern Lincolnshire Edge has low woodland cover, there are some notable local concentrations of woodland and forest, such as here near Metheringham to the east of the NCA.**

# Supporting document 3: Analysis supporting Statements of Environmental Opportunity

The following analysis section focuses on a selection of the key provisioning, regulating and cultural ecosystem goods and services for this NCA. These are underpinned by supporting services such as photosynthesis, nutrient cycling, soil formation and evapo-transpiration. Supporting services perform an essential role in ensuring the availability of all ecosystem services.

Biodiversity and geodiversity are crucial in supporting the full range of ecosystem services provided by this landscape. Wildlife and geologically-rich landscapes are also of cultural value and are included in this section of the analysis. This analysis shows the projected impact of Statements of Environmental Opportunity on the value of nominated ecosystem services within this landscape.

**There are numerous deserted medieval villages, suggestive of the severe impact of the Black Death and harvest failures.**

| Statement of Environmental Opportunity | Ecosystem Service | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Food provision | Timber provision | Water availability | Genetic diversity | Biomass provision | Climate regulation | Regulating water quality | Regulating water flow | Regulating soil quality | Regulating soil erosion | Pollination | Pest regulation | Regulating coastal erosion | Sense of place/Inspiration | Sense of history | Tranquillity | Recreation | Biodiversity | Geodiversity |
| **SEO 1:** Enhance the agricultural landscape and soils to increase efficiency of food production, conserve and connect fragmented patches of limestone grassland and woodland and maintain the traditional fabric of the rural landscape, to preserve sense of place and sense of history, protect water quality, enhance biodiversity and improve resilience to climate change. | ↑ *** | ↗ * | ↗ * | n/a | ↗ * | ↗ * | ↑ ** | ↗ * | ↑ ** | ↑ ** | ↗ ** | ↗ ** | n/a | ↗ ** | ↗ ** | O | ↗ * | ↑ ** | ↗ * |
| **SEO 2:** Protect and sympathetically manage geological features and historic features such as Ermine Street Roman road, medieval earthworks, industrial buildings, historic drystone wall networks and traditional villages, to sustain a sense of history and sense of place, providing interpretation to aid understanding of the landscape. | ↔ * | ↔ * | ↔ * | n/a | ↔ * | ↔ * | ↗ * | ↗ * | ↗ * | ↗ * | ↗ * | ↔ * | n/a | ↑ *** | ↑ *** | ↑ *** | ↑ *** | ↗ ** | ↑ *** |
| **SEO 3:** Ensure that new development is planned and executed to preserve a sense of place, sense of history, tranquillity and biodiversity, while minimising water use and avoiding exacerbation of flooding and habitat fragmentation. | O | ↗ * | ↗ ** | n/a | ↗ ** | ↗ ** | ↗ ** | ↗ ** | ↗ * | ↗ * | ↗ ** | ↔ * | n/a | ↗ ** | ↗ ** | ↗ ** | ↗ ** | ↗ ** | ↗ * |
| **SEO 4:** Enhance the provision for access and recreation while maintaining the tranquillity of undisturbed areas and providing educational opportunities and interpretation. | ↔ * | ↔ * | ↔ * | n/a | ↔ * | ↔ * | ↔ * | ↔ * | ↔ * | ↗ ** | ↔ * | ↔ * | n/a | ↗ ** | ↗ ** | ↗ ** | ↑ *** | ↗ * | ↗ * |

Note: Arrows shown in the table above indicate anticipated impact on service delivery: ↑ = Increase ↗ = Slight Increase ↔ = No change ↘ = Slight Decrease ↓ = Decrease. Asterisks denote confidence in projection (*low **medium***high) ° symbol denotes where insufficient information on the likely impact is available.

National Importance; Regional Importance; Local Importance

## Landscape attributes

| Landscape attribute | Justification for selection |
|---|---|
| **Elevated arable escarpment with underlying Jurassic limestone forming a distinct cliff running north–south along the western boundary providing far-reaching views over the Trent and Belvoir Vales.** | ■ Distinct landform of 'cliff' and open plateau contributes to a strong sense of place.<br>■ One Site of Special Scientific Interest (SSSI) designated for its geological interest, one for mixed biological and geological interest and 13 Local Geological Sites.<br>■ Disused limestone and aggregate quarries now provide important exposures of geological features along with semi-natural habitats. |
| **Productive loamy soils on limestone plateau giving rise to a large-scale open landscape of arable cultivation with large, regular fields and few boundaries of tightly cut hedgerows or rubble limestone walls.** | ■ Productive farmland, much of it managed in large units over 100 ha.<br>■ Predominantly arable (cereals, oilseeds, potatoes and other arable crops) with specialist pig and poultry farms and mixed farming to the east and south-west.<br>■ Large, rectilinear fields arising from 18th- and 19th-century enclosure of the limestone plateau.<br>■ Limestone walls more frequent on higher parts of the dip slope to the west, with hedgerows more common in the east and south-west. |
| **Heavy clay soils in the east and south-west of the area supporting more grazing land in smaller, less regular fields, along with small areas of woodland and parkland.** | ■ Parklands and country estates such as Rauceby and Belton can be found in the south-west.<br>■ Significant woodlands include a small group at the foot of the limestone dip slope near the junction with the fen edge at Potterhanworth and Nocton.<br>■ Less regular fields with more hedgerows, often closely clipped and gappy, and hedgerow trees. |
| **Semi-natural habitats in small, isolated fragments, with small pockets of woodland on clay soils, fen at the foot of the dip slope and flower-rich limestone grassland, particularly along road verges.** | ■ Priority habitats in the NCA include 770 ha of broadleaved woodland, 85 ha of lowland meadow, 49 ha of lowland calcareous grassland, 49 ha of reedbeds and 2 ha of lowland heathland.<br>■ The area's SSSI consist primarily of calcareous grassland on small sites, one of which is a verge along Ermine Street Roman road. SSSI have also been designated for geology, heath and neutral grassland. |
| **Sparse settlement on higher land, with springline villages along the foot of the cliff and larger settlements to the east of the dip slope including Sleaford, Ruskington and Metheringham.** | ■ Settlement is concentrated around the perimeter of the NCA.<br>■ Springline villages along the cliff foot include the aptly named Wellbourne and Fullbeck.<br>■ Villages to the east of the dip slope tend to be in elongated parishes that stretch between the wetter lowlands and higher, drier land. |
| **Active and disused airfields prominent on the ridgetop.** | ■ Disused airfields are still evident through hard standing, boundaries and derelict or re-used military buildings, although some loss of military features has occurred. |

