National Character Area profile:

80. The Broads

Supporting documents

Introduction & Summary | Description | Opportunities | Key facts and data | Landscape change | Analysis

NATURAL ENGLAND

www.gov.uk/natural-england

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.

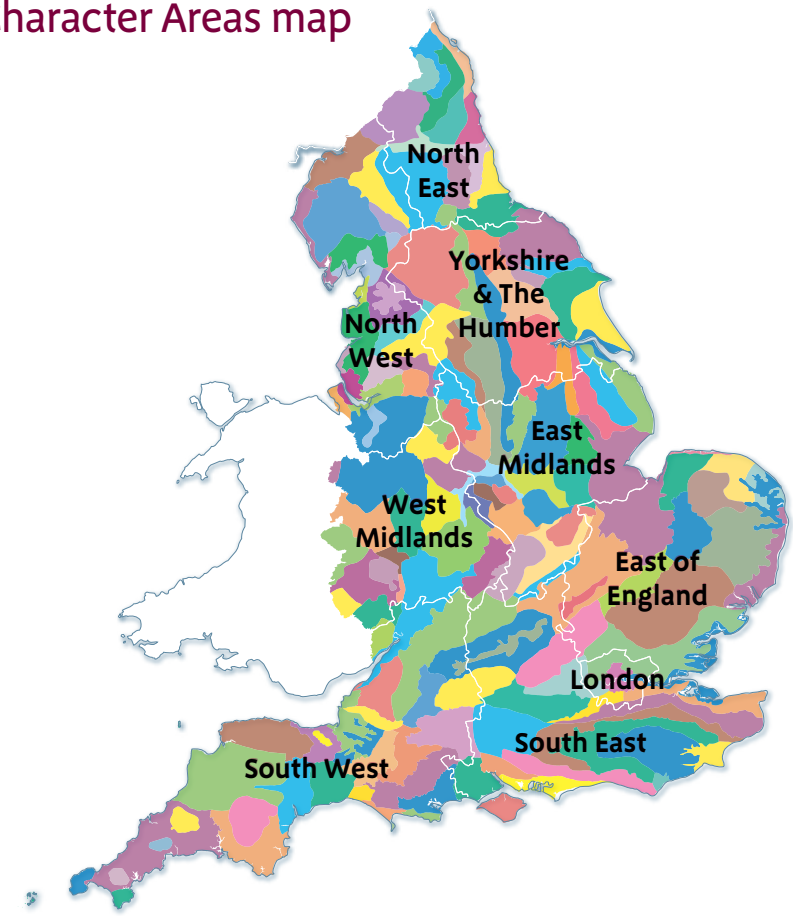
NCA profiles are guidance documents which can help communities to inform their decision-making about the places that they live in and care for. The information they contain will support the planning of conservation initiatives at a landscape scale, inform the delivery of Nature Improvement Areas and 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 Broads National Character Area (NCA) is situated on the eastern edge of East Anglia and is located predominantly in the county of Norfolk together with a small part of north Suffolk, between the peripheral urban areas of Norwich in the west and Great Yarmouth and Lowestoft in the east. Some 94 per cent of the NCA is open country and the remaining 6 per cent is urban. Its boundary follows the edge of the level, open marshland and valleys drained by the three principal rivers, the Yare, Bure and Waveney, and their tributaries, the Thurne, Ant, Wensum and Chet, giving the NCA its very distinctive shape. The rivers flow east into the sheltered estuary of Breydon Water, which lies at the confluence to the Broads river system.

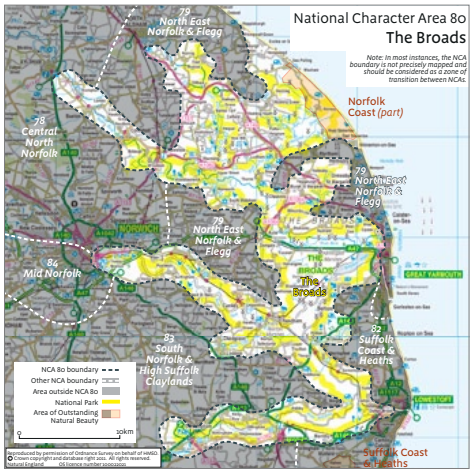
The whole area has become known for the shallow lakes, referred to as 'broads' that are contained within the river valleys. These broads are the effect of medieval excavations of peat that became flooded as sea levels rose. Since the 1950s the network of navigable rivers and areas of open water has assured that the Broads is a popular tourism and recreation destination, principally for boating holidays, attracting over 7 million visitors annually.[4]

The agricultural landscape is based on a long history of drainage to allow livestock grazing interspersed with arable cropping, mainly for cereals, which is supported by the moderately fertile river valley and flood plain soils. Woodland is limited, particularly across the coastal and flood plain marshes, although alder carr wet woodland is typical of the wetter areas surrounding the broads and on the flood plain of the middle and upper reaches of the valleys.

