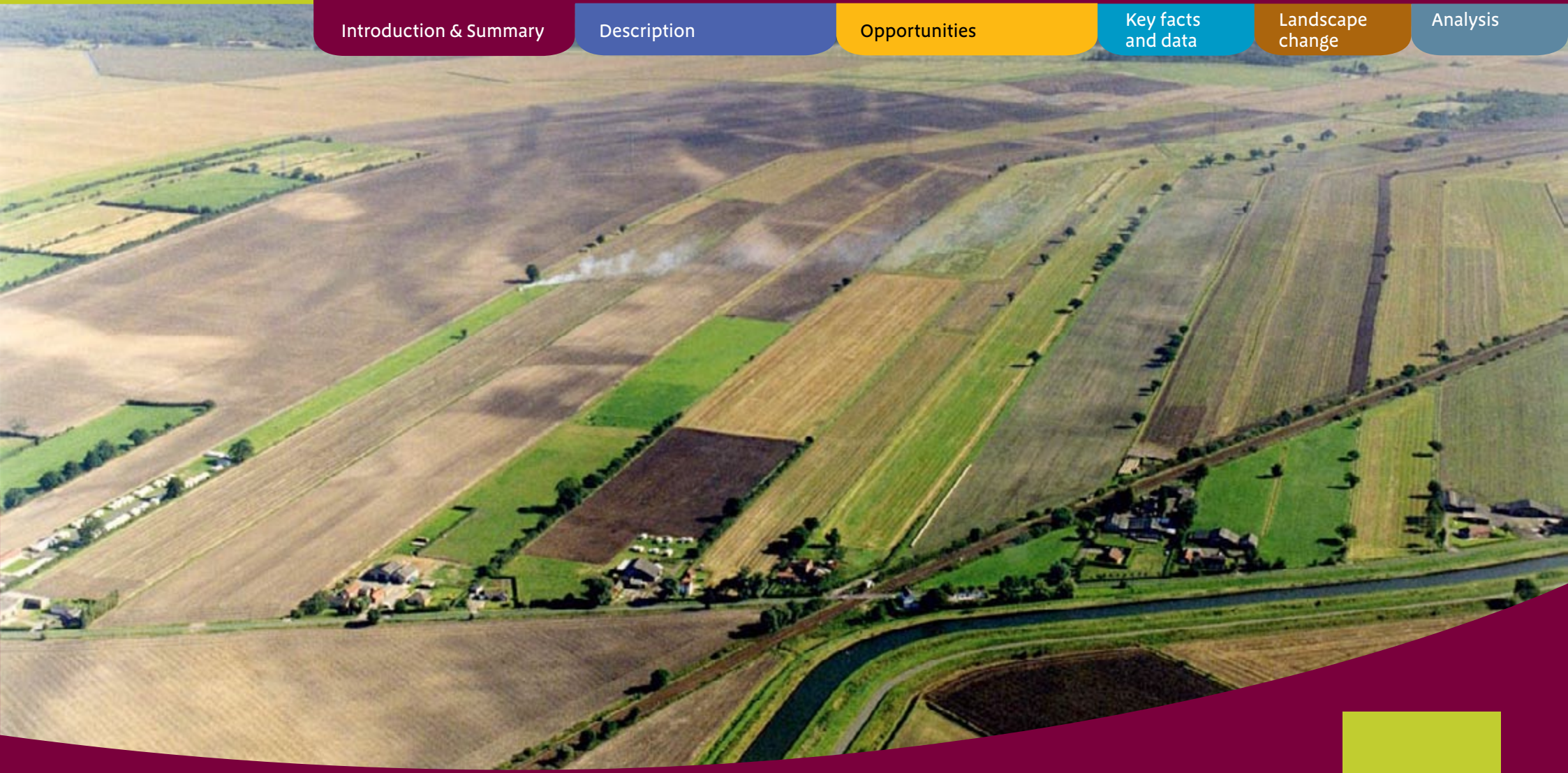
National Character Area profile:

39. Humberhead Levels



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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.

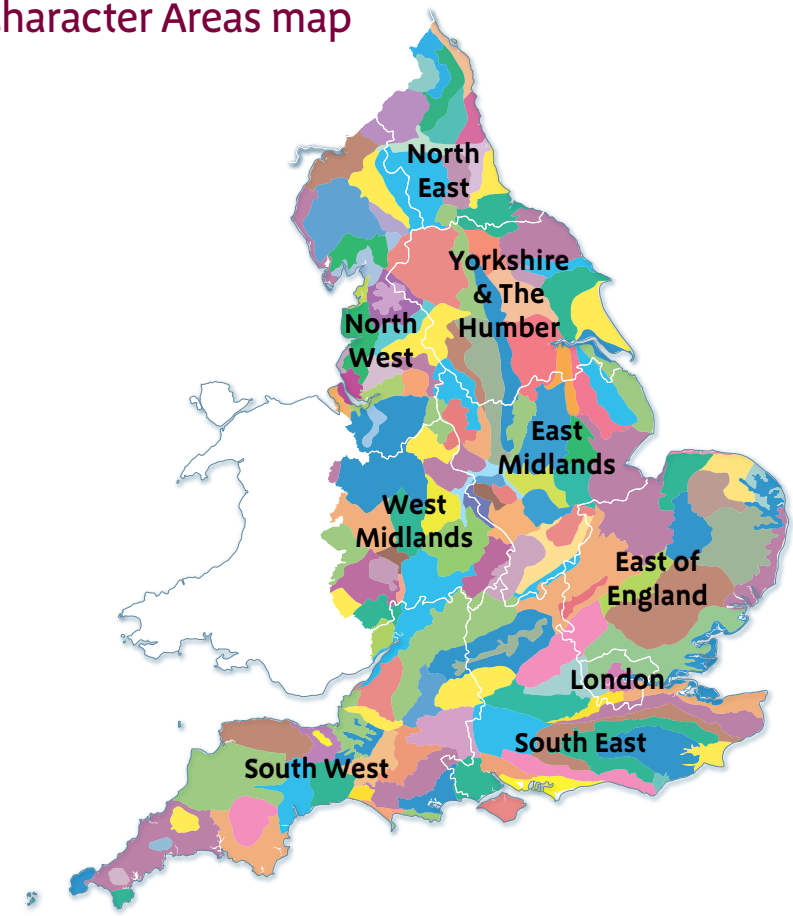
NCA profiles are guidance documents which can help communities to inform their decision-making about the places that they live in and care for. The information they contain will support the planning of conservation initiatives at a landscape scale, inform the delivery of Nature Improvement Areas and 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)

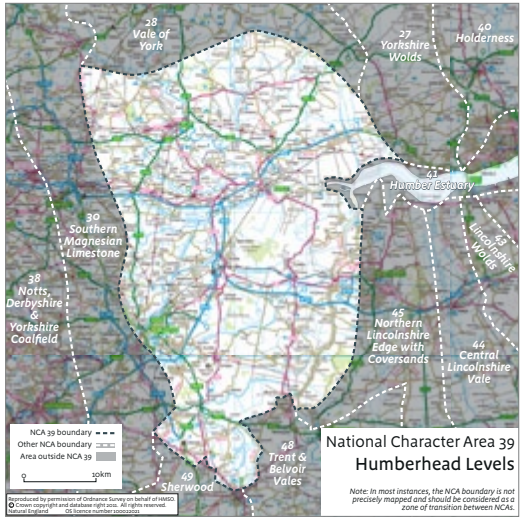
Summary

The Humberhead Levels is a flat, low-lying and large scale agricultural landscape bounded to the west by the low ridge of the Southern Magnesian Limestone and to the east by the Yorkshire Wolds (north of the Humber) and the Northern Lincolnshire Edge with Coversands (south of the Humber). To the north it merges into the slightly undulating landscape of the Vale of York, at the line of the Escrick Moraine, and in the south it merges in to the Trent and Belvoir Vales and Sherwood.

There are several sites of international significance for their biodiversity, designated as Special Protection Areas and/or Special Conservation Areas. These include the lowland peatlands at Thorne and Hatfield Moors, the wetlands along the lower reaches of the River Derwent, and those stretches of the tidal rivers Ouse and Trent that fall within the Humber Estuary designated site. The Derwent and the Humber Estuary are also Ramsar sites. Sandy soils give rise to lowland heathland such as at Skipwith Common, which is an SAC. Thorne and Hatfield Moors, the Lower Derwent valley and Skipwith Common are also all National Nature Reserves. The Isle of Axholme is of international significance for its extensive strip field system, while other areas reveal distinct field and drainage patterns linked to past uses and drainage of the area.

In the central areas the large geometric fields are generally bounded by ditches and the highly productive agricultural land is maintained by pumping to keep the water table down. There are challenges to maintain this level of productivity while also addressing soil quality and erosion, in particular the oxidation of peaty soils. With the lower stretches of several major rivers draining across the area into the Humber Estuary, there are significant flood management issues to address, such as finding ways of extending flood storage and floodplains, which would also open up possibilities for expanding wetland habitats. Other opportunities include working collaboratively to manage water table levels and the network of ditches. Managed realignment schemes along the upper Humber are valuable in increasing the capacity of the estuary to hold flood waters, an issue exacerbated by rising sea levels.

There are important road, rail and water routes linking industrial areas to the east with the hinterland, and towns include Doncaster, Selby and Goole. Despite these busy areas, there are some very remote and tranquil areas, notably at Thorne and Hatfield Moors and the Lower Derwent Valley. The whole area is characterised by long views and big open skies.



Click map to enlarge; click again to reduce.

Statements of Environmental Opportunity

- **SEO 1**: Safeguard, manage and expand the wetland habitats, including the internationally important lowland raised bogs, the floodplain grazing marsh, reedbeds, wet pastures and watercourses, to protect and enhance biodiversity, contribute to landscape character, address climate change and reduce flood risks.

- **SEO 2**: Manage the agricultural landscape to retain its distinctive character and its productivity, while improving its contribution to biodiversity, the protection of vulnerable soils and palaeo-environmental evidence, and the water resource.

- **SEO 3**: Manage the landscape features such as semi-natural habitats and historic field patterns that reveal local variations in landscape character, often arising from underlying soils and history of drainage, to enhance people's understanding and enjoyment of the landscape.

- **SEO 4**: Protect the open and expansive character of the landscape, its cultural features and sense of remoteness, by ensuring that new development is sensitively located, accommodates green infrastructure, retains long views and makes a positive contribution to biodiversity.

Fields are large and rectangular and bounded by ditches, with dispersed farmsteads.

Humberhead Peatlands National Nature Reserve: cotton grass is re-establishing on the re-wetted abandoned peat workings on Thorne Moors.

Description

Physical and functional links to other National Character Areas

Several major rivers flow in from the north (Derwent, Ouse), the west (Aire, Went) and south (Don, Torne, Idle, Trent). They flow slowly across the Levels and join to form the Humber Estuary which flows out east to the North Sea. Land use and land management activities and actions undertaken upstream, especially in the uplands of the Pennines and the North York Moors, thus have a significant impact on these lower stretches of the rivers.

The rivers and the network of drainage ditches and dykes form important ecological corridors linking the Humber Estuary with areas upstream. A network of wetland habitats throughout this area is important to enable species movement in response to climate change, including adapting to pressures arising from sea level rise. There are also several navigable waterways crossing the area, including the Selby, Pocklington, Market Weighton, Calder navigation and Stainforth / Keadby Canals.