| Landscape attribute | Justification for selection |
|---|---|
| **Evidence of Roman influence, through roads and tracks, and of medieval settlement, through abandoned villages, ridge and furrow and moated sites.** | ■ Long straight roads and tracks including Ermine Street, which follows the route of the key north–south Roman road, now the busy A15.<br>■ Historic Roman road network evident, with minor straight roads leading off Ermine Street to cross the limestone plateau.<br>■ Wide verges support a range of flowering species, creating important corridors for wildlife and an attractive setting for public rights of way.<br>■ Medieval earthworks in the form of ridge and furrow, evidence of abandoned medieval villages and moated sites are widespread. |
| **Vernacular architecture and walling, especially in villages, of local warm-coloured limestone with dark brown pantile roofs.** | ■ Historically there has been a plentiful supply of local building stone, as evidenced by active and disused quarry sites.<br>■ Stone-built vernacular architecture including villages, farmhouses and farmsteads. |

## Landscape opportunities

- Protect the scarp slope from inappropriate development, increasing woodland cover where possible.
- Retain long, panoramic views out over adjacent lower-lying land, especially from the scarp slope in the west and north towards Lincoln Cathedral.
- Protect, manage, enhance and extend the pockets of heathland, calcareous and neutral grassland linking existing areas where possible.
- Manage existing broadleaf woodland.
- Manage existing hedgerows sympathetically, cutting no more than every two years to allow them to fill out, and plant to fill in gaps.
- Restore and introduce hedgerows into key locations to reinforce field patterns.
- Manage existing plantation woodlands to ensure their long term survival as landscape features, increasing the content of native broadleaves where possible.
- Increase the area of native broadleaved woodland, especially along the scarp slope of the Edge (Lincolnshire Cliff) in the west and on the heavier soils of the east and south-west.
- Manage grassy verges to encourage greater species richness and to maintain them as a feature of the long straight roads.
- Restore and manage disused limestone and aggregate quarries to retain their geological interest, and expand their habitats of interest, including limestone grassland, heathland, open water and wetland habitats, providing access where possible.
- Protect stone-built vernacular architecture including farmhouses and farmsteads, and use appropriate materials and techniques when restoring them.
- Protect, conserve and interpret the many historic town houses, industrial buildings and other structures that reveal the rich Roman and medieval history of the NCA.
- Enhance the contrast between the open plateau and the wooded scarp slopes by encouraging more woodland establishment on the slopes.
- Encourage the establishment of permanent grassland to protect the evidence of medieval settlements and other ground features.
- Maintain and restore limestone rubble walls.
- Ensure that new irrigation reservoirs are constructed so that they contribute to biodiversity interest and fit in to local landform and landscape.

## Ecosystem service analysis

| Service | Assets/attributes: main contributors to service | State | Main beneficiary | Analysis | Opportunities | Principal services offered by opportunities |
|---|---|---|---|---|---|---|
| **Food provision** | Soils<br><br>Agricultural crops (arable and grassland)<br><br>Semi-natural habitats (limestone and neutral grassland) | This is a productive arable area. The majority of farmland soils are Grade 2 (36 per cent) or Grade 3 (59 per cent). There are also mixed and livestock farms, particularly on heavier soils to the east.<br><br>In 2009 cereals were the primary crop, taking up almost half of agricultural land, but oilseeds (12 per cent of the NCA) and cash roots (9 per cent) were also significant. Grassland and uncropped land accounted for a further 17 per cent of agricultural land.<br><br>Grazing land occurs on the heavier soils to the east and in 2009 supported sheep (15,100) and cattle (3,300). 9,200 pigs were kept on a mixture of outdoor and indoor pig units. | Regional | This is a productive area for agriculture, producing cereals, oilseeds, root crops, pigs and poultry, contributing to employment, the local economy and supporting local services. The potential to increase food production is good, depending on advances in crop varieties, soil and water management and agricultural technology.<br><br>The opportunities to increase the efficiency of food production is also good; farms are of a scale where investment in new technology, such as precision farming equipment, and infrastructure, such as rainwater harvesting systems and renewable energy, is likely to be financially viable.<br><br>Improvements in soil quality are likely to be particularly important in this area in terms of improving productivity and environmental efficiency of farming. The free-draining nature of the underlying geology makes it particularly important to maximise organic matter and protect soil structure, to aid water retention and sustain crop growth during dry spells.<br><br>Good soil structure and high organic matter content could also help to limit soil erosion, particularly wind erosion to which the open, windswept, larger fields on higher ground can be prone. Green manures could be beneficial in helping to build organic matter on farms without livestock, and by providing cover over winter to reduce erosion.<br><br>As even good condition soils on the plateau are likely to be prone to drying out, having reliable on-farm sources of water will also be important and climate change may increase the demand for on-farm reservoirs and water storage tanks. Farms should implement ways of saving and re-using greywater and rainwater, to limit use of treated mains water and water abstracted from ground and surface sources. (See also text under water availability below.)<br><br>The Renewable Energy Plant at Sleaford plans to re-use the ash from burning straw in the plant as fertiliser on agricultural land. Trials to establish the benefits and impacts of this could be a really useful contribution from this area to inform food production in other parts of the country. | Provide information, advice, training and other support to help farmers use new technology, such as precision farming, that reduces the negative environmental impacts of food production. Specific measures could include facilitating machinery rings, demonstration sites and farmer-to-farmer knowledge exchange.<br><br>Provide information, advice, training and other support to help farmers enhance soil structure and organic matter (through best practice and measures such as minimum tillage, controlled farm traffic and green manures) thereby minimising soil erosion, run-off, drought damage to crops and need for water abstraction.<br><br>Provide information, advice, training and other support to help farmers minimise water use and capture and re-use greywater and rainwater, thereby improving food production and reducing the need for water abstraction.<br><br>Support research into the benefits and impacts of applying ash from straw-fired power plants to agricultural land, and disseminate to the agriculture industry in other areas. | **Food provision**<br><br>**Water availability**<br><br>**Climate regulation**<br><br>**Regulating water quality**<br><br>**Regulating water flow**<br><br>**Regulating soil quality**<br><br>**Regulating soil erosion**<br><br>**Biodiversity** |