The low-lying marshes are traditionally unsettled, instilling a rather isolated character, while the pattern of settlement on the higher ground is clustered and linked by a minor road network that runs along the valley sides. A loose local vernacular of flint, pebble and brick, with pantiles and occasionally reed thatch, adds cohesion to settlements.

The ecologically rich wetland habitats form one of the finest and largest marshland complexes in the United Kingdom. Iconic species include the secretive bittern (rarely seen but frequently heard booming during the breeding season), the marsh harrier, and swallowtail butterfly and fen orchid. The coastline is also important for habitats such as dune heath and species including the natterjack toad, golden plover, little tern, and common and grey seals.

The importance of the Broads for biodiversity and nature conservation is borne out by the many sites within it afforded conservation status. Internationally designated sites cover 12 per cent of the NCA and include the Broadland and Breydon Water Ramsar site, three Special Protection



Click map to enlarge; click again to reduce

[4] Broads Authority (2013; URL: http://www.broads-authority.gov.uk/education/about-the-broads.html)

Areas (SPA) and two Special Areas of Conservation (SAC). There are ten National Nature Reserves and numerous Sites of Special Scientific Interest (SSSI) that together cover 12 per cent of the land area. There are also 103 local conservation sites covering 3 per cent of the NCA.

In the north-east the NCA meets the wild and open expanse of the North Sea along the 14 km stretch of coast between Happisburgh and Winterton-on-Sea. Approximately two-thirds of this coastline – 3 per cent of the NCA – lies within the Norfolk Coast Area of Outstanding Natural Beauty (AONB), designated in 1968 to recognise the national importance of the Norfolk coast landscape. The Norfolk and Suffolk Broads Act 1988 recognised the area's special qualities and constituted the Broads and some of the surrounding land – 52 per cent of the NCA – as equivalent in status to a national park. It is the only wetland national park area in the United Kingdom.

Today managing the Broads and its use is based on sustainable, integrated management of conservation, recreation and navigation interests. Challenges exist because, despite the extent of the navigable network in the Broads, very little use is made of the water as a means of public transport, with access mostly by car. In some areas, infill development is altering traditional settlement patterns and the quality and distinctiveness of the built environment. In recent years improvements have been made – through conservation efforts supported by agri-environment practices, and new initiatives in sewage treatment and the boating industry – resulting in 38 per cent of SSSI being in a favourable condition. However, many wildlife sites are currently in a poor condition, although 35 per cent are recovering. The increase in non-native species, seasonal variability in river flows, depleted groundwater resources, incursion of saltwater from tidal flooding, and diffuse pollution from land management potentially threaten the quality of water in the Broads and the whole nature of the flood plain environment. Climate change and rising sea levels add further challenges as well as opportunities for the landscape and local communities in this diverse and unique NCA.

Lower reaches of the Yare with wide grazing levels, isolated farms and wind pump relics.

Statements of Environmental Opportunities:

- **SEO 1:** Conserve and enhance the distinctive historic landscape of the Broads, which is of national and international significance for its heritage and biodiversity interest, through securing and expanding the open water, riverine and estuarine habitats which are vulnerable to abstraction, flooding, vegetation succession and altered land management. Manage the provision and quality of water in the whole catchment for human and ecological benefit.

- **SEO 2:** Conserve and manage the nationally significant coastal landscape, including that within the Area of Outstanding Natural Beauty (AONB) – between Sea Palling and Winterton-on-Sea – by implementing strategies to adapt to coastal change and sea level rise that are consistent with the current north-east Norfolk Shoreline Management Plan. Work with coastal processes as far as possible, while enhancing people's enjoyment of the area through improving its unique assemblage of coastal habitats and increasing opportunities for sustainably managed access to support recreation and education.

- **SEO 3:** Maintain a sustainable and productive agricultural landscape while expanding and connecting semi-natural habitats to benefit biodiversity, and improve soil and water quality by promoting sustainable farming practices that are able to adapt to changing agricultural economics and the considerable challenge of climate change, and comply with regulations on nitrate vulnerable zones.