The Sherwood Sandstone Aquifer, a strategically important source of water, underlies the western part of the area.

The higher ground of the Yorkshire Wolds to the north east, and to a lesser extent that of the limestone ridge to the west, provide extensive views out across the Levels. Within the NCA, there are long views across the arable landscape to the backdrop of the Wolds.

Distinct areas

- The Isle of Axholme
- Fishlake and Sykehouse pastoral landscape

Skipwith Common National Nature Reserve: open heath is maintained through grazing by ponies. Lowland heath still survives where underlying deposits of sand and gravel give rise to infertile soils.

Key characteristics

- A low-lying, predominantly flat landscape, with large, regular and geometric arable fields without hedges but divided by ditches and dykes, many of which form important habitats and key corridors for species movement.
- Much of the land is at or below mean high-water mark and maintained by drainage, with fertile soils giving rise to one of the most productive areas for root crops and cereals.
- Variations in underlying deposits create differences within the overall flat farmed landscape, including lowland raised mires and lowland heathland, many of which are of international ecological and historical importance.
- Sandy deposits give rise to lowland heath, which in places supports remnant birch and oak woodlands, with some conifer plantations.
- Heavier soils around Fishlake and Sykehouse result in a smaller scale pastoral landscape, with small, thickly hedged fields, ditches and ponds, and a network of small lanes.
- Important historic landscapes include the Isle of Axholme, with evidence of mediaeval open fields, the warps (land enriched by regular silting) near Goole and cables (long thin strip fields) around Thorne.
- Widespread evidence of drainage history, in particular the extensive drainage from the 17th century, revealed through canalised rivers, dykes, old river courses, canals, bridges and pumping stations.
- Views to distant horizons are often long and unbroken, with big expansive skies, and vertical elements like water towers, power stations and wind turbines are very prominent.
- Floodplains, washlands and traditionally grazed alluvial flood meadows (or ings) associated with the major rivers and canals that cross the Levels give rise to important wetland habitats, supporting large numbers of wetland birds and wildfowl, especially over winter.
- The waterlogged soils hold internationally important archaeological and palaeo-archaeological deposits.
- Despite settlements, motorways and main roads, there is still a sense of remoteness to be experienced on the Levels, in particular on Thorne and Hatfield Moors and along the Lower Derwent Valley.

The Isle of Axholme is a long low ridge rising above the low-lying land that, before it was drained, was marshy and provided summer grazing and fishing. Extensive evidence of open strip fields remains on the Isle, while the water tower, windmill and church are vertical features visible from afar in the open expansive landscape.

Humberhead Levels today

The Humberhead Levels have a strong unity derived from their geological history. Over time the underlying mudstones and sandstones were eroded and then shaped by glacial lake sediments. This has created a very flat land enriched by alluvial deposits, making it one of the most productive cropping areas in Britain. It is flat and low-lying, with some land at or below the mean high water mark, and encompasses the broad floodplains of several major navigable rivers which drain in to the Humber Estuary. The farmland is intensively farmed, generally high input cereals and root crops, in very large, open, geometric fields divided by ditches and dykes, with scattered and fragmented semi-natural habitats.

The more recently reclaimed land is without trees or hedgerows, giving long views unbroken to distant horizons, with the sky playing an important part.

Just small rises in the landform, as here at Gringley on the Hill, looking north out over Misterton Carrs and across the Humberhead Levels, can provide long and expansive views, with big skies.

The long history of drainage and water management is evident in many areas, with rivers contained by flood embankments and a network of ditches, dykes and canals, with associated brick bridges, pumphouses and sluices.

Underlying deposits of sand and gravel, along with local outcrops of sandstones and mudstones, create distinct but subtle variations in the landscape within the overall flat, farmed levels. In the north deposits of sand and gravel support remnants of heathland, which make significant contributions to the landscape and biodiversity of the area, notably Skipwith Common National Nature Reserve. The lowland heaths support species such as heather, bog rosemary and round leaved sundew, with purple moor grass found alongside cross leaved heath in wetter patches. Some deposits of sand and gravel have been extracted, in particular in the south, while some of the less fertile sandy soils have been planted up with conifers, which break up the expanses of large arable fields.

The low-lying central levels, around Goole and the Ouse and Trent levels, have very fertile soils although constant pumping is required to enable cultivation. Traditional management of floodplain grazing marshes alongside lowland hay meadows and fen vegetation creates variations in structure and habitats that support bird populations such as lapwing, curlew and teal, with local populations increasing during winter with birds arriving from northern Europe. The rivers are important corridors for migratory salmon and sea trout. Along with the rivers and wetlands, the network of ditches and dykes form important corridors for species, including water voles, dragonflies and butterflies, and otters have been recorded in the area.

The Lower Derwent Valley running south to join the Humber Estuary is a designated Special Area of Conservation and a Ramsar site, with a traditional riverine landscape with pastures, species-rich meadows and well vegetated

field drains, framed by occasional small woodlands and waterside willows. Along with the nearby Pocklington Canal there is a strong sense of tranquillity and serenity in these traditionally farmed areas. Other wetland habitats occur along the floodplains of the rivers Don, Idle, Torne, Ouse and Aire. The proximity of the Humber estuary, designated as a Special Protection Area, Special Area of Conservation and a Ramsar site for its bird populations, and inter-tidal and saline habitats, makes the area important for large numbers of over-wintering birds and wildfowl such as the ruff, bittern and marsh harriers.

The largest extent of remnant raised bogs in England occurs here, at Thorne and Hatfield Moors. These are of international ecological and historical importance, and the previously extensive commercial peat production has now been halted, and work is being undertaken to restore the damaged peat areas. These moor landscapes are important for their communities of bog mosses and rich invertebrate populations including several species of dragonfly, wolf spiders, water beetles and the mire pill beetle. Along with heather, it is possible to find cranberry, cross leaved heath, cotton grass, bog rosemary and bog myrtle. There are also belts of scrub and fen woodland amongst the lowland heath and bog. Over 200 species of birds feed or breed here, including the hobby and merlin, and the numbers of nesting nightjar is a significant proportion of the western European population. There is a very strong sense of remoteness and tranquillity on these moors, despite the proximity of motorways and towns.

Underlying mudstone forms the low ridge of the Isle of Axholme, which retains extensive evidence of medieval open strip fields, of international significance. Combined with the nearby turbaries (where common rights to cut peat exist) at Haxey and Epworth, these historic landscapes reveal the earlier interdependence of the cropped land and settlements with the marshes, which provided rights of seasonal grazing, fishing, and peat cutting. Other historic field patterns include the warps (land enriched by regular silting) near Goole and cables (long thin strip fields) around Thorne.

North of Doncaster, around Fishlake and Sykehouse, heavier clay soils have given rise to a smaller scale pastoral landscape, with more livestock rearing and relatively small fields enclosed by thick hedges, some with evidence of ridge and furrow. There are still some traditional orchards associated with farmsteads, and there are networks of small lanes, ditches, and several field ponds.

Settlement is limited, with villages generally concentrated on slightly higher, drier ground. There are small market towns and more industrial centres like Doncaster, Goole and Selby. Building materials are red Barton brick and red pantiles, with slate being used in the north, but more recent development has used many different materials. Outside the villages there are dispersed large, relatively isolated farmsteads with brick and pantile farmhouses and other traditional farm buildings, along with large, sometimes industrial style, modern buildings reflecting the large scale arable agriculture.

The horizons are punctuated by water towers, major power stations such as Eggborough and the iconic grouping of cooling towers at Drax, and more recently several windfarms. The motorways M18 and M62 cut across the area, often on raised embankments, which increase their visibility but also provide views out across the open landscape. The strong traditions of angling and wildfowling remain popular.

The landscape through time

The landscape of the Humberhead Levels is influenced by glacial and alluvial deposits overlying bedrock dominated by Triassic Mercia mudstone and sandstone. To the west earlier Permo-Triassic Sherwood Sandstone underlies the area and provides an important aquifer. Many of the superficial deposits were laid down by the extensive glacial Lake Humber, formed when melt water from the last glaciation became trapped by further ice sheets. The lake has a complex history and the variations in its size and shape can be traced in the deposits. Following the escape of the water through the Humber Gap, the silt deposits left were reworked and added to by the numerous rivers that ran down from the Pennines to the Humber, with sand and gravel deposits being laid down. These fluvial deposits can be very varied, and include material brought down from both the Pennines and the Magnesian Limestone ridge to the west. Although the rivers cut channels through the Lake Humber deposits, these then filled due to rising sea levels, resulting in a predominantly flat landscape, with extensive flooding and wetting of the soils, and the development of large areas of peaty fen and bog.

In prehistory the lighter soils, to the north and south, were extensively cleared for small-scale pastoral farming. Between these areas the early landscape was marshy with a complex system of rivers and creeks. This remained largely unpopulated, although finds of prehistoric boats suggests that it was used for hunting and fishing. Large enclosures dating from the Iron Age have been discovered at Sutton Common, where wet soil conditions have preserved organic remains.

Roman activity has been recorded across the Humberhead Levels including farmsteads, roads, salterns, and pottery kilns. The extensive river system was used by invading Angles and Danes to penetrate deep into the country, although evidence of settlement from this period is scarce. This may be due to high deposition of alluvial soils in riverside and marshland areas which have masked archaeological remains.

Slightly higher drier land of fluvio-glacial deposits formed islands within the wetland, enabling early settlement during the medieval period. This is shown by the remnants of turbaries (peat cutting), retting pits, and 'ridge and furrow' fields as well as the largest stretch of open strip field systems in the country at the Isle of Axholme, which is of international significance. During this period towns developed along river trade routes and with occupiers of medieval ecclesiastical sites, began the process of land drainage, which was to be intensified during later periods. Moated sites, associated with heavy clay soils, were established to the north of Doncaster, and around the Isle of Axholme.

Dirtness pumping station is one of many attractive structures, along with bridges and sluices, which reveal the history of the drainage of the Levels.

Significant drainage activity began in the 1620s when Dutch drainage engineers began large-scale river diversions and land drainage. They introduced the practice of 'warping' where farmland was inundated with seasonally impounded tidal waters to deposit fertile alluvial silt. Drainage and warping continued into the 18th century and created today's characteristic flat treeless landscape drained by a network of drains and dykes. In the 18th and 19th centuries new technologies encouraged more efficient drainage, and private and parliamentary enclosure followed, enabling increasingly productive agriculture. However the traditional pattern of livestock farming supported by hay meadows has survived on an unparalleled scale along the River Derwent.

In the 20th century this landscape had a role to play in both World Wars with military remains, airfields (one of which is now part of Skipwith NNR), and bombing decoys. It also continued to provide sources of energy, in particular through the major concealed coalfield accessed from Selby until 2004. The plentiful supply of water drawn from the main rivers for cooling, along with the local source of coal, resulted in the construction of several power stations, including the iconic Drax.

Over recent decades there has been continued pressure on the rural character of the area through expansion of housing and industry, including warehousing near the motorways and large agricultural sheds in rural areas, and recently a number of windfarms. Transport infrastructure continues to expand, with the development of an airport, and an inland freight and transport interchange at Rossington.

The intensive arable cropping has also continued, with a decline in mixed farming and a move towards more diverse crops such as flax, borage and maize. Root crops have declined since the closure of the local sugar beet factory. Livestock numbers have remained relatively low, with a substantial decline in pig numbers since 2000, and the size of holdings remains large.