| Service | Assets/attributes: main contributors to service | State | Main beneficiary | Analysis | Opportunities | Principal services offered by opportunities |
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| **Timber provision** | Soils<br><br>Woodland | Woodland cover is very low in this NCA at only 2,136 ha (approximately 4 per cent of the NCA). Where woodland does occur it tends to be in small blocks and shelterbelts and is generally not actively managed for timber. There are no major sawmills in the NCA. | Local | Existing woodland occurs mostly in small, isolated fragments. Much of it does not receive active management and could benefit from some management for timber extraction.<br><br>The potential to increase timber production is limited by the sensitivity of the open landscape to new woodland planting. However, consideration should be given to planting of new woodlands in appropriate places that help reinforce landscape character and provide 'stepping stones' to help wildlife move through an otherwise quite impermeable landscape. Such tree planting could provide timber on a small-scale. | Explore opportunities for tree planting in locations where it will produce viable timber while helping to reduce wind erosion of agricultural soil, intercept run-off from agricultural land, connect isolated fragments of woodland and/or provide stepping-stones for woodland species. | **Timber provision**<br><br>**Climate regulation**<br><br>**Regulating water quality**<br><br>**Regulating soil erosion**<br><br>**Regulating soil quality**<br><br>**Sense of place/ inspiration**<br><br>**Tranquility**<br><br>**Biodiversity** |

| Service | Assets/attributes: main contributors to service | State | Main beneficiary | Analysis | Opportunities | Principal services offered by opportunities |
|---|---|---|---|---|---|---|
| **Water availability** | Watercourses<br><br>Limestone aquifer<br><br>Soils<br><br>Farm reservoirs | The Limestone Edge forms a watershed between the major river basins of the Trent to the west and Anglian rivers to the east.<br><br>The Lincolnshire Limestone aquifer is regionally important and large demands are placed upon it to meet domestic, industrial and agricultural water supplies, as well as supporting base flows to rivers and supporting local surface water features.<br><br>The Lincolnshire Limestone can be up to 40 m thick, and groundwater movement within the aquifer is generally west to east. In the west of the area the limestone outcrops at the ground surface allowing rainfall to recharge the aquifer. The limestone becomes confined as it is overlain by younger deposits to the east. Although abstraction takes place mainly from the confined region, the aquifer becomes too deep and the quality is considered to be too poor to exploit more than a few kilometres east of the outcrop area.<br><br>The main rivers in the NCA are the River Slea in the south of the NCA and the River Witham and Fossdyke Canal in the far north of the NCA. In the Lower Witham channel (and associated tributaries) and Lower Bain there is water available for abstraction at high and medium flows, restricted water available at medium/low flows, but no water available for abstraction at low flows. Upstream of Leasingham there is no water available for abstraction except at very high flows.[7]<br><br>The Witham catchment benefits from the Trent Witham Ancholme River Transfer Scheme, a key infrastructure link for managing water resources, to maintain summer water levels and meet abstraction needs.[8] | Regional | Quarry operators are encouraged to maximise the amount of groundwater recharge they provide so that water is retained locally.<br><br>Rainwater harvesting is currently actively promoted, particularly amongst the agriculture and industrial sectors. A suite of booklets has been produced by the Environment Agency, Natural England, Cranfield University, NFU, and the UK Irrigation Association which cover many aspects of water use in the agriculture sector.<br><br>Spray irrigators are provided with advice on water efficiency and irrigation scheduling. There are various agricultural water efficiency projects underway. Water security groups have been set up and consist of regional and area Environment Agency staff. The approach is to encourage farmers to improve water security. For example, letters have been sent to farmers including information on extending the irrigation season, the impact of climate change, sharing resources and high flow reservoirs.[9]<br><br>New development should be planned and existing development adapted to incorporate sustainable urban drainage systems and water-saving features, to minimise demand on water from treatment plants. | Continue to work with quarry operators, agricultural contractors, farmers and other businesses to support implementation of water-saving measures, capture and re-use of greywater and rainwater and reduce demand for abstraction.<br><br>Plan new development and adapt existing development to incorporate sustainable urban drainage systems and water-saving features.<br><br>Provide information and advice for householders on how to minimise water consumption. | **Water availability**<br><br>**Food provision**<br><br>**Climate regulation**<br><br>**Regulating water quality**<br><br>**Regulating water flow**<br><br>**Regulating soil quality**<br><br>**Regulating soil erosion**<br><br>**Biodiversity** |

7 Witham Catchment Abstraction Management Strategy, Environment Agency (2013; URL: http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/LIT7776_be21df.pdf)
8 River Basin Management Plan Anglian River Basin District, Environment Agency (2009; URL: http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geana910bspm-e-e.pdf)
9 Witham Catchment Abstraction Management Strategy, Environment Agency (2013; URL: http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/LIT7776_be21df.pdf)

| Service | Assets/attributes: main contributors to service | State | Main beneficiary | Analysis | Opportunities | Principal services offered by opportunities |
|---|---|---|---|---|---|---|
| **Genetic diversity** | N/A | N/A | N/A | N/A | N/A | **N/A** |
| **Biomass energy** | Soils<br><br>Woodland<br><br>Biomass crops | A 38MW straw-fired power plant was established in Sleaford in 2013. It is anticipated it will burn 240,000 tonnes of straw per year, sourced primarily from farms within a 50-kilometre radius. The intention is to recycle the ash as crop fertiliser.[10]<br><br>There are two large capacity biomass boilers, supplying 312 kWH.[11]<br><br>The NCA has a generally medium potential for short rotation coppice (SRC). The potential miscanthus yield in the NCA varies between high potential yield to the immediate north, east and south of Sleaford to a band of low potential yield to the west of Sleaford running north to Lincoln. There are also a few areas of medium potential yield, for example around Waddington in the north-west of the NCA.[12]<br><br>In 2010 the East Midlands had the highest levels of biomass production on farms in England – with 52 per cent of farms producing biomass to produce biogas, and 54 per cent of farms producing other forms of biomass.[13] | Regional | Existing woodland occurs mostly in small, isolated fragments. Much of it does not receive active management. Management for wood fuel extraction would, in some cases, be beneficial for wildlife.<br><br>The potential to increase wood fuel production is limited by the sensitivity of the open landscape to new woodland planting. However, consideration should be given to planting of new woodlands in appropriate places that help to reinforce landscape character and provide 'stepping stones' to help wildlife move through the landscape. The most appropriate parts of the NCA for new woodland planting include the eastern edge, the escarpment and the south-west corner.<br><br>There could be opportunities to include tree planting for biomass in new developments, where it could achieve multiple objectives of screening new developments, providing shade to help keep buildings cool during hotter summers and providing a renewable fuel to heat houses, offices and industrial buildings. | Explore opportunities for production of woody biomass from existing woodlands, where this is compatible with or beneficial to nature conservation objectives.<br><br>Explore opportunities for new woodland planting to produce woody biomass, particularly along the eastern edge and south-west corner of the NCA.<br><br>Explore opportunities to incorporate tree planting into new developments to provide a local source of fuel while also screening new development and providing shade to help regulate temperatures inside buildings. | **Biomass energy**<br><br>**Food provision**<br><br>**Climate regulation** |