- **SEO 4:** Improve opportunities to enhance people's enjoyment of the area while protecting high levels of tranquillity by conserving intimate Broadland valleys and extensive coast and marshland views, which contribute to sense of place, and conserve and promote the geodiversity, archaeology and historical evidence of past human settlement and landscape change.

Reedbeds and ponds on the Mid Yare National Nature Reserve shape the distinctive historic landscape of the Broads.

Description

Physical and functional links to other National Character Areas

There are strong visual, physical and functional links between the low-lying Broads and the higher land of the five neighbouring National Character Areas (NCAs), all of which have open views down and across the Broadland river valley flood plains and coastal plain. Views out of the Broads are subsequently either up the enclosed river valleys towards the elevated arable plateaux of the surrounding NCAs that form the horizon line, or out to the coast and seascape.

The Broads NCA follows the flood plains of three major tidal rivers and their tributaries which dissect the surrounding landscape. The ecological status of the wetland habitats and many of the ecosystem values within the Broads are critically dependent on sustainable water management and land use practices upstream in the extensive catchment, most of which lies outside The Broads NCA, as these directly affect the quality and quantity of both groundwater and surface water sources.

In the west the arable upper valleys of the rivers Wensum and Bure interlink with the more varied, wooded terrain of Central North Norfolk NCA, which, on its eastern flanks, shares a similar geology of crag and clay deposits.

To the south-east of Norwich in the upper reaches of the Yare valley, the Broads meets the Mid Norfolk NCA which is interlinked by the catchments of the Yare, Wensum and Tud, which drain the upper arable plateau of Mid Norfolk.

The arable clay plateau landscape of South Norfolk and High Suffolk Claylands abuts The Broads NCA in the south. Here the Yare and Waveney river valley corridors of riparian vegetation intertwine the two NCAs. A large proportion of the catchments of these two Broadland rivers as well as the catchment of the River Tas are found within this adjacent NCA.

Wetland habitats including remnants of the traditionally wet grassland and grazing marsh.

In the far south-east The Broads NCA merges with the heathy character of the Suffolk Coast and Heaths NCA with its mixed mosaic of farmland, heathland, coniferous woodland and coastal wetlands. This NCA also has its own broads which help make up the landscape area known as the Norfolk and Suffolk Broads.

North East Norfolk and Flegg NCA borders The Broads NCA to the north and east where it occupies the higher ground surrounding the flood plain. It is intimately linked and shares similar fertile landscape characteristics. The Broads NCA divides the North East Norfolk and Flegg NCA by occupying the lowland along the coast between Happisburgh and Winterton-on-Sea. The NCA also contains 1,694 hectares of the Norfolk Coast Area of Outstanding Natural Beauty (AONB) which it shares with the Central North Norfolk, North Norfolk Coast and North West Norfolk NCAs.

The geomorphological processes of erosion and sediment transfer from the soft sea cliffs to the north between Sheringham and Happisburgh, are important in helping to maintain the beaches and sand dunes further south at Horsey, as well as the continued evolution of coastal landscape as seen at Winterton Ness. It also underpins coastal management by functionally linking the Central North Norfolk and North East Norfolk and Flegg NCAs with the Broads NCA. This is a vital link as the beach and dunes provide a natural defence that helps shield the large area of low-lying hinterland of the Broads from coastal flooding during storms.

Distinct areas

- Halvergate and Haddiscoe Island marshland triangle
- The coastline between Happisburgh and Winterton-on-Sea

Natural erosion of the soft crumbling sea cliffs at Happisburgh.