The Isle of Axholme is of international significance for its extensive evidence of medieval strip field cultivation.

Some stretches of the Pocklington Canal are quiet and remote, providing valuable habitats and a sense of tranquillity.

Ecosystem services

The Humberhead Levels 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 Humberhead Levels NCA is contained in the 'Analysis' section of this document.

Provisioning services (food, fibre and water supply)

- **Food provision**: This is one of the most productive agricultural areas in the country, with 10 per cent of the land classified as Grade 1, 33 per cent as Grade 2, while a further 41 per cent is Grade 3.

- **Biomass energy:** The existing woodland cover of 5.4 per cent offers limited potential for the provision of biomass through bringing unmanaged woodland under management. However, there is potential for increasing the area of biomass crops such as miscanthus; the extent of this will be determined by the market led decisions of the many local power stations.

- **Water availability**: The availability of water is likely to become more critical with the anticipated effects of climate change such as summer droughts. The western half of the NCA overlays the major Sherwood Sandstone Aquifer, which provides a strategically important source of water for domestic use as well as industry and agriculture, and needs to be replenished. Levels of abstraction of water from the rivers need to be managed carefully, and the demands of summer irrigation of crops may lead to an increase in construction of farm reservoirs.

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

- **Climate regulation:** Significant climate regulation is offered by the carbon captured in the areas of peat with their high carbon content soils. An expansion of wetland habitats and permanent grasslands would also assist with building up soil carbon and reducing the use of artificial fertilisers.

- **Regulating soil erosion**: The continued cultivation of peat soils, with the lowering of water table levels, is exacerbating the process of drying out and oxidisation of the peat, thus making them vulnerable to both wind and water erosion, while the organic content of the sandy soils is low. Agricultural practices should address protecting the soil resource from erosion by maintaining cover and increasing organic content.

Most watercourses have been realigned and canalised between flood defences, but they can still provide good recreation opportunities, as here for the fishermen along the River Torne.

- **Regulating coastal flooding and erosion:** Some central stretches of this NCA are close to sea-level and are maintained as agricultural land by pumping. The Humber Estuary drains one fifth of the area of England and much of the area is at risk from fluvial flooding from rivers that drain into the Levels from surrounding higher ground. The risk is exacerbated by combinations of high rainfall within the catchment of the estuary, high tides, on-shore winds and low atmospheric pressure. Extensive areas are dependent upon flood defences including land in the floodplain of the rivers Ouse and Aire, while along the Humber Estuary some significant managed realignment is being carried out to increase the capacity of the river. Opportunities exist for extending flood storage areas and managed realignment of the estuary banks, with consequent creation of wetland and inter-tidal habitats.

Cultural services (inspiration, education and wellbeing)

- **Sense of place/inspiration**: A sense of place is provided by the flat, low lying and large scale farmed landscape crossed by major rivers and dykes. The big open skies and long views can be inspirational, as can the chances to see large numbers of birds, especially overwintering waders. The subtle variations within the area give rise to distinct local areas such as the quiet marshes and meadows of the Lower Derwent Valley and the heathlands of Skipwith and Strensall commons. The lowland peat bogs in particularly provide a sense of remoteness and wildness, unusual within such a cultivated landscape.

- **Sense of history**: A sense of history is associated with the management of water, evidenced by old river courses such as the Don, historic ditches, berms, dykes, canals, bridges, disused windmills, water towers and canals, reflecting both the reclamation of the area for cultivation, and the importance of the waterways as major transport routes. There are distinctly different historic landscapes such as the warps near Goole, the cables near Thorne, and the enclosed agricultural landscape around Fishlake and Sykehouse. In particular there are the remnant medieval open field patterns of the Isle of Axholme, one of the largest examples of open field strip cultivation, which is associated with Haxey and Epworth Turbaries, where traditional peat cutting rights were exercised.

- **Tranquility**: Although the area has experienced a significant decline in tranquillity since the 1960s, there are still significant areas of tranquillity at Thorne and Hatfield Moors, the Lower Derwent Valley and around Fishlake and Sykehouse.

- **Recreation**: There are recreational opportunities associated with the National Nature Reserves at Thorne and Hatfield Moors, flagship reserves for providing access, while the paths along dykes and canalised watercourses provide ways of experiencing the remote open spaces.

- **Biodiversity:** While the predominant land use is agriculture, there are sites of international and national importance, including 2 Ramsar sites, 3 Special Protection Areas, 6 Special Areas of Conservation and 40 Sites of Special Scientific Interest, as well as 577 local wildlife sites. The lowland raised mires of the Humberhead Peatlands, the lowland heathland at Skipwith Common and the Lower Derwent Valley are all National Nature Reserves, while the Lower Derwent Valley and Humber Estuary are both Ramsar sites.

Statements of Environmental Opportunity

SEO 1: Safeguard, manage and expand the wetland habitats, including the internationally important lowland raised bogs, the floodplain grazing marsh, reedbeds, wet pastures and watercourses, to protect and enhance biodiversity, contribute to landscape character, address climate change and reduce flood risks.

For example, by:

- Seeking opportunities to restore and expand lowland raised bogs, and to bring adjacent land into management that will support these vulnerable habitats, including raising the water table levels and reverting arable land to pasture.
- Seeking opportunities to restore and expand floodplain meadows, wet pastures, grazing marsh, fens and other water dependent habitats, creating links where possible to improve the resilience of habitats to climate change and enable species movement.
- Working collaboratively with groups of farmers and landowners, Internal Drainage Boards and others to achieve comprehensive management of water table levels, raising them where appropriate to prevent peaty soils from drying out, support semi-natural habitats, and protect palaeo-environmental evidence.
- Encouraging cultivation practices that will maintain cover on vulnerable peaty soils and protect underlying palaeo-environmental evidence.
- Ensuring that managed realignment sites on the Humber are managed to create new intertidal and saline habitats that will maintain and enhance biodiversity and landscape character, while also providing effective flood defence.
- Optimising the benefits from extending washlands for flood storage, and accommodating occasional overtopping of flood defences through putting land down to wet pastures / floodplain grazing marsh, thus reducing flood risk elsewhere.

SEO 2: Manage the agricultural landscape to retain its distinctive character and its productivity, while improving its contribution to biodiversity, the protection of vulnerable soils and palaeo-environmental evidence, and the water resource.

For example, by:

- Ensuring that the network of ditches and dykes are brought under sound rotational management so that they continue to function while also retaining a proportion of emergent vegetation, thus forming key links between wetland and other semi-natural habitats, and providing important habitats for species such as water voles and dragonflies.
- Seeking opportunities to bring land adjacent to semi-natural habitats, especially wetland habitats, into appropriate management so that habitats can be protected from any potentially adverse impacts from nutrient run-off, chemical spray drift and / or reduction of water table levels.
- Encouraging the introduction of a wider range of habitats within the arable areas, such as permanent grassland field margins and buffers alongside watercourses and wetland habitats, and linking them where possible to other semi-natural habitats to create more resilient networks and enable species movement, while also reducing sediment and nutrient run-off.
- Encouraging the use of land management practices and arable options that enhance conditions for farmland birds and invertebrates.
- Encouraging the use of land management practices such as over-wintering stubble and introducing fallow into rotations, to improve soil structure and organic content especially on sandy soils, and improve resistance to erosion on peaty soils.
- Seeking opportunities to create species rich grassland along the many miles of floodbank, thus providing support for pollinating insects within the agricultural landscape.

SEO 3: Manage the landscape features such as semi-natural habitats and historic field patterns that reveal local variations in landscape character, often arising from underlying soils and history of drainage, to enhance people's understanding and enjoyment of the landscape.

For example, by:

- Managing and expanding existing semi-natural habitats, including floodplain grazing marsh, lowland heathlands, fens, wet woodlands, wet pastures and meadows so that the influences of the underlying soils and drainage are made evident, establishing connecting networks of semi-natural habitats where possible, and enhancing their biodiversity value and their contribution to landscape character.
- Conserving the internationally significant medieval strip fields on the Isle of Axholme and actively seeking ways of encouraging land managers to retain the evidence of the strips.
- Conserving the strong patterns of cables and warps, as around Thorne and Goole.
- Conserving the ridge and furrow fields and managing and strengthening the pastoral landscape around Fishlake and Sykehouse, with its hedges, pastures and meadows, and typical moated farmhouses.
- Conserving the medieval strip fields, meadows and pastures of the Lower Derwent Valley, for their historic interest as well as their contribution to landscape character and biodiversity.
- Ensuring that the existing lowland heaths are under sound management to achieve a robust habitat with mosaics of diverse structure and vegetation, to protect soils from erosion and enhance their biodiversity and contribution to the landscape.
- Seeking opportunities to interpret the influence of underlying deposits and the history of drainage of the area on the landscape of today, to expand people's understanding and enjoyment of the landscape.

SEO 4: Protect the open and expansive character of the landscape, its cultural features and sense of remoteness, by ensuring that new development is sensitively located, accommodates green infrastructure, retains long views and makes a positive contribution to biodiversity.

For example, by:

- Ensuring that development associated with transport corridors, Robin Hood airport and other urban and industrial expansion includes provision of green infrastructure and addresses flood risk mitigation.
- Ensuring that new developments are located and designed with particular consideration for keeping long views open, and limiting the use of native tree and shrub planting to integrate structures but without unduly impacting on the open character of the area.
- Ensuring that local styles and materials such as Barton brick are used in the restoration of traditional vernacular buildings.
- Seeking opportunities in the transport corridors to create and improve linear connections between habitats, to aid species movements.
- Restoring sand and gravel extraction sites to semi-natural habitats where possible so that they enhance biodiversity interest and make a positive contribution to landscape character, while retaining exposures and providing access where appropriate so that understanding of geodiversity can be improved.
- Minimising light spill and noise through careful control and design, in particular to retain the tranquillity in the more remote rural areas.
- Avoiding development which would impact on the lowland raised mires, heathlands and floodplain meadows, where there is a particularly strong sense of remoteness and high levels of tranquillity.
- Maintaining the long and unbroken views to distant horizons.

Parts of the Levels function as flood storage areas, and the River Derwent, which has avoided canalisation, regularly floods on to the adjacent grasslands as here at Aughton Ings. In the background can be seen Drax and Eggborough power stations.

Additional opportunity

1. Plan for the improved enjoyment and understanding of the landscape and its subtle variations, its inspirational qualities, its biodiversity, geodiversity and historic interest, its role in producing food and mitigating climate change.

For example, by:

- Maintaining and improving the recreational opportunities provided by the network of canals, paths along flood banks, and navigable waterways, seeking opportunities to create circular routes linked to local towns and villages.
- Conserving the network of drainage ditches, dykes, canals and other watercourses with all their historic features such as brick bridges, pumphouses, sluices, and old river courses.
- Measuring, monitoring and recording elements of the historic environment to improve understanding and provide interpretation of the history of the area for residents and visitors.
- Encouraging sustainable access to selected semi-natural habitats such as the lowland heaths at Skipwith Common, and the Humberhead Peatlands National Nature Reserves, a flagship for access, education and public enjoyment.
- Providing interpretation to reveal the connections between geodiversity, historic development and the landscape of today with its biodiversity interest, agricultural production and subtle variations in landscape character.
- Seeking opportunities for more people to be inspired by the long views, open skies, sightings of birds and other wildlife, and links to past ways of living, including traditional wildfowling.