[10] URL: www.sleafordrep.co.uk/ (accessed 20 February 2014)
[11] Forestry Commission (2011)
[12] For information on the potential landscape impacts of biomass plantings within the NCA, refer to the tables on the Natural England website at: URL: www.naturalengland.org.uk/ourwork/farming/funding/ecs/sitings/areas/default.aspx
[13] Diversification and Renewable Energy Production on Farms in England – 2010 Dataset, Defra (2013; URL: www.gov.uk/government/publications/diversification-and-renewable-energy-production-on-farms-in-england-in-2010)

| Service | Assets/attributes: main contributors to service | State | Main beneficiary | Analysis | Opportunities | Principal services offered by opportunities |
|---|---|---|---|---|---|---|
| **Climate regulation** | Soils<br><br>Woodland<br><br>Other semi-natural habitats (unimproved/ semi-improved grassland) | The mineral soils over most of the NCA have a low carbon content (0–5 per cent) with carbon levels likely to be particularly low in areas of continuous arable cultivation. There are scattered pockets of soils with a higher carbon content associated with small areas of naturally wet very acid sandy and loamy soils (covering 2 per cent of the NCA) which contain organic topsoils and the loamy and sandy soils with naturally high groundwater and a peaty surface (also covering 2 per cent). These are likely to be found in river valleys.<br><br>Higher soil carbon levels will be found under the small areas of existing woodland, heathland and semi-natural grassland, but due to the small areas involved this will make a limited contribution to climate regulation. | Local | Small increases in the carbon sequestration and storage potential of the area could appropriately be gained through small-scale woodland planting and increasing the organic matter content of agricultural soils. An increase in woodland and tree cover would also help with adaptation to climate change by reducing wind and water erosion of soils, reducing run-off and therefore water pollution and flooding, and by providing shade for livestock.<br><br>Creation of permanent grassland, heathland and arable reversion to grassland could help increase carbon sequestration and storage and could be targeted towards areas of marginal arable production and where it could help to reduce soil erosion, flooding and water pollution, such as on sloping ground and along watercourses.<br><br>There are good opportunities to reduce the carbon emissions associated with agriculture by using more efficient machinery and techniques, and by using waste straw which is not needed for increasing soil organic matter, for energy production in Sleaford Renewable Energy Plant. | Encourage measures to increase organic matter in agricultural soils.<br><br>Explore opportunities for tree planting in places where it will help to reduce erosion, flooding and heat stress to livestock, and will not detract from landscape character.<br><br>Explore opportunities to increase carbon storage and sequestration by creating areas of heathland and grassland where this will not affect the most productive arable land and will help to reduce soil erosion, water pollution and flooding.<br><br>Provide information, advice, training and other support to help farmers reduce the carbon dioxide emissions associated with farming. | **Climate regulation**<br><br>**Food provision**<br><br>**Timber provision**<br><br>**Biomass energy**<br><br>**Water availability** |

| Service | Assets/attributes: main contributors to service | State | Main beneficiary | Analysis | Opportunities | Principal services offered by opportunities |
|---|---|---|---|---|---|---|
| **Regulating water quality** | Geology<br><br>Aquifer<br><br>Precipitation<br><br>Semi-natural habitats | 97 per cent of the area is within a nitrate vulnerable zone (NVZ) for both surface water and groundwater.<br><br>The surface water chemical status of the River Witham and the Fossdyke canal is 'good', (the River Slea has not been subject to surface water chemical testing).<br><br>The potential ecological status of the River Slea, the River Witham and the Fossdyke canal is only 'medium'.<br><br>The groundwater chemical status in the NCA is generally 'good'.<br><br>Issues in the area's rivers include heavy algal growth on the River Witham, making angling and boating difficult, causing water quality fluctuations and reducing biodiversity.[14] | Regional | All farms within the NVZ are required to comply with regulations around the application of organic and manufactured manures, including rates of application and provision of adequate storage of livestock manures. These regulations are to ensure that water quality is not affected by the application of nutrients.<br><br>Water resources in the area are potentially vulnerable to diffuse pollution from agriculture and discharges from water treatment plants.<br><br>Measures to address water quality include matching nutrient inputs to the needs of the crops; establishing strips of unfertilised permanent grassland alongside watercourses to help to trap sediments, nutrients and chemicals before they can enter the water system; and careful planning of times to spread organic and artificial fertilisers to ensure optimum take-up by crops.<br><br>Summer droughts and more frequent and more intense rainfall events may arise from climate change. These are likely to have adverse impacts on the quality of watercourses, for instance by reducing the oxygen content of the water, or by increasing the amount of sediment entering streams and rivers. | Provide information, advice, training and other support to help farmers reduce diffuse and point-source pollution through best practice, updated infrastructure, using new and innovative techniques and by creating features such as buffer strips, settlement ponds or silt traps and riparian woodland.<br><br>Provide information, advice, training and other support to help farmers enhance soil structure and organic matter content (through measures such as minimum tillage, controlled farm traffic and green manures) thereby minimising soil erosion, run-off, drought damage to crops and need for water abstraction.<br><br>Provide training for agricultural contractors and sprayer operators on protection of water resources.<br><br>Work with water companies to reduce discharge of pollutants from water treatment works. | **Regulating water quality**<br><br>**Food provision**<br><br>**Water availability**<br><br>**Climate regulation**<br><br>**Regulating water flow**<br><br>**Regulating soil quality**<br><br>**Regulating soil erosion**<br><br>**Recreation**<br><br>**Biodiversity** |