Key characteristics

- The landscape is low-lying with some areas below sea level and has characteristic open, extensive views over slow meandering rivers, drained marshland and coastal plain in the lower valley flood plain. Views inland are framed by the tree-lined valley ridge lines.
- The middle, upper and narrow incised side valley tributaries are small-scale, low and enclosed, often supporting woodland.
- Rivers dominate the landscape with the middle and lower river reaches flowing between flood banks, above the level of the surrounding land which is drained by dykes, ditches and pumps.
- The broads, which are former flooded peat workings, form naturally nutrient-rich shallow lakes of various sizes surrounded by fens, wet woodland and large expanses of reedbed, rich in biodiversity.
- Woodland cover is generally sparse, especially in the marshland area. Small areas of mainly deciduous woodland occur around the broads. Carr woodland and willow pollards are typical of the wetter areas, while broadleaved woodland is present as copses and plantations on higher land.
- The dynamic coastal landscape from Happisburgh to Winterton-on-Sea is semi-natural in character with soft, eroding and mobile maritime cliffs and long, sweeping stretches of shifting sand and shingle beach habitat, backed by a coastal vegetated dune ridge.
- Glacial deposits of outwash gravels and till are in many places overlain by peaty, loamy and clayey flood plain alluvial soils. Where drainage has been carried out, the fertile soils support arable production while in the wetter areas grazing marsh is common.
- Field patterns are principally defined by drainage over most of the Broads. Regular 18th- and 19th-century enclosure fields (generally marshland) are clearly defined by straight, reed-fringed drainage ditches that form a strongly geometric layout across the lower flood plain. Some earlier curvilinear enclosure of marshland also survives.
- Much of the Broads is remote and isolated with settlements clustering on higher ground inland, linked by the few roads that run along the valley sides. Isolated farmhouses are the most significant buildings in the marshes.
- Vertical features are very distinctive in this generally flat landscape and include some very fine medieval churches on the higher ground and several traditional drainage mills located on embankments flanking some of the drainage channels on the marshes and coastal plain.
- Small boatyards and marinas form part of the traditional riverside scenery although, increasingly, extensive modern boatyard/marina developments challenge the traditional character.

- Traditional buildings make use of flint, pebble and brick walls, with pantiles and rare surviving reed thatch.
- The road system is limited and follows the edge of the rising land, although footpaths and boat access are extensive. Key river crossing points include bridges at Wroxham/Hoveton, Potter Heigham, Acle, Haddiscoe, Great Yarmouth, Norwich, Beccles and Bungay.
- Three railway lines cross the Broads area, serving a number of smaller settlements between Norwich, Great Yarmouth and Lowestoft.
- The sense of tranquillity and wildness is integral to the distinctiveness of the Broads, inspiring many writers, artists and naturalists and increasing its popularity as a recreation and tourist destination, which is notable within the popular villages particularly during the summer months.

Traditional reed thatched boat sheds at Hickling.

The Broads today

The low-lying river valleys, broads and marshland that are predominantly below or at sea level define the character of the NCA. The landscape is principally defined by drainage, extending over the lower valleys of the rivers Yare, Bure and Waveney, together with their tributaries, the Thurne, Ant, Wensum and Chet, which drain almost two-thirds of Norfolk and much of north Suffolk. In the middle and upper valleys, slight changes in relief create a small-scale, diverse and patterned landscape character with enclosed views. In contrast, the level, open and remote valleys towards the coast offer expansive, open views over rivers and drained marshland, the greater part of which is known as the Halvergate Marshes.

The NCA meets the North Sea along its 14 km coastline between Happisburgh and Winterton-on-Sea. The slightly curved shoreline, aligned to the north-east, supports long, sweeping stretches of open, sandy beach. Between Eccles and Winterton-on-Sea these are adjacent to sand dunes and acid dune heathlands, which in turn shield the low-lying hinterland from inundation from the North Sea. The beach and dunes themselves are stabilised and currently pinned by groynes, artificial offshore reefs, revetments and a long concrete wall along the dune frontage. At both ends of the NCA's coastline the land rises to form low (10 m) 'active' maritime cliffs which are made up of soft materials that are vulnerable to wave erosion. The offshore waters have strong currents and hidden sand banks.

The coastal cliffs display the NCA's geology: mostly Early Pleistocene shelly, muddy and sandy sediments known as Norwich Crag and Wroxham Crag, overlain by substantial quantities of Middle Pleistocene outwash gravels and chalky and sandy till. The river valleys contain layers of peat and alluvial silts with clays, which give rise to moderately fertile flood plain soils across the lower marshlands. The most fertile soils, rich loams, are present on the upper slopes of the northern valleys.

Where drained, the river valley flood plain soils support high-quality, productive grassland and arable cultivation (mostly cereals), replacing much of the traditionally wet grassland that was once common. The drier valley sides and tops support modern fields dominated by cereal cultivation, although some pockets of 18th- and 19-century enclosure survive in the west. The drained marshland is divided into drainage levels, defined by a planned rectilinear framework of raised river flood embankments and ditches and dykes. Some earlier curvilinear enclosure of marshland survives along the middle Bure and Hundred Stream to the north and on the Chedgrave and Wickhampton Marshes in the middle Yare and upper Waveney. Marsh gates mark the crossing points between the individual marshes.