Supporting document 1: Key facts and data

Total area: 171,805 ha

1. Landscape and nature conservation designations

There are no national landscape designations within this National Character Area. However, the Isle of Axholme is considered of international significance as the mediaeval open field strips are still in evidence over an extensive area.

Source: Natural England (2011)

1.1 Designated nature conservation sites

The NCA includes the following statutory nature conservation designations:

Tier	Designation	Name	Area (ha)	Percentage of NCA
International	Ramsar	Lower Derwent Valley, Humber Estuary	843	<1
European	Special Protection Area (SPA)	Thorne and Hatfield Moors SPA; Lower Derwent Valley SPA; Humber Estuary SPA	3,359	3
	Special Area of Conservation (SAC)	Thorne Moor SAC; Hatfield Moor SAC; Lower Derwent Valley SAC; Skipwith Common SAC; Humber Estuary SAC; River Derwent SAC.	4,598	3
National	National Nature Reserve (NNR)	Humberhead Peatlands NNR, Lower Derwent Valley NNR	3,478	2
National	Site of Special Scientific Interest (SSSI)	A total of 40 sites wholly or partly within the NCA	5,742	3

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 5,722 ha. designated as SSSI, which overlap with the designations of Ramsar, SPA and SAC to a very great extent. Over 3 per cent of the area is designated SSSI, comprising mostly lowland bogs, lowland heaths, wetlands, meadows and sandpits.

There are 577 Local sites in the Humberhead Levels NCA covering 7,264 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 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) -select 'Designations/Land-Based Designations/Statutory'

1.2 Condition of designated sites

A breakdown of SSSI conditions as of March 2011 is as follows:

SSSI condition category	Area (ha)	Percentage of SSSI in category condition
Unfavourable declining	194	3.5
Favourable	882	15
Unfavourable no change	430	7.5
Unfavourable recovering	4,223	74

Source: Natural England (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

Elevation ranges from extensive areas at or just below sea level, to a few low undulations that rise above 10 m. Mean elevation is around 6 m, and the only extensive higher land is the low ridge of the Isle of Axholme, which rises to around 30 m above sea level.

Source: Humberhead Levels Countryside Character description

2.2 Landform and process

The Levels are largely flat, with subtle rises in landform reflecting underlying deposits of sand and gravel.

Source: Humberhead Levels Countryside Character description

2.3 Bedrock geology

The solid geology is poorly visible within the Humberhead Levels, being largely obscured by superficial glaciolacustrine, glaciofluvial and alluvial deposits. The underlying bedrock geology comprises Permian rocks in the west, and Triassic Sherwood Sandstone and Mercia Mudstone groups, with the Lias group in the extreme east. There are significant aquifers in the Sherwood Sandstone group and Permian rocks. There are a few higher areas where ridges of the underlying sandstones or mudstones rise above the alluvium, notably the low ridge of the Isle of Axholme.

Source: British Geological Society

2.4 Superficial deposits

North of the river Aire there are glacial Lake Humber deposits of glaciolacustinre clays and glaciofluvial sand and gravel, with some till. South of the River Aire, the superficial deposits are alluvium and river terrace gravels of the Humber Estuary and associated rivers, peat and blown sand, creating a largely flat landscape with local undulations. There are extensive areas of glaciofluvial and river terrace sands and gravels, which give rise to infertile free draining soils, some planted with conifers and others worked commercially, leaving a legacy of restored or partly restored gravel pits. Peat and peat soils occur along former river channels and flood areas, and Thorne and Hatfield Moors comprise the largest extent of lowland raised bog in England.

Source:Humberhead Levels Natural Area Profile; British Geological Society

2.5 Designated geological sites

Tier	Designation	Number
National	Geological Site of Special Scientific Interest (SSSI)	2
National	Mixed interest SSSIs	1
Local	Local geological sites	18

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

The soils vary considerably depending upon the underlying deposits. About half of the NCA has loamy and clayey soils, many of them with naturally high groundwater. Across much of the central low-lying area the water table is maintained at a low level to enable cultivation throughout the year by a very extensive system of pumping. There are small areas of deep peaty soils, notably at Thorne and Hatfield Moors. These soils are at risk of shrinkage and oxidation, and wind erosion where surfaces are bare. About 30 per cent of the NCA has free draining sandy soils which are prone to water erosion on slopes, and wind erosion where bare.

Source: Natural England (2010)

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)	Percentage of NCA
Grade 1	16,736	10
Grade 2	55,874	33
Grade 3	71,260	41
Grade 4	14,764	9
Grade 5	3,405	2
Non-agricultural	4,165	2
Urban	5,415	3

Source: Natural England (2010)

The area contains some of the most productive soils in the country, with 43 per cent classified as Grade 1 and 2, and only 15 per cent below Grade 3 or non-agricultural.

Maps showing locations of statutory sites can be found at: http://magic.defra.gov.uk - 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 Trent	38
River Idle	38
River Torne	32
River Aire	32
Aire and Calder Navigation	26
River Don	24
Stainforth and Keadby Canal	24
River Ouse	24
River Derwent	19
River Foulness	19
River Went	14
Dutch River	10
Market Weighton Canal	9
Selby Canal	9
New Junction Canal	9

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.

Much of the central area lies close to or even below sea level, where continued settlement and agricultural activity is dependent upon a complex system of drainage, achieved through a network of ditches, drains and dykes. The lower stretches of several major rivers (above) cross the Levels to join the Humber Estuary which flows east into the North Sea. There are also several navigable waterways crossing the area, emphasising its importance as a route for moving agricultural produce, raw materials and manufactured goods between the North Sea and the industrial hinterland. The western half of the area overlies the Sherwood Sandstone aquifer, an important water supply.

3.2 Water quality

The total area of Nitrate Vulnerable Zone is 125,408 ha, 73 per cent of 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 http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e

4. Trees and woodlands

4.1 Total woodland cover

The NCA contains 9,203 ha of woodland (5.4 per cent of the total area), of which just 945 ha (1 per cent) is ancient woodland, reflecting the fact that much of the land has been relatively recently reclaimed.

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

4.2 Distribution and size of woodland and trees in the landscape

Woodlands are limited in extent, except in the areas of sandy soils to the north and south where remnant birch and oak woods along with some extensive

conifer plantations occur, and on Thorne and Hatfield Moors. There are few hedge or hedgerow trees, except in the more pastoral enclosed landscape on clay soils around Fishlake and Sykehouse, where there are also some traditional orchards associated with farmsteads.

Source: Humberhead Levels Countryside Character 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)	Percentage of NCA
Broadleaved	6,400	4
Coniferous	627	4
Mixed	1,987	1
Other	189	<1

Source: Forestry Commission (2011)

Area and proportion of ancient woodland and planted ancient woodland within the NCA

Woodland type	Area (ha)	Percentage of NCA
Ancient semi-natural woodland	301	<1
Ancient re-planted woodland (PAWS)	644	<1

Source: Natural England (2004)

5. Boundary features and patterns

5.1 Boundary features

Many of the fields have been created on drained land, so boundaries are dykes and ditches. Hedges are only frequent in the pastoral enclosed landscape around Fishlake and Sykehouse, and in some of the other slightly higher and drier arable landscapes away from the central low-lying levels.

Source: Humberhead Levels Countryside Character Area description; Countryside Quality Counts (2003)

5.2 Field patterns

Fields are generally large, regular and form strong geometric patterns. There are localised areas of other striking field patterns, notably the extensive open strip fields from mediaeval times on the Isle of Axholme, of international significance. There are also long thin cables near Thorne, long strips of warp lands near Goole and a complex of ancient strip-farmed meadows along the Lower Derwent Valley. Smaller irregular fields enclosed by hedges occur in the pastoral landscape around Fishlake and Sykehouse.

Source: Humberhead Levels Countryside Character Area description; Countryside Quality Counts (2003)

6. Agriculture

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

6.1 Farm type

High input cropping systems dominate the area, with cereals and root crops predominating. There is limited livestock rearing, with only 13 per cent of holdings involved in grazing livestock, and some specialist pig and poultry enterprises. Since 2000 there has been a reduction in general cropping, with a move towards more diverse cropping enterprises such as flax, borage, field beans, peas for dry harvesting, maize and miscanthus.

Source: Agricultural Census, Defra (2010)

6.2 Farm size

Farm holdings are generally large, with 24 per cent of holdings over 100 ha. in size which make up 72 per cent of the farmed area. However there is also a high number (24 per cent) of holdings between 5 and 20 ha. The number of holdings under 5 ha. (less than 0.5 per cent of the area) has reduced considerably over the past decade and is now just 10 per cent of holdings.

Source: Agricultural Census, Defra (2010)

6.3 Farm ownership

75 per cent of the total farmed area is owner occupied, although there has been a slight increase in the tenanted farm area since 2000.
2009: Total farm area = 124,974 ha; owned land = 93,554 ha
2000: Total farm area = 131,136 ha; owned land = 99,842 ha

Source: Agricultural Census, Defra (2010)

6.4 Land use

The predominant land use is arable cropping – cereals, roots, oilseeds, stock feed and other arable crops – which accounts for 48 per cent of the farmed area, with grassland and uncropped land accounting for just 22 per cent. Oilseeds and other arable crops have increased in area while cash root crops have decreased. The loss of set-aside (included in the 2000 figures) has not had much impact, possibly because it was limited in extent within this NCA, usually confined to soils unsuitable for cropping.

Source: Agricultural Census, Defra (2010)

6.5 Livestock numbers

As a primarily arable cropping area, numbers of cattle and sheep are relatively low, and have stayed low over the past decade. Pigs are the most numerous livestock, but their numbers have decreased significantly from nearly 238,000 in 2000 to 133,800 in 2009.

Source: Agricultural Census, Defra (2010)

6.6 Farm labour

The majority of holdings are run by principal farmers, but since 2000 there has been a general trend towards a reduction in numbers of those engaged in agriculture, with significant reductions in full time farmers and casual 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

There are important biodiversity resources associated with the variations in soils and hydrology. One of the most important are the lowland raised bogs of Thorne and Hatfield Moors, which support bog mosses (Sphagnum species), nightjars and notable assemblages of invertebrates, including dragonflies and the mire pill beetle.

The numerous watercourses and associated floodplains and wetlands are highly valued for the range of species that they support, in particular strong populations of water vole and otter. They also have an important function as ecological networks across an intensively farmed landscape. Of particular note is the extensive and intact flood meadow landscape in the Lower Derwent Valley and Pocklington Canal. The wetlands support large assemblages of overwintering wetland birds such as lapwing and ruff.

Intertidal and saline habitats along the Humber are also important for populations of waders, including bitterns. On free draining sandy soils remnants of lowland heathland have survived which comprise species such as heather, bog rosemary and round leaved sundew, alongside species such as cross leaved heath in wetter areas. In addition the NCA contains important arable habitats. These support nationally important assemblages of arable birds.