[14] River Basin Planning: Summary of significant management issues – Anglian River Basin District, Environment Agency (2007; URL: www.environment-agency.gov.uk/static/documents/Research/anglianswmidoc_1953860.pdf)

| Service | Assets/attributes: main contributors to service | State | Main beneficiary | Analysis | Opportunities | Principal services offered by opportunities |
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| **Regulating water flow** | Geology<br><br>Topography<br><br>Precipitation<br><br>Soils<br><br>Semi-natural habitats | The main catchment in the NCA is that of the River Witham. The Environment Agency flood risk map indicates that for much of the NCA flooding is not a major issue. There has been some flooding from the River Witham along the northern boundary of the NCA, particularly in Lincoln just outside the NCA to the north. The probability of river flooding has been reduced in Lincoln by the construction of a major flood storage reservoir (the Till Washland flood alleviation scheme and the Witham/ Brant Washland flood alleviation scheme upstream of Lincoln (outside the NCA), and the construction of concrete flood walls in the city.[15]<br><br>Sleaford is vulnerable to flooding from the River Slea, and parts of the town and the surrounding area could be susceptible to groundwater flood risk.[16]<br><br>The rivers Witham and Slea suffer from low flows at times,[17] but the Witham catchment benefits from the Trent Witham Ancholme River Transfer Scheme, a key infrastructure link for managing water resources, to maintain summer water levels and meet abstraction needs.[18] | Regional | To manage the risk of flooding in Sleaford from the River Slea, extensive maintenance work along the rivers in this area has been carried out and concrete flood walls have been constructed in Sleaford. The Catchment Flood Management Plan states that there is a need to develop a surface water and groundwater study for Sleaford to investigate ways to manage flood risk.[19]<br><br>Improved infiltration of rainwater on agricultural land could help to limit rates of run-off down the dip slope.<br><br>Measures to improve soil structure and organic matter content will help to improve infiltration and slow run-off and also increase slow release of water to surface water bodies, thereby helping to maintain summer flow levels. Other measures on farms that could help to slow run-off and flow into rivers include buffer strips, hedgerow planting, water storage ponds and creation of riparian woodland and wetlands.<br><br>New development should incorporate sustainable urban drainage systems to minimise run-off and stagger water release into watercourses. Measures such as permeable ground surfaces should also be incorporated into urban areas. | Explore opportunities to limit groundwater and surface water flooding in Sleaford.<br><br>Provide information, advice and training for farmers on enhancing soil structure and organic matter content, to improve infiltration rates and slow run-off.<br><br>Encourage farmers to create features and habitats that slow run-off into watercourses.<br><br>Plan new developments to incorporate sustainable urban drainage systems and retrofit measures to existing development and urban areas. | **Regulating water flow**<br><br>**Food provision**<br><br>**Timber provision**<br><br>**Biomass energy**<br><br>**Water availability**<br><br>**Climate regulation**<br><br>**Regulating water quality**<br><br>**Regulating soil erosion**<br><br>**Regulating soil quality**<br><br>**Biodiversity** |

[15,16,19] River Witham Catchment Flood Management Plan Summary Report, Environment Agency (December 2009)

[17] River Basin Planning: Summary of significant management issues – Anglian River Basin District, Environment Agency (2007; URL: www.environment-agency.gov.uk/static/documents/Research/anglianswmidoc_1953860.pdf)

[18] River Basin Management Plan Anglian River Basin District, Environment Agency (2009; URL: http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geana910bspm-e-e.pdf)

| Service | Assets/attributes: main contributors to service | State | Main beneficiary | Analysis | Opportunities | Principal services offered by opportunities |
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| **Regulating soil quality** | Geology<br><br>Soil<br><br>Soil flora and fauna<br><br>Semi-natural habitats | There are six main soilscape types in this NCA:<br><br>■ Shallow lime-rich soils over limestone (covering 41 per cent of the NCA);<br><br>■ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils (27 per cent);<br><br>■ Freely draining lime-rich loamy soils (23 per cent);<br><br>■ Loamy soils with naturally high groundwater (3 per cent);<br><br>■ Naturally wet very acid sandy and loamy soils (2 per cent); and<br><br>■ Loamy and sandy soils with naturally high groundwater and a peaty surface (2 per cent). | Local | Maintaining and increasing organic matter is of particular importance to the free-draining loess soils on higher ground, to help sustain plant growth during droughts, maintain structure and reduce soil erosion and run-off. Techniques such as controlled farm traffic and minimum tillage can help to maintain good soil structure and reduce compaction.<br><br>The heavier less permeable soils on lower ground are more vulnerable to structural problems such as poaching, compaction, panning and smearing. On these soils it will be particularly important to optimise timing of field operations to avoid waterlogged conditions as far as possible. Careful management of grazing regimes will also help to reduce poaching and compaction. | Provide information, advice, training and other support to help farmers enhance soil structure and organic matter (through best practice and measures such as minimum tillage, controlled farm traffic and green manures) thereby improving soil quality and minimising soil erosion, run-off, drought damage to crops and need for water abstraction. | **Regulating soil quality**<br><br>**Food provision**<br><br>**Water availability**<br><br>**Regulating water quality**<br><br>**Regulating water flow**<br><br>**Regulating soil erosion**<br><br>**Climate regulation**<br><br>**Biodiversity** |