The rivers and open waterbodies represent an area of 2,449 ha of open water (including lakes/broads of 816 ha), rivers, ditches and estuaries (to mean high water). The rivers are rich in calcium and flow slowly between embankments above the level of the surrounding land along their lower reaches as they meander across the valley floor, linking areas of semi-natural habitat, while the upper flood plains are generally unembanked. Some have been deepened, re-cut and re-profiled to remove meanders to aid navigation. The River Thurne has even undergone a flow reversal. The lower reaches of the rivers Yare, Bure and Waveney also show a strong tidal influence.

The 'broads' are shallow stretches of open water varying in size from tiny isolated lakes to huge expanses of water as at Hickling Broad. There are around 40 to 50 broads that are distributed unevenly, with far more in the northern half of the NCA than in the south. Most are of artificial origin, produced by medieval and later peat excavations that subsequently became flooded. The majority of the broads are freshwater while some such as Hickling and Horsey Mere, which lie at or below sea level, rely on coastal protection to prevent saline inundation, although saline intrusion via overtopping of the coastal defences or via ground percolation is still possible. Some, particularly those in the Bure Valley, are in direct connection with the river and tidal effects are significant. The remnant, embanked estuary of Breydon Water, the United Kingdom's most easterly estuary, lies at the junction of the northern and southern broads.

The NCA is home to a great diversity of wildlife and the ecological importance of the area is reflected in the variety of international, national and local nature conservation designations. These cover the network of freshwater and saline semi-natural habitats, including open reedbeds, grazing marsh, fen carr woodland, salt marsh and intertidal mudflats (Breydon Water). Some 75 per cent of the remaining species-rich peat fen in lowland Britain is found here. Where water clarity is good, the broads support an abundance of aquatic plant communities. Rare plants include the nationally scarce water soldier, holly-leaved naiad, fen orchid and three species of nationally rare stoneworts (freshwater seaweeds). An important plant of the fens is milk parsley, the sole food source for the larvae of the adult swallowtail butterfly, Britain's largest butterfly which is restricted to the wetland habitat of the Broads. Other rare invertebrates include the shiny ramshorn snail, the emperor and Norfolk hawker dragonflies.

In addition, the area's ornithological richness draws in many visitors. Three rare bird species particularly associated with the Broads are the bittern, bearded tit and marsh harrier, and in the north-east a recently re-established resident population of common crane is present. The extensive reedbeds and wet grassland are valuable roosting and feeding sites for large numbers of winter migratory species, including the widgeon, gadwall and shoveler. The coastal habitats support ringed plovers and a nationally important colony of little terns. Freshwater wet dune slacks also contain natterjack toad and great crested newt populations.

Woodland is sparse, covering just 8 per cent of the NCA. The upper reaches of the river valleys contain small-scale fields bounded by thick hedgerows with deciduous woodland, copses and plantations. In parts of the Waveney Valley and on the higher land to the north, the landscape is typically more open, with widespread field boundary loss evident. In the valley bottoms, the predominance of alder, willow and willow pollards contributes to the traditional wetland character, with the valley margins loosely contained by semi-natural fen carr woodland including alder, sallow and birch trees. In the middle and upper reaches of the valleys, wet woodland occurs on the flood plain where it has developed through natural succession, mainly over the course of the last 100 years in response to a decline in traditional fen management practices.

The abundance of wildlife is supported by the tranquillity of the wetland area, which contains very little urban development. The marshes are traditionally unsettled, with isolated farmhouses (buildings principally of the late 18th and 19th centuries) built on islands or 'holmes' (higher ground within a low-lying situation formed by glacial deposits) being the most

significant buildings along with derelict drainage mills and later diesel and electric pumping stations. Linear timber-chalet developments originating from the interwar years line some of the rivers in the north, and small boatyards and marinas such as at Somerleyton, Sutton and Ludham Bridge form part of the traditional riverside scenery. Extensive modern boatyard/marina developments are increasing though (for example, Brundall, St Olaves and Wroxham). The pattern of settlement away from the marshes is linear as well as clustered with a mixture of small towns, nucleated villages/hamlets and many individual farms.