Source: Humberhead Levels Natural Area Profile, Natural England (2012)

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; 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)	Percentage of NCA
Coastal and floodplain grazing marsh	6,058	4
Broadleaved mixed and yew woodland (Broad Habitat)	3,871	2
Lowland raised bog	3,103	2
Reedbeds	2,032	1
Lowland meadows	877	<1
Lowland dry acid grassland	734	<1
Fens	512	<1
Lowland heathland	487	<1
Purple moor-grass and rush pasture	94	<1

Source: Natural England (2011)

Maps showing locations of priority habitats are available at

- http://magic.defra.gov.uk select 'Habitats and Species/Habitats'

7.3 Key species and assemblages of species

- Maps showing locations of some key species are available at: http://magic.defra.gov.uk select 'Habitats and Species/Habitats'
- Maps showing locations of S41 species are available at: http://data.nbn.org.uk/

8. Settlement and development patterns

8.1 Settlement pattern

The population is generally low, with a few large towns notably Doncaster, Selby, Thorne and Goole on the navigable rivers and canals. Goole still has working docks providing access to the Humber estuary and thus the North Sea. Elsewhere there are small towns and large villages on the slightly higher and thus drier land, and there are large dispersed farmsteads throughout the area.

Source: Humberhead Levels Countryside Character Area description; Countryside Quality Counts (2003)

8.2 Main settlements

Doncaster, Selby and Goole are the main settlements, but generally the low population is dispersed in small towns and large villages including Bawtry, Thorne, Stainforth, Askern, Howden, Epworth, Crowle, Gilberdyke, Belton, Holme on Spalding Moor, Eggborough, Church Fenton and Ranskill. The total estimated population for this NCA (derived from ONS 2001 census data) is: 363,270.

Source: Humberhead Levels Countryside Character Area description; Countryside Quality Counts (2003)

8.3 Local vernacular and building materials

Buildings in the villages tend to be of mixed materials and styles, with 2-storey farmhouses and combination barns in brick and pantile in the open countryside. 76 per cent of historic farm buildings remain unconverted, of which about 77 per cent are intact structurally.

Source: Humberhead Levels Countryside Character Area description; Countryside Quality Counts (2003)

9. Key historic sites and features

9.1 Origin of historic features

There is evidence of prehistoric settlement where sand and gravel deposits have raised land above the marshes. Watercourses were important routes, and wetlands were used for hunting, fishing and summer grazing. In places the wet soils have preserved evidence well, as at Sutton Common. Roman farms, salterns and potteries have been recorded across the Levels, although there is only slight evidence for later Saxon use of the area. There are many historic villages with associated field systems and turbaries dating from Medieval times. Significant medieval towns include Selby, Thorne, Epworth and Howden. Moated sites are a feature around the Isle of Axholme and north of Doncaster. The Isle of Axholme retains extensive and important evidence of strip fields of this period. Ridge and furrow fields are a feature of the pastoral areas around Fishlake and Sykehouse. Large scale canalisation of key rivers and extensive drainage systems were introduced from the 17th century, resulting in the many dykes and drains, with associated bridges, pumphouses and sluices. Late 19th and 20th century airfields, water towers, power stations and windfarms are now features of the landscape.

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

9.2 Designated historic assets

This NCA has the following historic designations:

- 1 Registered Parks and Gardens covering 68 ha
- 1 Registered Battlefield/s covering 622 ha
- 91 Scheduled Monuments
- 1,552 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

- Over 3% of the NCA 5,525 ha is classified as being publically accessible.
- There are 1,357 km of Public Rights of Way at a density of 0.8 km per km^2.
- There is 1 National Trail within the NCA. The Trans-Pennine Trail runs north of Doncaster, past Hatfield Moor and on to Selby and Howden.

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

Access designation	Area (ha)	Percentage of NCA
National Trust (Accessible all year)	0	0
Common Land	2,110	1
Country Parks	0	0
CROW Access Land (OC and RCL)	1,949	1
CROW Section 15	334	<1
CROW Access Land (Section 16 Dedicated)	91	<1
Village Greens	62	<1
Doorstep Greens	2	<1
Forestry Commission Walkers Welcome Grants	290	<1
Local Nature Reserves (LNR)	248	<1
Millennium Greens	10	<1
Accessible National Nature Reserves (NNR)	3,221	2
Agri-environment Scheme Access	5	<1
Woods for People	2,035	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.

11. Experiential qualities

11.1 Tranquillity

Based on the CPRE map of Tranquillity (2006) the highest tranquillity values are around Thorne and Hatfield Moors, along the Lower Derwent Valley, and in rural areas around Fishlake and Sykehouse and north-west of Selby. Tranquillity is reduced by the presence of motorways cutting across the area, and around the urban areas of Doncaster, Thorne, Goole, Selby and Bawtry.

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

Tranquillity	Score
Highest value within NCA	102
Lowest value within NCA	-70
Mean value within NCA	3

Sources: CPRE (2006)

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

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. Disturbed areas are those around the towns and motorways. The figures reveal significant increases in intrusion over the past 40 years, with disturbed and urban areas both doubling in extent. A breakdown of intrusion values for this NCA is detailed in the table below.

Intrusion category	1960s (%)	1990s (%)	2007 (%)	Percentage change (1960s-2007)
Disturbed	25	48	53	28
Undisturbed	72	49	43	-19
Urban	2	2	4	2

Sources: CPRE (2007)

Notable trends from the 1960s to 2007 are the doubling of the disturbed areas, arising from the M62, airport and other developments, and the increase in urban areas. More information is available at the following address: http://www.cpre.org.uk/resources/countryside/tranquil-places

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 Inventory of Woodland & Trees, Forestry Commission (2003)
- 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%. 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

- From 1999 to 2003 there was an increase in uptake of Woodland Management Grants and improved management of existing blocks, with about 20 per cent of the woodland cover managed through a Woodland Grant Scheme.

Boundary features

- Field boundaries are generally ditches and dykes in the central low-lying areas, with hedges on slightly higher land to the north and south.

Agriculture

- Intensive cropping of arable and root crops continues, but with a decline in mixed farming and general cropping since 2000, and a move towards more diverse crops such as flax, borage and maize. There has also been a reduction in root crops, probably linked to the closure of the sugar beet factory near York.

- The size of holdings remains high, with 24 per cent over 100 ha accounting for 72 per cent of the farmed area, while small farm holdings (under 5 ha) have reduced in number.

- Livestock numbers remain relatively low, with a more substantial decline (44 per cent) in pig numbers from 237,885 in 2000 to 133,798 in 2009.

- Countryside Quality Counts data shows that between 1999 and 2003 there was a below national average uptake of agri-environment agreements. The most extensive agreements were for over-wintered stubble, spring / summer fallow, and regeneration of grassland and semi natural habitats.

Settlement and development

- There has been continued pressure on the rural character of the area as a result of growth pressures, with housing, transport infrastructure and industry expanding, in particular around Doncaster.

- Other recent developments include warehousing adjacent to motorway junctions, large agricultural buildings in rural areas, and transport infrastructure and industry related to the airport near Rossington. There has been a recent increase of the number of windfarms constructed in the area.

Semi-natural habitat

- The productive agriculture has continued to limit the network of semi-natural habitats. There are instances where the lowering of the water table as a result of drainage and pumping to abstract water for consumption and summer irrigation is causing the drying out of peat bogs and water dependent habitats.

- The Wetland Vision initiative has invested in habitat restoration and creation over recent years, and agri-environment schemes have targeted wetland creation, so the results of these initiatives should become evident in the near future.

Historic features

- The Heritage at Risk register indicates that there are currently 70 designated monuments at risk in this NCA. However, the historic field patterns, especially the open strip fields on the Isle of Axholme, remain vulnerable to amalgamation.

Coast and rivers

- Since 2007 the Water Framework Directive has monitored the ecological status of waterbodies, and the majority of surface water within this NCA is of moderate or poor quality. Rivers in the middle of the area are generally of good chemical status, although several other rivers in the north and south are failing to achieve good chemical status.

- The majority of groundwater sources are of poor chemical status. The Sherwood aquifer underlies part of the area to the south and west, and here abstraction levels are above those needed to achieve 'good status' in line with the Water Framework Directive, and deterioration of this resource may result from the continuation of over-abstraction and nutrient inputs.

Minerals

- Commercial peat cutting has now ceased on Thorne and Hatfield Moors, but elsewhere, and in particular in the south, extraction of sand and gravel deposits still occurs.

Drivers of change

Climate change

- Summer droughts leading to increased water demands in particular on groundwater supplies, resulting in greater pressure on the Sherwood Sandstone Aquifer and a possible increase in farm reservoirs.
- Hotter drier summers may lead to drying out of peat, of wetland habitats and ditches and increased incidence / severity of wildfires, and also could increase stress on small or isolated habitats, in particular wetland habitats, ditches, lowland raised mires and floodplain grazing marshes, and a tendency towards eutrophication in dykes and canals.
- A longer growing season potentially leading to double cropping, and a warmer climate leading to new crops.
- Wetter winters and more storm events may lead to increased frequency and magnitude of flooding in the lower catchment reaches, with the risk of over-topping defences, with consequent risk of poor water quality inundation and salinisation of quality agricultural land.
- Increased intensity of rainfall will also result in an increase in sediment loads and nutrient run-off from agricultural land into ditches, canals and rivers, and erosion of peat soils.
- Increased flood water flows will impact on the vulnerable lower reaches of many of the rivers, such as the lower Derwent, which will require improvements and management upstream to mitigate the effects.
- Increases in frequency of flooding and increased depth and speed of flood waters, especially on the Aire and Don catchments, will need additional washlands and flood storage, with the possibility of creating more permanent grassland and other semi-natural habitats.

- Rising sea levels will put pressure on existing flood defences, which can lead to higher or more robust tidal defences being built, or opening up opportunities for more managed realignment and flood storage schemes, which could include creation of wetland habitats.

Other key drivers

- Opportunities will arise to incorporate green infrastructure networks in new development, and to deliver high standards of sustainable design, for example in the areas around Thorne, Moorends, Stainforth, Hatfield, Armthorpe and Rossington, as well as in the principal towns of Doncaster, Selby and Goole.
- Doncaster may develop as a nationally significant transport centre, with its proximity to motorways, the airport, the Humber and mainline rail, while there is likely to be significant development associated with Rossington as an inland rail port, with road and airport expansion, warehousing and housing.
- There is likely to be an increase in traffic associated with the Doncaster – York and Doncaster – Immingham strategic transport corridors which pass through the area.
- There may be an increase in water-borne freight along the navigable waterways which serve the Humber ports in the adjacent Humber Estuary NCA.
- The extension of flood storage sites along the Aire and Don, along with new flood storage areas near Goole and Flixborough Grange, will open up opportunities for the creation of new wetland habitats.
- There may be an increase in the number of small reservoirs on farms, built to increase water supply for irrigation in the summer.
- Continued demand for sand and gravel may lead to further extraction, with opportunities for restoring existing and future sites so that they make a positive contribution to local landscape character and biodiversity.
- The continuation of inappropriate cultivation practices on peaty soils will result in oxidation and erosion, causing lowering of soil levels and thus increasing the risk of flooding, along with a reduction in agricultural productivity, soil quality and sediment run-off.
- The NCA is administered by five local authorities; Selby, Doncaster, East Riding of Yorkshire, North Lincolnshire and Bassetlaw, and thus while many of its systems and functions are connected, the area lacks a coherent approach to some resource management and land use issues.
- Working and restored canals and paths alongside dykes will continue to provide attractive foci for recreational use, but lack of funding may limit the opportunities for further restoration and management.
- There is likely to be a continued demand for renewable energy generation, which could result in further onshore wind turbines, new structures at the existing power station complexes, and the establishment of biomass crops, including miscanthus and short rotation coppice.

The Levels are one of the most productive agricultural areas in England, with large rectangular fields often bounded by ditches.

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.

Drax Power Station and wind turbine.