| Service | Assets/attributes: main contributors to service | State | Main beneficiary | Analysis | Opportunities | Principal services offered by opportunities |
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| **Regulating soil erosion** | Soils<br><br>Soil flora and fauna<br><br>Watercourses<br><br>Vegetation (particularly grassland, any ground cover in winter, hedgerows and woodland) | The shallow lime-rich soils over limestone, (covering 41 per cent) and light textured/ shallow variants of the freely draining lime-rich loamy soils (covering 23 per cent) are particularly at risk of erosion on sloping cultivated ground or where soil is exposed along footpaths/tracks or as a result of outdoor pig-rearing.<br><br>The naturally wet very acid sandy and loamy soils (covering 2 per cent) are at risk of wind erosion and are also easily eroded if heavily trafficked or after heavy rain. Likewise, the loamy and sandy soils with naturally high groundwater and a peaty surface (covering 2 per cent) are at high risk of wind erosion (blowing) and peat erosion and carbon loss through peat wastage.<br><br>The slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils and the loamy soils with naturally high groundwater (together covering some 30 per cent of the NCA) are not prone to erosion.<br><br>Trees, hedgerows and walls play an important role in limiting wind erosion of lighter soils. | Regional | Soil erosion is a particular issue here, and is likely to be exacerbated by climate change which will bring more frequent and more intense rainfall and storm events, and also potentially longer periods of drought.<br><br>The lighter soils on the free-draining plateau are vulnerable to wind erosion, particularly where fields are very large and lack protection from field boundaries or adjacent woodland. On sloping ground these soils are vulnerable to water erosion at times of heavy rainfall, particularly if without cover over winter.<br><br>Hedgerows can help to reduce both wind and water erosion, so should be protected where they still occur and reinstated where possible.<br><br>Enhancing organic matter and ensuring vegetative cover can also be beneficial, with green manures helping to achieve both, particularly on farms with no livestock and therefore no manure. | Provide information, advice, training and other support to help farmers enhance soil structure and organic matter (through best practice and measures such as minimum tillage, controlled farm traffic and green manures) thereby minimising soil erosion, run-off, drought damage to crops and need for water abstraction.<br><br>Provide information, advice and training on measures to reduce soil erosion such as: planting of hedgerows or woodland; creation of buffer strips, infield grass strips or beetle banks; and establishing vegetative cover, particularly green manures, over winter. | **Regulating soil erosion**<br><br>**Food provision**<br><br>**Water availability**<br><br>**Regulating water quality**<br><br>**Regulating water flow**<br><br>**Regulating soil quality**<br><br>**Biodiversity**<br><br>**Geodiversity** |

| Service | Assets/attributes: main contributors to service | State | Main beneficiary | Analysis | Opportunities | Principal services offered by opportunities |
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| **Pollination** | Semi-natural habitats (especially limestone grassland and meadow)<br>Agricultural plant varieties<br>Gardens and allotments<br>Wild pollinator species | Pollination will be important for the oilseed crops that, in 2009, covered 12 per cent of the agricultural land.<br>Nectar sources for pollinators will include the small fragments of limestone grassland and meadow, and the few hedgerows that have not been cut annually.<br>Environmental Stewardship agreements between 2005 and 2014 included 42 ha of nectar flower mix, specifically designed to provide a long-lasting source of nectar for pollinators and other nectar-feeding insects. | Regional | Provision of nectar sources in primarily arable parts of the NCA will help to support pollinator populations. Valuable sources of nectar in arable areas could include hedgerows cut every two years or less often, flower-rich buffer strips, headlands and field corners, and specially sown nectar flower mix. Uncultivated areas with tall grass are important as over-wintering areas for pollinators. Existing areas of calcareous grassland, particularly along road and track verges will be an important habitat, providing not only food and habitat but also helping pollinators to move through the agricultural landscape.<br>Insecticides can seriously harm pollinator populations so appropriate and economical use is very important. Measures such as integrated crop management, regular crop monitoring, and the use of biological and cultural controls can all help to minimise the use of insecticides. | Encourage farmers, particularly in primarily arable areas, to provide or leave flower-rich habitats as a nectar-source for pollinators and areas of rough grass for over-wintering.<br>Provide information, advice and training for farmers on alternative measures for insect pest management and control.<br>Provide training for sprayer operators on best practice to avoid harm to pollinator populations. | **Pollination**<br>**Food provision**<br>**Sense of place/ inspiration**<br>**Biodiversity** |
| **Pest regulation** | Semi-natural vegetation<br>Beneficial predator species | Hedgerows, unimproved and semi-improved grassland, heathland and woodland may all support beneficial predator species in this NCA. Flower-rich, infrequently-cut road and track verges may be particularly valuable as habitats to support beneficial predator species and provide a pest control function as these are often adjacent to arable fields. | Regional | There is evidence to suggest that certain habitats such as hedgerows, flower-rich buffer strips and unimproved grassland can support populations of beneficial predator species which can help control common agricultural pests (for example ladybirds controlling aphids).[20] Habitats which provide a nectar source, shelter and additional prey species all have the potential to increase beneficial predator numbers.<br>Studies suggest that hedgerows cut every year have less value for invertebrates, so less frequent cutting of hedgerows in this area could help support higher numbers of beneficial predators. Appropriate cutting regimes for road and track-side verges may be equally important.<br>Where pest regulation services are provided by semi-natural habitats and associated species, this could reduce the need for pesticides, thereby affording benefits for water quality, soil quality, pollinators and wider biodiversity.<br>If the approach could be perfected for this area, to maximise the agronomic benefits, it could play a valuable role in terms of increasing production of arable crops while reducing negative impacts on the environment. | Support research into the potential for and value of natural pest control services in this NCA and disseminate useful findings to local farmers and agricultural contractors.<br>Encourage less frequent cutting of hedgerows and appropriate cutting regimes for road and trackside verges.<br>Encourage creation of beetle banks, buffer strips and areas of pollen and nectar mix on arable farms. | **Pest regulation**<br>**Food provision**<br>**Pollination**<br>**Sense of place/ inspiration**<br>**Biodiversity** |

[20] Ecosystem Services from Environmental Stewardship that Benefit Agricultural Production, Natural England (2012)