Traditional dwellings and farmsteads are characterised by a diverse use of flint, pebble and brick, with pantiles and occasionally dark, dense and flat Norfolk water reed thatch. The use of boats and particularly 'wherries' for trade is reflected in some local vernacular architecture, with a number of examples of 'wherry architecture' present in Beccles, Bungay, Norwich and the Ant Valley. The Yare and Waveney valleys contain many of the distinctive round-tower churches (some of which are thatched) that are characteristic of early medieval ecclesiastical architecture in East Anglia. The coastline is essentially natural in character and largely undeveloped with only a small number of settlements, isolated properties and camping sites dotted along the cliff-top or tucked in behind the dunes.

The NCA is crossed by a number of major transportation links, including the A47 that links Norwich with Great Yarmouth. In general, though, roads and river crossings are few and far between, with access to the villages, rivers and broads usually off minor roads. Footpaths and boat access are extensive. The medieval bridge at Potter Heigham is distinctive as a well-known landmark and the Reedham chain ferry is a reminder of the once numerous ferry crossings, that now offers the only crossing of the Yare between Norwich and Yarmouth. The majority of the rivers and broads are navigable and so are busy with all types of pleasure craft, especially during the summer months, as the area remains an attractive holiday destination owing to this network of waterways, abundant wildlife and inspiring landscapes.

Modern infrastructure developments are scarce, although overhead lines and pylons gain visual prominence in this open, low landscape. When coastal visibility is clear, the thirty 108-metre-high wind turbines of Scroby Sands, located offshore from Great Yarmouth, can be seen from Horsey and all points south.

Rockland Broad, Yare Broads and Marshes SSSI.

The landscape through time

The landscape of the Broads is founded on a complex and unique sedimentary sequence, involving several periods of marine transgression and regression that deposited the Early Pleistocene bedrock (between approximately 2.2 and 0.7 million years ago) over an eroded surface of Late Cretaceous chalk. This bedrock comprises a sequence of shelly, muddy and sandy sediments known as the Norwich Crag and Wroxham Crag.

The effects of the Anglian glaciation (c.480, 000–430,000 bp) are shown by the existence of substantial quantities of boulder clay and sandy and chalky till deposited over the crag bedrock.

Layers of wind-blown silt were deposited during the last (Devensian) cold period of the ice age and made a major contribution to the topsoil of the upland parts of the NCA. The extensive flatness of the topography is a legacy of the rise in sea level that followed the melting of the Devensian ice sheets after 12,000 bp.

The Holocene period has seen fluctuations in relative sea level. The sea rose to approximately the same levels as today by about 6,000 bp during Mesolithic times. Freshwater fen and alder carr environments were established on the valley floors. Relative sea levels rose in Neolithic times and an extensive estuary system developed depositing a layer of marine alluvium. By the Bronze Age marine influences had become blocked and freshwater conditions returned. By the later Iron Age an open estuary had once again begun to form, remaining throughout the Roman period. This sizeable sea inlet, known as the Great Estuary, eventually silted up during the Anglo-Saxon period leaving Breydon Water as its sole remnant. This historical pattern of wetland creation is broadly reflected in the various soil types found today.

Further reminders of the past include the ruins of Burgh Castle, originally built by the Romans to defend against coastal raids and later developed as a Saxon shore fort on this marine inlet – although it is now inland overlooking the River Waveney. The courses of old estuarine salt marsh creeks are also still visible in the pattern of some marshland drainage dykes as it was during the medieval period that large-scale drainage and enclosure of the marshlands commenced, usually being undertaken by monastic institutions.

At the time of Doomsday Book a fully functioning wetland, demonstrating an unrestricted transition from sea to freshwater, existed. Sea levels were considerably lower and the extent and distribution of saltings and fens were very different from today. The Yare Valley was densely populated at this time and its cluster of Saxo-Norman churches reflects the period's manorial structure and serves as a reminder of this populous past.

In the late 11th century, eastern Norfolk was documented to be the most densely populated county in Britain, with Norwich the second largest city in England after London. The historic settlement pattern has been dictated largely by social and economic need, with groupings often around a parish staithe, riverside common, ferry or bridge. Cultural influences stemmed from contact with the ports along the Baltic and North Seas, as the area's tradable goods of wool, weaving and agricultural produce were exported throughout the world from the port of Great Yarmouth. At this time the demand for timber and fuel was so high that most woodland was felled, and the growing population then began digging the peat in the river valleys to provide a suitable fuel alternative. Peat digging, also known as 'turbary', was extensive

until the 14th century, providing fuel for Norwich and its hinterland and for the smoking of herring at Great Yarmouth and other coastal settlements. Rising sea levels then flooded these early commercial diggings and, despite numerous drainage attempts, the flooding continued and subsequently today's broads were formed. Originally these cut basins were steep-sided and deep, although siltation and vegetative growth softened and reduced their depths. The newly formed lakes were interconnected by existing rivers, providing essential channels for communication and commerce throughout the 16th century. Peat cutting remained commercially viable up to the end of the 19th century and large areas of fen between the broads were dug shallowly from time to time, temporarily extending the water area. It was not until the 1950s, when Dr JM Lambert presented a series of findings, that it was understood that the lakes were not natural formations, but actually early manmade excavations that had become flooded.