Statement of Environmental Opportunity	Ecosystem Service																		
	Food provision	Timber provision	Water availability	Genetic diversity	Biomass engergy	Climate regulation	Regultating water quality	Regulating water flow	Regulating soil quality	Regulating soil erosion	Pollination	Pest regulation	Regulating coastal erosion	Sense of place/inspiration	Sense of hisotry	Tranquillity	Recreation	Biodiversity	Geodiversity
SEO 1: Safeguard, manage and expand the wetland habitats, including the internationally important lowland raised bogs, the floodplain grazing marsh, reedbeds, wet pastures and watercourses, to protect and enhance biodiversity, contribute to landscape character, address climate change and reduce flood risks.	↘ ***	↔ ***	↗ *	°	↘ **	↑ ***	↗ **	↗ **	↑ ***	↗ **	↗ **	°	↑ ***	↑ ***	↗ **	↑ **	↔ **	↑ ***	↔ **
SEO 2: Manage the agricultural landscape to retain its distinctive character and its productivity, while improving its contribution to biodiversity, the protection of vulnerable soils and palaeo-environmental evidence and the water resource.	↑ ***	↔ ***	↗ **	°	↔ **	↗ ***	↗ **	↗ ***	↑ ***	↑ ***	↑ ***	°	↔ **	↔ **	↗ ***	↔ **	↗ **	↗ ***	↔ ***
SEO 3: Manage the landscape features such as semi-natural habitats and historic field patterns that reveal local variations in landscape character, often arising from underlying soils and history of drainage, to enhance people's understanding and enjoyment of the landscape.	↔ ***	↔ ***	↗ ***	°	↔ ***	↗ **	↗ **	↔ **	↗ ***	↗ ***	↗ **	°	↔ **	↑ ***	↑ ***	↗ **	↑ ***	↗ ***	↗ ***
SEO 4: Protect the open and expansive character of the landscape, its cultural features and sense of remoteness, by ensuring that new development is sensitively located, accommodates green infrastructure, retains long views and makes a positive contribution to biodiversity.	↔ **	↔ ***	↔ ***	°	↔ ***	↗ **	↗ **	↗ ***	↔ **	↔ **	↗ **	°	↔ ***	↑ ***	↗ ***	↑ ***	↗ ***	↗ **	↔ ***

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
Low-lying, flat, large scale productive arable landscape with large geometric fields divided by ditches and dykes; central areas generally without trees or hedges.	■ These features mark the area out as distinctive from adjacent cultivated areas. The open, treeless but productive landscape reveals the relatively recently reclamation of the land from marsh. ■ 43 per cent of the land is classified Grade 1 or 2 Agricultural Land. ■ The network of ditches makes a significant contribution to the landscape character, as well as providing important wetland habitats with potential for improved connectivity.
Variations in underlying drift deposits give rise to a mix of soils and habitats, notably lowland raised bogs of international significance, sandy deposits giving rise to heathland, and heavier clays giving rise to pastoral landscapes.	■ Past management has responded to the underlying soil and drainage conditions, resulting in subtle variations in landscape character. ■ Sandy infertile soils are revealed by areas of conifer plantations and heathland (as at Strensall Common), and bracken in the road verges; Skipwith Common is a National Nature Reserve and is designated SAC. ■ The lowland bogs have developed their own specialised plant and animal communities, with two large areas, Thorne and Hatfield Moors are of international significance (SAC, SPA) and designated National Nature Reserves. ■ Heavier soils give rise to more pastoral landscape around Fishlake and Sykehouse, with small fields bounded by hedges, narrow lanes and ponds.
Widespread evidence of reclamation and drainage history with an extensive network of ditches, dykes, canals and rivers, with flood banks, bridges, pumping stations and evidence of old river courses.	■ 7 canals cross the area in addition to the many navigable rivers. ■ 91 scheduled monuments include several moated sites, and there are 1,552 listed buildings. ■ Strong network of ditches, dykes and canals are visually very obvious, and also provide opportunities for access to quiet stretches as well as viewing the historic features themselves.
Important historic landscapes, most notably the Isle of Axholme with its medieval open strip fields, linked to surrounding turbaries and marshes; warps near Goole; cables near Thorne and Goole; medieval open fields and flood meadows along the Lower Derwent valley.	■ English Heritage describes the Isle of Axholme as 'a special landscape of medieval origin. This is the largest and most varied survival of open field strip cultivation in the country, characterised by nucleated settlements, extensive areas of narrow hedgeless cultivated strips or 'lands' often arranged in a contrasting patchwork of differently aligned groups or furlongs. Associated with the strip field landscapes are areas of peat moor enclosed from the medieval period onwards'. ■ Cable field patterns similarly reveal earlier practices in cultivation. ■ Warps reveal the connection between the farmed land and its reclamation from the rivers and marshes, and use of 'warping' (periodic flooding) to bring sediments in to enrich the farmland.
Lowland raised bogs at Thorne and Hatfield Moors, create distinctive wetlands with some woodland, with a strong sense of remoteness and wildness.	■ The lowland raised bogs are of international significance, with Thorne and Hatfield Moors designated as National Nature Reserves, SPA and SAC.

Landscape attribute	Justification for selection
Important and distinctive wetlands associated with watercourses, including flood meadows, fens and wet woodlands, and intertidal habitats along the Humber estuary.	■ Lower Derwent valley is designated as a Special Protection Area for its birdlife, a Special Area of Conservation for its biodiversity, and is a Ramsar site for its value overall as a wetland; it is also a National Nature Reserve. It is a distinctive riverine landscape, with extensive medieval open field patterns. Thorne & Hatfield Moors comprise rich combinations of wetland habitats, also designated SPA and SAC. ■ The designations of SPA and SAC covering the Humber Estuary reach up into this NCA; the estuary is also a Ramsar site. ■ Extensive networks of ditches and dykes to drain the area now form important connecting links between wetland habitats, as well as significant habitats and landscape features in themselves.
Clear settlement pattern with small villages and large farms on slightly higher drier land; large settlements of Doncaster, Goole, Selby and Bawtry.	■ Clear and visible connection between drainage and settlement patterns over time.
Waterlogged soils hold internationally significant palaeo-archaeological deposits.	■ An extensive example of organic remains dating from the Iron Age has been uncovered at Sutton Common. ■ Intact palaeo-environmental evidence of occupation through time remains under the meadows along the Pocklington Canal, for example at Grange Ings.
Long views to distant horizons, with big expansive skies; the more robust semi-natural habitats provide good opportunities for accessing and enjoying the lowland landscape, and raised flood defences provide slight elevations to provide walkers with extensive views across the flat landscape.	■ Although a relatively low density of footpaths, those routes that do exist, including elevated flood banks alongside watercourses and canal towpaths, provide good views and experiences of remote and rural countryside. ■ The Trans Pennine trail crosses the area and the Peatlands Way provide access opportunities near Doncaster. ■ The Humberhead Peatlands NNR is a flagship reserve for public access, education and enjoyment.

Landscape opportunities

- Protect the open character of the landscape with its long and expansive views, big skies.
- Protect areas with a strong sense of remoteness, 'wildness' and tranquillity, including Thorne and Hatfield Moors, lower Derwent valley, and lowland heaths.
- Manage and expand wetland habitats, including wet pastures, fens, reedbeds and, where appropriate, wet woodland.
- Ensure that the important network of ditches is managed to encourage emergent vegetation thus forming important landscape features and wildlife corridors.
- Manage the water table levels so that existing wetland habitats are protected and opportunities to extend them or create buffering pastures can be developed.
- Conserve and interpret the important historic landscapes, especially the Isle of Axholme, the Lower Derwent Valley and Thorne and Hatfield Moors, and the distinctive differences in historic management including warps, cables and turbaries, and the pastoral landscape around Fishlake and Sykehouse.
- Conserve, manage and expand semi-natural habitats that reveal the influence of underlying soils and hydrological conditions, especially lowland heath, lowland raised bogs, wet woodlands, birch / oak woodlands, fens, intertidal and saline habitats .
- Ensure that managed realignment sites, new flood storage areas or where flood defences are allowed to occasionally over-top, are managed to create wetland habitats including wet pastures that contribute both to landscape character and biodiversity.
- Ensure a high level of design so that any new or reinforced flood defences, or new irrigation reservoirs, are constructed with minimal adverse impact on the landscape, and provide new habitat creation opportunities where possible.
- Protect palaeo-archaeological evidence, especially within peaty soils, and the widespread artefacts and evidence of drainage history.
- Seek opportunities to interpret the particular landscape character and history, and provide opportunities for more people to understand and enjoy the landscape.
- Conserve the high quality and productive soils for continued agricultural production while ensuring that the agricultural landscapes make a greater contribution to wildlife, especially farmland birds, avoiding or reducing cultivation where there are archaeological features.
- Restore sand and gravel pits so that they make a positive contribution to the local landscape character, and enhance biodiversity interest.
- Improve access, especially where it is possible to link existing path networks and sites with towns and villages, and provide interpretation, to enable more people to enjoy and understand the landscape, its history and functions.
- Use appropriate local building materials and vernacular styles in restoring traditional buildings and structures.

Ecosystem Service analysis

The following section shows the analysis used to determine key Ecosystem Service opportunities within the area. These opportunities have been combined with the analysis of landscape opportunities to create Statements of Environmental Opportunity.

Please note that the following analysis is based upon available data and current understanding of ecosystem services. It does not represent a comprehensive local assessment. Quality and quantity of data for each service is variable locally and many of the services listed are not yet fully researched or understood. Therefore analysis and opportunities may change upon publication of further evidence and better understanding of the inter-relationship between services at a local level.

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Food provision	Cultivation of cereals and other arable crops Fishing, wildfowling	Fertile soils, with 10% of the land classified as Grade 1, 33 per cent as Grade 2, and a further 41 per cent classified as Grade 3.	National	To retain the current levels of productivity, need to ensure that soils remain fertile; peaty soils in particular are vulnerable to desiccation and erosion. Also water table level management and availability of water for irrigation, especially in the summer, need to be addressed. The generally high levels of nutrient input can lead to issues around nutrient run-off into ditches and wetlands. Some soils, especially peaty ones, are prone to erosion and oxidation if intensively cultivated; different cultivation practices or crop selection could reduce these impacts. Wildfowling, and to a lesser extent fishing, are local activities providing food.	Encourage sustainable land management practices such as over-wintering stubble, to avoid leaving peaty soils exposed. Encourage the introduction of break crops or fallow into rotations, to improve soil structure and organic content especially on sandy soils, and to improve resistance to erosion on peaty soils. Consider the selection of crops to reduce impacts on soils. Maintain wetland and riparian habitats and water quality to enable continued fishing and wildfowling.	**Food provision** **Regulating soil quality** **Regulating soil erosion** **Regulating water quality** **Climate regulation**
Timber provision	Existing woodland cover	Existing woodland covers 5.4 per cent of the area, and is limited to small scattered woodlands, with some blocks of conifers in the south.	Local	There is limited potential for increasing the timber production in this area by bringing all existing woodlands under management to increase their productivity. The scope for new woodland is limited, as the predominant land use is agriculture	Ensure that existing woodlands are under management to produce timber, primarily for local use	**Timber provision** **Regulating soil erosion** **Regulating soil quality** **Climate regulation**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biomass energy	Existing woodland cover Cereal cropping	The existing woodland cover (5.4 per cent) offers only limited potential for the provision of biomass through bringing unmanaged woodland under management. The straw produced from the extensive cereal cropping could be considered as a source of biomass.	Local	Local power stations, including Drax, are all exploring ways of achieving more energy production through use of renewable biomass sources, and their decisions may impact on the crops grown in close proximity. There is a medium potential yield for short rotation coppice, and high potential yields for miscanthus throughout the NCA.[4] Biomass crops could be easily assimilated into the current pattern of cropping, although there are areas where historic field patterns should not be obscured. However a significant increase in biomass would have implications for agricultural outputs from the area. A substantial increase in the area of miscanthus and coppice would affect local landscape character. Information on the potential landscape impacts of biomass plantings within the NCA can be seen here[5].	Encourage the establishment of biomass crops including miscanthus and short rotation coppiced willow, locating them on the less fertile soils (to reduce impact on agricultural production), and avoiding any adverse impacts on long views or historic landscapes.	**Biomass energy** **Climate regulation** **Timber provision**