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| **Sense of place/ inspiration** | Geology<br><br>Topography<br><br>Archaeology (particularly prehistoric burial sites and Roman routeways)<br><br>Cultivated land<br><br>Field boundaries<br><br>Parkland and woodland | The high slopes of the ridge with its distinctive 'cliff' or western facing scarp edge, long views and open rural character with a lack of tree cover, contribute to a strong and distinctive sense of place, which is shared with the Northern Lincolnshire Edge and Coversands NCA to the north.<br><br>At Lincoln on the northern boundary of this NCA the River Witham breaches the limestone ridge to flow to the Wash while between Grantham and the A17 the 'cliff' takes the form of a two-tier scarp where there is a second outer scarp of ironstone closer to the Trent.<br><br>The higher areas are relatively open and dominated by arable farmland with large fields either lacking defined boundaries or with a mixture of limestone walls, discontinuous, tightly-trimmed hedgerows and shelter belts. To the east smaller, irregular hedgerow-bound fields are more common and combine with small areas of parkland.<br><br>The ridgetops are sparsely settled with smaller villages associated with a springline along the foot of the western scarp and larger settlements, including Sleaford and Metheringham, located to the east of the dip slope. | Regional | Some of the key components of sense of place are vulnerable to lack of management, inappropriate management, deterioration and damage, such as stone walls, traditional buildings, archaeological earthworks and woodlands. Hedgerows are vulnerable to overly frequent and severe cutting, and conversely lack of management such as gapping-up and laying, becoming sparse, gappy and stunted as a result.<br><br>Some of the historic routes, green lanes and their flower-rich verges are vulnerable to damage from off-road vehicles and fly-tipping.<br><br>Development can have a negative impact on character where it is unsympathetic to existing features and styles. | Encourage and support positive management and protection of characteristic features of rural landscapes such as stone walls, hedgerows, woodlands and archaeology.<br><br>Protect historic linear routes and seek ways to minimise vehicular damage and secure positive management to maintain flower-rich grassland.<br><br>Provide information, advice and training to property owners and tradesmen in the maintenance and restoration of old buildings using appropriate materials and techniques.<br><br>Encourage the use of local stone for building and walling.<br><br>Provide high quality interpretation material using a range of media to increase understanding and appreciation of the landscape and its evolution.<br><br>Protect far-reaching views. | **Sense of place/ inspiration**<br><br>**Sense of history**<br><br>**Tranquillity**<br><br>**Recreation**<br><br>**Biodiversity**<br><br>**Geodiversity** |

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| **Sense of history** | Prehistoric burial mounds<br><br>Roman routeways<br><br>Medieval sites<br><br>Ridge and furrow<br><br>Traditional field boundaries<br><br>Historic buildings<br><br>Traditional villages | A sense of history is evident in the prehistoric burial mounds, remains of bronze-age linear routes and triple ditch system at Honington, and remains of Roman roads and tracks and a later dyke or canal, Car Dyke, surviving in visible form near Potterhanworth and Martin.<br><br>The large fields forming part of today's elevated open farmlands are a reminder of enclosure in the 18th and 19th centuries. More recent history is evident in the 20th-century RAF airfield at Waddington and RAF base at Cranwell.<br><br>Aspects of history that are likely to be particularly evident to the general public include estate parklands and manor houses including Belton – north of Grantham and considered the crowning achievement of restoration country house architecture (1685–88) – and at Rauceby, Leadenham and Fillingham.<br><br>Sleaford is home to the largest industrial building on English Heritage's at risk register – Bass Maltings. It is a large and dramatic complex of Grade II* red brick industrial buildings. It was built in the first decade of the 1900s, to designs by Bass, Ratcliff and Gretton's chief engineer and architect, H.A. Couchman. It is possibly the largest malting house ever built.[21] Recent plans to develop the centre and save the iconic and historically important buildings had not yet come to fruition in early 2014. | National | Conservation and management of historic routeways, particularly Ermine Street, is important for maintaining an important historic feature and the context of the surrounding landscape which has evolved in association with these routes. It also represents a valuable opportunity to preserve and enhance wildlife corridors of flower-rich limestone grassland which could be particularly valuable for nectar-feeding insects.<br><br>The ground features of prehistoric and medieval times are at risk of being lost through cultivation. Key sites should be identified and protected by the establishment of permanent grassland.<br><br>The distinctive long straight roads dating from Roman times form the basis of the current road networks.<br><br>Airfields provide a strong sense of more recent history. New development on disused airfields should be designed and executed in such a way as to retain the footprint of existing structures as closely as possible and to limit visual intrusion and the loss of surrounding landscape features. Original features of the airfields should be retained as far as possible and interpreted to serve as a reminder of the role this area played in the World Wars. | Protect and manage key prehistoric, Roman and medieval archaeological sites, particularly Ermine Street, Car Dyke, deserted medieval villages, ridge and furrow and moated sites.<br><br>Encourage developers to plan and execute redevelopment of disused airfields in ways that retain the essence and some of the features of the original airfield.<br><br>Facilitate sympathetic restoration and future use of key disused historic buildings such as Bass Maltings.<br><br>Provide high-quality interpretation using a range of media to improve understanding of the area's history. | **Sense of history**<br><br>**Sense of place/ inspiration**<br><br>**Tranquility**<br><br>**Recreation** |

[21] Strategy for the Historic Industrial Environment Report No. 1 – Maltings in England, Amber Patrick for English Heritage (2004; URL: www.english-heritage.org.uk/publications/maltings/maltings-pt1.pdf)

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| **Tranquillity** | Topography<br><br>Watercourses<br><br>Parkland<br><br>Semi-natural habitats, particularly woodland | CPRE has given the NCA an average tranquillity score of 3 (highest value 42 and lowest -66). 52 per cent of the NCA is considered undisturbed, 45 per cent disturbed and 2 per cent urban. The highest levels of disturbance are along major transport routes and around the larger settlements such as Sleaford. More remote rural areas on the cliff edge and the more enclosed lowlands to the east and south-west offer the highest levels of tranquillity. | Local | Screening of new transport routes and development with tree planting could help to reduce visual intrusion and light and noise pollution. Efforts should be made to preserve the tranquillity of existing undisturbed areas.<br><br>Hedgerows, trees and woodland can all help to limit noise pollution and should be maintained or introduced in strategic locations. | Ensure appropriate location and design of new development and transport routes to minimise disturbance.<br><br>Preserve the tranquillity of existing undisturbed areas.<br><br>Seek opportunities to use hedgerow and tree planting to screen new developments and transport routes, and protect existing hedgerows and trees where these serve to reduce noise pollution. | **Tranquillity**<br><br>**Sense of place/ inspiration**<br><br>**Sense of history**<br><br>**Recreation**<br><br>**Biodiversity** |
| **Recreation** | Rights-of-way network<br><br>Long-distance routes and historic trackways<br><br>Nature reserves | There are 522 km of public rights of way (a density of 0.9 km per km$^2$) and 311 ha of publicly accessible land.<br><br>The area lacks any country parks or National Nature Reserves, but has some publicly accessible parklands and long-distance routes such as the Viking Way and routes along historic trackways such as Ermine Street. Routes along the edge of the escarpment give dramatic views over the Trent and Belvoir Vales. | Local | The density of public rights of way is lower than in many NCAs. But what the area lacks in quantity it somewhat makes up for by the high quality of some of the routes alongside dramatic ancient trackways, with colourful flower-rich verges of calcareous grassland and dramatic views into the vales below the scarp and down the dip slope.<br><br>Restoration of disused quarries presents a valuable opportunity to provide new access routes and open access land with high-quality restored habitats and interpretation. | Ensure that restoration of disused extraction sites incorporates open access and opportunities for quiet recreation where possible.<br><br>Provide high quality interpretation, using a range of media, to explain the context and significance of paths along historic routeways.<br><br>Create more links between urban populations and the surrounding countryside, finding links between existing accessible sites and semi-natural habitats, especially woodlands, for use by walkers, cyclists and horse riders.<br><br>Explore opportunities to improve access to parklands and estates, where appropriate. | **Recreation**<br><br>**Sense of place/ inspiration**<br><br>**Sense of history**<br><br>**Tranquillity** |