The influx of recreation visitors to the area began with the arrival of the railway in the mid-1800s, although the Broads did not participate in the growth of coastal tourism until the late 19th and early 20th centuries, becoming a truly popular holiday destination during the 1950s and 1960s. The popularity of the area as a holiday location has meant that some Broadland villages (in particular Wroxham beside the River Bure) have experienced enormous growth over the last century.

Whereas the key to the Broads becoming a popular tourist destination has been the flooding of the earlier peat diggings, drainage of the marshland has provided the key to successful agriculture over several centuries. Today's open marshland is a product of medieval and later drainage and reclamation, largely by the embankment of the rivers and estuary. Grazing by livestock (principally sheep) was a feature from early on, with livestock having easy access to fens and marshes, this being privately rather than communally managed.

By the 16th century there was a move towards cattle production in preference to sheep grazing on the many areas that had been reclaimed through improvement to existing flood banks, driven by increases in sea level rise and a wish to increase agricultural production. These changes are visible in the area's farmsteads, which developed into courtyard plans around barns that often reveal several phases of construction.

By the 18th century most of the grazing marshes of today were formed, although transient flooding occurred frequently due to the inefficiency of drainage pumps driven by windmills; there were around 110 mills in the Broads by the late 19th century.

Substantial amounts of Parliamentary enclosure (though not wholly of marshland) took place during the early part of the 19th century, and this paid for improvements to the land drainage infrastructure. Former open areas of marsh were divided up by straight drainage ditches into strongly geometric new fields. Flooding reduced as drainage was further facilitated by the introduction, in around 1840, of steam pumps. The river valleys also contain drained marshland, although less extensive and representing later improvements and enclosure dating from the 17th to 19th centuries. The use of the marshland for grazing cattle from surrounding farms resulted in few agricultural buildings, although with enclosure, some new farms were built in the drained fields.

The 20th century has seen further improvements in land drainage, driven by agricultural production. The Broads 18 Internal Drainage Boards came into

existence during the 1930s and by the 1940s highly efficient electrical pumps became widespread, leading to the extent of the marsh pasture diminishing significantly during the second half of the 20th century, as previously wet pasture was converted for arable cultivation.

Throughout history, each stage of agricultural intensification has seen a corresponding decline in the ecological value of the Broadland habitats, such as flower-rich fen meadows, and traditional washlands which have disappeared. Reclamation has also resulted in an expansion of freshwater habitats, with a corresponding reduction in brackish elements.

The undrained fen peatlands adjacent to the rivers and broads have also seen significant change. Historically they were host to swampy vegetation that was exploited for thatching reed, sedge and marsh hay. Post-war economic and social change, coupled with agricultural advances, led to their abandonment, resulting in the reversion to scrub, wet woodland, alder and willow carr. This is very evident in the Bure Valley where a significant amount of this carr woodland has regenerated since the 1950s.

Pressure to drain and convert the marshes to arable land had an important influence on agricultural policy. The Broads Grazing Marsh Conservation Scheme experiment of the 1980s was the precursor of Environmentally Sensitive Area (ESA) designations. Together with the replacement Environmental Stewardship (ES) scheme, introduced in 2005, these agri-environment programmes combined with water level management plans largely reversed the trend of agricultural intensification that took place throughout much of the previous four decades.

Since the 1980s significant improvements in water quality have been made, helped by improvements and new initiatives in sewage treatment, agri-environment practices and the boating industry, leading to some recovery of freshwater communities. However, the Water Framework Directive status and Site of Special Scientific Interest (SSSI) condition of open water remains below target in almost all cases. The natural transition from saltwater to freshwater in the river system has changed over this period, particularly within the Bure system, as low summer flows and depleted groundwater resources combined with tidal flooding have allowed saltwater to penetrate further upstream. The consequent enrichment of fen vegetation has led to a reduction in the floristic quality in some wetland areas. Nutrient enrichment issues also exist in grazing marsh ditch systems, although the increased sustainable management of wetland habitats via agri-environment schemes has overall benefited the Broadland ecology. For example, the otter is recovering from its rapid decline in the 1960s and birds such as the bittern and marsh harrier have made a successful comeback over recent decades in response to improved fen management and restoration, and there remains a great potential to restore further large areas of fen to their former glory.