4 Defra's Opportunities and optimum sitings for energy crops within the Yorkshire and Humber region http://archive.defra.gov.uk/foodfarm/growing/crops/industrial/energy/opportunities/yh.htm
5 Ibid

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Water availability	Major river systems including Ouse, Trent, Aire, Derwent, Don, Idle, Torne and Went Sherwood Sandstone Aquifer underlies western half of the area	The western half of the NCA overlays the major Sherwood Sandstone aquifer, which provides a strategically important source of public water supply, as well as industrial and agricultural abstractions[6]. Surface water sources are over abstracted in the southern half of the NCA.[7] The rivers Torne and Idle in the south of the NCA are over-abstracted, and the Environment Agency aims to reduce actual abstraction from both surface and groundwater sources.[8] There is no water available along the River Don,[9] while the only resource available for additional abstraction is the River Foulness in the northeast, although this will be downgraded to 'no water available' by 2015 if there is shown to be demand for abstraction[10].	Regional	The whole of the Sherwood Sandstone Aquifer is currently over licensed and is expected to remain over-licensed to at least 2015. There is no groundwater available for abstraction within the Selby area, as groundwater levels have dropped below sea level. Thus the replenishing of the Sherwood Aquifer needs to be addressed, as does the issue of potential salination of groundwater supplies. Further abstractions would risk the availability of water to existing license holders and may lead to the introduction of saline water, and therefore are to be prohibited. Throughout the aquifer, abstractions will only be allowed where groundwater levels are above sea level.[11] The availability of water is likely to become more critical with the anticipated effects of climate change, including more storm events and summer droughts. The latter may result in an increase in reservoirs on farms for irrigation. The sandy permeable soils (30 per cent of the area) may be valuable for aquifer recharge, thus requiring the maintenance of good soil structure to aid water infiltration.	Seek opportunities to increase areas of semi-natural habitats, especially grassland, to improve water infiltration. Encourage the restoration of peat bogs to increase their capacity to store water. Work with Internal Drainage Boards and land owners/managers to manage watercourses and allow water table levels to rise where appropriate. Ensure that new irrigation reservoirs are assimilated into the local landscape, and are designed to contribute to biodiversity where possible. Adopt agricultural practices on sandy soils to build up a good soil structure and increase the organic matter content to improve permeability.	**Water availability** **Regulating water quality** **Food provision** **Regulating soil quality** **Climate regulation**
Genetic diversity	N/A	N/A	N/A	N/A	N/A	N/A

6 Environment Agency, The Idle and Torne Catchment Abstraction Management Strategy, March 2007.
7 Environment Agency, River Basin Characterisation 2, January 2009.
8 Environment Agency, Idle and Torne Catchment Abstraction Management Strategy, May 2007.
9 Environment Agency, Don and Rother Catchment Abstraction Management Strategy, October 2003.
10 Environment Agency, Hull and East Riding Catchment Abstraction Management Strategy, March 2006.
11 Environment Agency, Aire and Calder Catchment Abstraction Management Strategy, May 2007.

Analysis of Regulating Services

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Climate regulation	Peat and peaty organic soils Wetlands Woodland cover	Significant carbon regulation is offered by the peat and peaty soils (30 per cent) with their high carbon content soils. The wetlands, including floodplain grazing marsh, reedbeds and fens (5 per cent), also contribute. The relatively low woodland cover (5.4 per cent) makes a limited contribution.	Regional	Peat and peaty soils should be managed so that they are actively sequestering and storing carbon. Peaty soils under cultivation are highly vulnerable to oxidation, as well as wind and water erosion; cultivation practices should avoid leaving them exposed. Such soils can be protected by keeping the water table levels high and managing as permanent grassland. The carbon content of mineral soils can be increased under permanent grassland and managed on an extensive regime that reduces or excludes the use of artificial fertilisers. Woodlands can be managed to increase their productivity, thus improving their efficacy in carbon sequestration. The natural regeneration of woodlands on wet peaty soils would effectively capture carbon.	Maintain lowland bogs and peaty soils in favourable condition. Encourage the natural regeneration of wet woodland on peaty soils where appropriate. Adopt agricultural practices that do not require ploughing, or that reduce the frequency of ploughing, such as including fallow in rotations, and avoid soils being left exposed by, for instance, retaining stubble over-winter. Increase the area of permanent grassland and other semi-natural habitats, and manage them on a low-input basis. Improve management of existing woodlands.	**Climate regulation** **Regulating soil quality** **Regulating soil erosion** **Water availability** **Regulating water quality** **Biodiversity** **Timber provision**
Regulating soil erosion	Loamy and clayey soils Peat and peaty soils (8 per cent) Sandy soils (30 per cent)	Just over half of the NCA has soils that are at low risk of soil erosion, covering the slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils, loamy and clayey soils of coastal flats with naturally high groundwater, and the loamy and clayey floodplain soils with naturally high groundwater. In addition, the loamy soils with naturally high groundwater are at low risk of erosion except where coarser textured variants occur on sloping or uneven ground. Deep peat and peaty soils cover some 8 per cent of the area, and where cultivated are vulnerable to wind and water erosion and oxidation. Sandy soils cover 30 per cent of the area.	National	Responses need to be different to respond to the two main concerns with soil erosion in this NCA. Peat and peaty soils are at risk of both wind and water erosion when left bare, and of loss through shrinkage and oxidation. The free draining sandy soils are light textured and prone to erosion on sloping ground where cultivated land is left bare, and especially when organic matter levels are low following continuous cultivation or compaction. There is also widespread potential for erosion of sandy soils from rapid run-off during storm events or where compacted. Oxidation of peaty soils and erosion of all soils needs to be addressed here, as the soils underpin the importance of the area for food provision.	Ensure that on peaty soils agricultural practices encourage minimum cultivation and avoid leaving surfaces exposed, for example by introducing fallow into rotations, over-wintering stubble, or reversion to permanent grassland. Encourage agricultural practices that retain cover and build up organic matter especially on free draining sandy soils	**Regulating soil erosion** **Food provision** **Regulating water quality** **Regulating soil quality**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating soil quality	Wide range of soil types	This NCA has 13 main soilscape types: ■ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils (24 per cent). ■ Loamy and clayey soils of coastal flats with naturally high groundwater (22 per cent). ■ Naturally wet very acid sandy and loamy soils (14 per cent). ■ Freely draining slightly acid sandy soils (11 per cent). ■ Loamy soils with naturally high groundwater (8 per cent). ■ Loamy and clayey floodplain soils with naturally high groundwater (6 per cent). ■ Loamy and sandy soils with naturally high groundwater and a peaty surface (4 per cent). ■ Fen peat soils (2 per cent). ■ Raised bog peat soils (2 per cent). ■ Freely draining slightly acid loamy soils (2 per cent). ■ Freely draining lime-rich loamy soils (1 per cent). ■ Slightly acid loamy and clayey soils with impeded drainage (1 per cent) ■ Freely draining very acid sandy and loamy soils (1 per cent).	Regional	The slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils may suffer compaction and / or capping as they are easily damaged when wet. This may lead to increasingly poor water infiltration and diffuse pollution as a result of surface water run-off. Management measures that increase organic matter levels can help reduce these problems. The loamy and clayey soils of coastal flats with naturally high groundwater (22 per cent) have a high agricultural potential but this is dependent on the continued ability to pump drain and protect the soils from sea flooding / saline intrusion. With continued abstraction, locally some soils are at risk of becoming saline; these soils are also vulnerable to sea level rise. Where there is a high silt / fine sand content, compaction and / or capping may be an issue which can be reduced by increasing soil organic matter content. The freely draining slightly acid sandy soils (11 per cent) have potential for increasing organic matter levels by management interventions, which would also help to minimise erosion risk. The quality of the more fertile soils here needs to be maintained, as it underpins the importance of the area for significant food production.	Encourage agricultural practices that build up organic matter, especially on the free draining sandy soils. Ensure that agricultural practices do not further deplete peaty soils, for instance, by avoiding leaving surfaces bare and thus vulnerable to drying out and oxidation.	**Regulating soil quality** **Climate regulation** **Regulating soil erosion**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating water quality	Sherwood Aquifer in western part Groundwater Major rivers and dykes	The quality of the lower stretches of the major rivers is largely determined by inputs and land management activities further upstream.	Regional	The aquifer, other groundwater sources and all the watercourses are vulnerable to nutrient pollution. With the predominance of arable cropping in this area, it is essential to ensure that nutrient inputs are matched to needs. The rivers form important corridors for migrating salmonids, so good water quality and lack of barriersare essential to enable this movement of species.	Encourage arable reversion and the establishment of permanent grassland, especially alongside watercourses, with low input management, to reduce nutrient run-off and aid water infiltration. Encourage management of farmland under principles established under the Catchment Sensitive Farming Delivery initiative. Adopt management that encourages emergent vegetation along ditches, and introduce reedbeds and other wetland habitats, that help to filter water.	**Regulating water quality** **Regulating soil erosion** **Regulating soil quality** **Food provision** **Biodiversity**
Regulating water flow	Lower stretches of major rivers including Ouse, Aire, Derwent, Trent, Don, Idle, Torne and Went , as well as the River Humber into which they all flow	This NCA encompasses the open, flat plain that is dominated by the major river systems of the Aire, Ouse and Trent, which flow from surrounding higher ground south, north and east into the Humber estuary. Some land is now close to sea level and is maintained as agricultural land by pumping. Most stretches of the rivers are contained between flood banks to prevent flooding of adjacent land.	Regional	The majority of the NCA is at risk from fluvial flooding, exacerbated by combinations of high rainfall within the extensive catchments of the rivers with high tides and rising sea level. The major flood risk in the Aire and Don catchments arise through an increased frequency of flooding and greater depth and speed of flood water, which can be mitigated by further washlands and additional flood storage. Settlements at risk include Doncaster, Goole and Selby. The Lower Derwent Valley is vulnerable to increased flood water flows, which can be mitigated by changes in management upstream, including improvements to floodbanks and washlands. Drainage from development can be managed by reducing new developments within flood risk areas.[12] Sites suitable for allowing occasional over-topping of flood defences will also need to be identified.	Work with key partners and landowners to identify suitable sites for flood storage and occasional over-topping of flood defences. Optimise design and implementation of future flood storage areas to create new wetland habitats, such as floodplain grazing marsh, and creating links with existing semi-natural habitats. Manage water bodies, including ditches, to increase structural diversity which will help to retain winter floodwater for longer and provide refuges for species vulnerable to inundation events. Encourage agricultural practices that build up organic matter and reduce the risk of soil compaction and thus improving water infiltration. Restore and expand wetland habitats on floodplains, including wet pastures, reedbeds and traditionally grazed alluvial flood meadows, to attenuate flood flows. Find ways of assimilating new or reinforced flood defences into local landscapes with minimum visual impact and disruption to existing habitats or species movement. Adopt strategic approaches to increasing the capacity of catchments to retain water, including addressing river management upstream to reduce impacts on landscapes downstream, notably the vulnerable floodplain of the Lower Derwent Valley. Allow watercourses to revert to natural, dynamic courses where possible, thus allowing the energy of the water flow to dissipate.	**Regulating water flow** **Regulating soil quality** **Regulating soil erosion** **Biodiversity** **Sense of place/ inspiration**