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| **Biodiversity** | Soils<br><br>Waterbodies<br><br>Semi-natural habitats (especially native woodland, unimproved grassland and hedgerows)<br><br>Cultivated land | There are over 955 ha (just under 2 per cent of the NCA area) of priority habitats within the NCA including 770 ha of broadleaved mixed and yew woodland, 85 ha of lowland meadows and smaller areas of lowland calcareous grassland, reedbeds and lowland heathland.<br><br>There are eight SSSI covering 118 ha (0.2 per cent of the NCA), 30 per cent of which are in favourable condition, 21 per cent are unfavourable recovering and 49 per cent are unfavourable no change. There are also 152 local sites covering 2,130 ha (4 per cent of the NCA). There are no sites with European or international nature conservation designations.<br><br>The area is a hotspot for farmland birds. The NCA was considered by Natural England specialists to be one of the top five in the country for skylark and one of the top ten for song thrush, in 2012. In the Witham target area (in the north-east of the NCA) Higher Level Stewardship prioritised measures that would benefit arable birds (particularly lapwing, grey partridge, yellow wagtail, tree sparrow, turtle dove and corn bunting) and bird species associated with wet grassland (particularly lapwing, snipe, redshank, curlew and yellow wagtail).[22]<br><br>Threats to biodiversity in the area include invasive non-native species, for example white-clawed crayfish are under threat from signal crayfish in the River Witham.[23] | National | Habitats are highly fragmented in this landscape, leaving many species vulnerable to the impacts of genetic isolation and lack of habitat and food. The extent of fragmentation will also make sites and species more vulnerable to climate change.<br><br>There is a really important role for habitat network creation in this area, building on the existing value of flower-rich verges, hedgerows and small patches of semi-natural habitats (calcareous and neutral grassland, heathland and woodland). Efforts should be made to plan effective networks of interconnecting habitats, buffers and 'stepping-stone' habitats and work with landowners to identify cost-effective ways of achieving them with minimal impact on food production.<br><br>The restoration of disused quarries should include the establishment of priority habitats (heathland, grassland, woodland) along with open water and other freshwater habitats where groundwater levels are high enough.<br><br>The rivers are a valuable wildlife resource and riparian habitats have good potential to act as wildlife refuges and movement corridors, as well as slowing the flow of water and protecting rivers from water pollution.<br><br>Arable land is important for the farmland birds it supports. Management of arable land can have a big impact on its value for farmland birds and measures such as overwintered stubbles, fallow nest plots, wild bird seed mix and less-frequent hedgerow cutting can all be beneficial. | Seek opportunities to buffer and connect existing priority habitats, particularly calcareous and neutral grassland, woodland and heathland, in ways that minimise the impact on food production.<br><br>Seek opportunities to restore riparian habitats such as woodland and wetlands, to protect water quality, reduce flooding and benefit biodiversity.<br><br>The restoration of sites where minerals have been extracted should include the establishment of priority habitats (particularly heathland, grassland and woodland) along with open water and other freshwater habitats where groundwater levels are high.<br><br>Encourage farmers to implement measures that are beneficial for farmland birds, such as overwintered stubbles, fallow nest plots, wild bird seed mix and less-frequent hedgerow cutting. | **Biodiversity**<br><br>**Water availability**<br><br>**Regulating water quality**<br><br>**Regulating water flow**<br><br>**Regulating soil quality**<br><br>**Regulating soil erosion**<br><br>**Sense of place/ inspiration**<br><br>**Tranquility**<br><br>**Sense of history**<br><br>**Recreation** |

[22] HLS Target Area Statement EM16: Witham Target Area, Natural England (2008; URL: www.naturalengland.org.uk/images/hlstargeting/Witham.pdf)
[23] River Basin Planning: Summary of significant management issues – Anglian River Basin District, Environment Agency (2007; URL: www.environment-agency.gov.uk/static/documents/Research/anglianswmidoc_1953860.pdf)

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| **Geodiversity** | Geology<br><br>Topography<br><br>Soils<br><br>Disused extraction sites | Elevated, gently sloping plateau with a sharply defined north–south scarp of Jurassic Limestone to the west of the NCA.<br><br>The area has one geological SSSI (Metheringham Heath Quarry) and one mixed interest SSSI (Copper Hill), both designated for their exposures of the Aalenian–Bajocian Stage boundary.<br><br>There are 13 Local Geological Sites.<br><br>There are good exposures of limestone at some points along the cliff and at disused mineral extraction sites. | Regional | The resources of limestone, ironstone and aggregates have been exploited over time, and disused quarries and extraction sites now provide geological exposures and geomorphological features that contribute to scientific research and understanding, as well as offering opportunities for interpretation, wider education and awareness-raising.<br><br>Restoration of disused mineral sites should retain exposures that illustrate geological processes, as well as providing for the establishment of priority habitats and access where appropriate.<br><br>Vernacular buildings, including farmhouses, barns, village houses, walls and churches are built with local limestone, making evident the links between underlying geology and historic development. | Provide high quality interpretation using a range of media at key geological sites to convey the origins of the geology and its importance to the area.<br><br>Improve access to key geological sites, particularly for educational visits, where appropriate.<br><br>Facilitate the recording and sampling of temporary sections and excavations exposing geological features.<br><br>Ensure that restoration of disused mineral extraction sites retains exposures that illustrate geological processes.<br><br>Maintain and restore field boundaries constructed from limestone rubble.<br><br>Use local building materials and techniques when restoring vernacular buildings. | **Geodiversity**<br><br>**Sense of place/ inspiration**<br><br>**Sense of history**<br><br>**Recreation**<br><br>**Biodiversity** |

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