12 Environment Agency, Catchment Flood Management Plans for the Ouse, Don, Aire, 2010

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating coastal flooding and erosion	Upper reaches of Humber estuary Tidal stretches of all the main rivers	Much of the NCA is at risk from coastal flooding. The protection of the area depends upon flood defences along the Humber, which in places are at risk of overtopping. Over 26,000 properties are at risk, including land in the floodplains, in particular of the rivers Ouse and Aire, and the whole of the town of Goole. To protect these properties, the lower reaches of the River Trent and the River Ouse, and the Humber are confined by flood defences.	Regional	The risk of coastal flooding is exacerbated by combinations of high rainfall within the extensive river catchments flowing down to meet high tides and increases in sea level, which in turn are exacerbated by low atmospheric pressure and on-shore winds. Future plans include maintaining the flood defences, for example, around Goole, but accepting occasional overtopping of defences, such as from Brough Haven to Weighton Lock; Faxfleet to Saltmarshe; Goole Fields and Crowle. Possible sites for increasing flood storage are under consideration near Goole and Flixborough Grange.[13] Allowing the development of intertidal habitats such as reedbeds and salt marsh are an effective way of dissipating wave energy and thus providing coastal flood defence, and reducing the costs of maintenance of flood banks. Thus managed realignment schemes are a cost effective flood defence strategy, in addition to proving new intertidal habitat, which enhances biodiversity.[14]	Seek opportunities to expand inter-tidal habitats along the Humber to offset coastal squeeze. Seek opportunities for managed realignment of the estuary banks, to increase the capacity of the estuary to hold flood waters, and restore suites of inter-tidal and wetland habitats in the process. Measure, monitor and record elements of the historic environment to enable a prioritised response to rising sea levels and increased inundation events.	**Regulating coastal flooding and erosion** **Biodiversity** **Sense of place/ inspiration** **Sense of history**
Pollination	Semi-natural habitats	Limited extent of semi-natural habitats throughout the area, with substantial blocks of raised bog and lowland heath.	Local	With extensive areas of cereal and general cropping, there are limited sites currently supporting pollinating insects. Floodbanks contain most of the main rivers, and could provide pollinating support if the sward comprised a greater range of flowering species.	Seek opportunities to introduce species-rich grassland, pollen and nectar strips, margins along arable field edges and alongside watercourses within the agricultural landscape, to encourage and support pollinating insects . Seek opportunities to create species-rich grassland on floodbanks.	**Pollination** **Biodiversity** **Sense of place/ inspiration** **Food provision**

13 Environment Agency, The Humber Flood Risk Management Strategy, March 2008.

14 The Seascape character area assessment for the East Inshore and East Offshore marine plan area can be seen here: www.gov.uk/government/publications/east-marine-plan-areas-seascape-character-assessment

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Sense of place/ inspiration	Open, large scale low-lying farmed landscape, with extensive network of ditches and dykes Variation introduced by slight changes in soils and elevation Long views, big skies	A sense of place is created by the generally flat, low-lying intensively farmed landscape, divided by ditches into large regular fields, with variation introduced by slight changes in soils and elevation, giving rise to lowland heathlands and raised bogs. The watercourses form a key part of the landscape, with the extensive network of ditches and dykes, large rivers contained within floodbanks, and wide river floodplains.	Regional	This is a distinctive large scale open landscape, dominated by agriculture, providing striking contrasts to the upland landscapes of the region. Its general lack of hedges, long views and openness create a strong sense of place.	Retain long views and the experience of big skies. Ensure that the network of ditches and dykes are managed so that they contribute visually to the landscape, by encouraging emergent vegetation, and thus also provide effective linking habitats with diverse vegetation and wildlife. Adopt cultivation practices that will ensure the long term sustainability of agriculture. Seek opportunities to bring attention to the rivers and their role of water in shaping the landscape, especially where rivers are concealed behind flood defences. Retain the contrasts with the local differences in landscape character, notably the more enclosed pastoral landscape north of Doncaster, and the wild and remote feel to the lowland bogs and heaths and the lower Derwent valley. Protect and enhance the biodiversity interest, so that more people can enjoy the sights of overwintering birds, of water voles, marsh harriers, nightjars and bitterns, dragonflies and butterflies, and all the plant and animal communities associated with the important semi-natural habitats.	**Sense of place/ inspiration** **Food provision** **Biodiversity** **Regulating water quality** **Regulating water flow**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Sense of history	Artefacts associated with drainage history Areas of distinct field patterns, for example warps, cables Isle of Axholme medieval open strip fields	A sense of history is revealed through all the many features associated with the reclamation and control of the drainage of the area, such as dykes, floodbanks, berms, bridges, canals, pumping stations, disused windmills, water towers and old river courses. The watercourses and canals were also important communications and trading routes linking the industry inland with the North Sea and Europe. More recently, the several power stations reflect the close links between the plentiful water supply and underlying coal supplies. The historic landscape character is further reinforced by the contrasts between the large rectilinear fields of relatively recent reclamation, and more intimate areas such as the enclosed pastoral landscape around Fishlake and Sykehouse. Also there are strong field patterns notably the remnant medieval open field patterns of the Isle of Axholme, the cables near Goole and the warps near Thorne. The landscape at Haxey and Epworth Turbaries also reveals past practices of peat cutting, while the Lower Derwent valley still maintains some of the medieval strip field meadow system.[15]	National	The distinctive field patterns are of note, and can be retained through sympathetic farming practices. The open strip fields on the Isle of Axholme are particularly vulnerable to amalgamation. Palaeo-environmental evidence is vulnerable to drying out of peaty soils through continued or increased pumping and cultivation.	Protect the evidence of different histories of land management, land use and settlement, including field patterns, turbaries. Protect the internationally significant historic landscape of the Isle of Axholme and its setting. Protect palaeo-archaeological evidence by maintaining and managing water table levels, and protect historic field features, including ridge and furrow, through appropriate land management, eg. arable reversion to permanent pasture. Protect and interpret the history of the area, in particular that of its drainage history, and the significance of the Humber in linking hinterland with north west Europe. Encourage use of local building materials in new build, and ensure appropriate materials and styles are used in restoration of traditional vernacular buildings.	**Sense of history** **Sense of place/ inspiration** **Regulating water quality** **Regulating soil erosion** **Regulating soil quality** **Recreation**

15 JCA statements of historic interest, English Heritage, 2007 (unpublished)

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Tranquillity	Pockets of tranquillity around Thorne and Hatfield Moors, Lower Derwent Valley	The area has experienced a significant decline in tranquillity since the 1960s. Undisturbed areas have decreased from 72 per cent in the 1960s to 43 per cent in 2007. Remaining areas of tranquillity are concentrated around Thorne and Hatfield Moors and the Lower Derwent Valley.	Local	The extensive bogs of Thorne and Hatfield Moors provide a particularly strong sense of remoteness and 'wildness', as do the smaller scale riverine landscape of pasture, flood meadows and small woodlands along the Lower Derwent, and to a lesser extent the pastoral landscapes around Fishlake and Sykehouse.	Protect those areas with a strong sense of remoteness and 'wildness', notably Thorne and Hatfield Moors and the Lower Derwent Valley, from further intrusion and development, including unnecessary night lighting.	**Tranquillity** **Recreation** **Sense of place/ inspiration**
Recreation	Paths along floodbanks Thorne and Hatfield Moors National Nature Reserves	The NCA offers a network of rights of way totalling 1,357 km at a relatively low density of 0.8 km per km^2, and open access land covering 1,949 ha or just over 1 per cent of the NCA.	Local	Particular recreational opportunities are associated with paths alongside canals and along floodbanks, which offer elevated views out over the flat landscape, and the Trans Pennine Trail and the Peatlands Way around Doncaster. Thorne and Hatfield Moors NNRs are flagship reserves for access and enjoyment of their special qualities. Angling and wildfowling are popular and long established activities in the area.	Seek opportunities to provide links to the existing rights of way network. Develop Thorne and Hatfield Moors as flagship National Nature Reserves for access and enjoyment of their special qualities . Provide interpretation of the history, biodiversity and other aspects of the landscape in well visited locations.	**Recreation** **Sense of place/ inspiration** **Sense of history**

Service	Assets/ attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biodiversity	2 Ramsar sites 3 SPAs 6 SAC 3 National Nature Reserves 40 SSSI 577 local sites	5,729 ha (3 per cent) of the area is designated Site of Special Scientific Interest, which largely overlap with European and international designations of Ramsar, Special Protection Areas and Special Areas of Conservation. Over 85 per cent of the SSSI area is in either favourable or unfavourable recovering condition. Supporting the international and national designated sites are 577 Local Wildlife Sites of biodiversity interest which cover another 7,264 ha, or 4.2 per cent of the area.	National	Continued or increased pumping or other abstraction of water will impact on existing sites, especially the lowland raised mires, and will limit the possibilities for expanding wetland habitats. The existing network of ditches and dykes provides an important resource for wildlife to penetrate agricultural areas and connect with other semi-natural habitats. The management of water quality is necessary to enable the migration of important salmonid species along the rivers.	Ensure that sites of particular biodiversity interest are protected and managed, and that surrounding areas are managed to create buffers and reduce impacts of pollutants and sediment run-off, so that the biodiversity interest is protected and enhanced . Work with groups of landowners and Internal Drainage Boards to manage water table levels to support a wider range of semi-natural habitats and permanent grassland. Increase the connectivity and permeability between semi-natural habitats, especially along the network of watercourses, making links with other semi-natural habitats, to improve habitat resilience and enable species movement.	**Biodiversity** **Regulating water quality** **Regulating soil erosion** **Sense of place/ inspiration** **Recreation** **Water availability**
Geodiversity	2 geological SSSI and 1 mixed interest (Humber Estuary) 18 Local Geological Sites	The main geological interest of the area is the influence of the post-glacial Lake Humber and the laying down of deposits. Also of interest is the development of peat which now contains much palaeo-environmental evidence. The underlying coal beds were exploited from Selby until 2004.	Local	Extraction of sand and gravel deposits has taken place in several locations. The deep coal beds were exploited from Selby until 2004. The combination of a local source of coal with plentiful water supplies in the main rivers gave rise to the construction of several large power stations.	Ensure palaeo-environmental evidence is retained and protected where possible. Ensure that sand and gravel extraction sites are restored to contribute to local landscape character and enhance biodiversity, providing improved access where possible.	**Geodiversity** **Biodiversity** **Recreation**

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Front cover: A large scale landscape with regular fields bounded by ditches, with few trees other than some scrub and woodlands on the less fertile soils © Keith Miller/English Heritage
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NATURAL ENGLAND

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