Water companies' forward plans are committed to continuing investment in protecting the most important habitats and species and encouraging biodiversity. Increased partnership working and community engagement have also resulted in conservation improvements for habitats including salt marshes, intertidal mudflats, wet woodland and various coastal formations, with 73 per cent (5,050 ha) of the SSSI meeting national public service agreement condition targets in 2011.

Ecosystem services

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

Provisioning services (food, fibre and water supply)

- **Food provision**: Around three-quarters of the NCA are under some form of agricultural management, with a large proportion of the managed area comprising grazed marshland supporting the production of beef and lamb. Despite its fertile soils, the Broads has the smallest area under cultivation among the Norfolk NCAs, except the North Norfolk Coast, yet remains an important producer of arable crops, principally cereals. Livestock numbers have decreased significantly during the last decade as have dairy herds. Poultry units are common and there has been an increased use of flood plain land for free-range poultry.

- **Water availability:** Water availability is critically dependent on the land management in the surrounding NCAs that lie up stream; (Central North Norfolk, North East Norfolk and Flegg, South Norfolk and High Suffolk Claylands, and Mid Norfolk) and directly affect the quantity of water entering the catchment from both groundwater and surface water sources. The eastern area of the NCA overlays the crag aquifer, which itself is overlain by varying thicknesses of sands and gravels that act as locally important minor aquifers. Abstraction of water provides benefits to the public water supply, industry and agriculture within the NCA. There are a number of both agricultural and potable water boreholes around the flood plain periphery; however abstraction from all of these sources is limited owing to concerns about the impact of abstraction on aquifer-fed fen communities, low river flows, and saltwater ingress from the North Sea via the aquifer. Water is also drawn from the Trinity Broads complex and waterbodies at Lound. Surface waters are an important water source for the surrounding farmland and settlements, and vital for supplying the broads themselves and the associated key wetland habitats as well as the local economy, which is underpinned by water-based recreation and ecotourism.

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

- **Climate regulation:** The flood plain fen peat soils formed by the Broads wetland vegetation stores 38.8 million tonnes of carbon.[5] Peat soils release previously stored carbon where they are dry, and as a result of oxidation shrinkage occurs. The undisturbed organic soils of the coastal and flood plain grazing marsh, and the wet loamy and sandy soils with a peaty surface, also offer a significant carbon storage resource and future carbon storage capacity. High carbon levels may also be associated with the soils of the coastal flats where some variants may have organic-rich topsoils. Soil carbon will also be high in areas under the woodland and coastal heathland habitats, which also sequester carbon. The standing biomass, which includes winter-green species such as sedge, and the woodland, scrub and hedgerows also lock up carbon over a shorter timescale.

[5] Carbon Audit for the Broads, Broads Authority (2009)

- **Regulating water quality:** Water quality is critically dependent on the land management in the surrounding NCAs which directly affect the quality of water entering the catchment from both groundwater and surface water sources. Water quality is, in general, gradually improving in response to the installation of phosphate-stripping equipment on many of the sewage treatment works, as a result of major lake restoration projects and the uptake of agri-environment schemes that protect and improve watercourses. Improvement can, however, be compromised by low flows in dry summers, which are predicted to increase as a consequence of climate change.

  The groundwater chemical status for the whole of the NCA is 'poor', while the surface water chemical status in the NCA is generally 'good'. The ecological status of river waters, canals and surface waters in the NCA is varied and ranges between 'poor' and 'good'. The biological and chemical river water quality ranges from 'very good' to 'fair' depending on the location within the river system and/or proximity to sources of point-source pollution. The catchments of the Bure, Ant and Muckfleet and the Yare and Waveney have been prioritised under the England Catchment Sensitive Farming Delivery Initiative (ECSFDI) owing to low, or falling, water quality. Currently, none of the coastal and estuarine waterbodies are achieving either 'good' or 'potentially good' status.[6] Improvements are expected through the implementation of actions listed in Diffuse Water Pollution Plans for all the main catchments (Yare, Bure, Ant, Thurne, Waveney and the Trinity Broads waterbodies) as well as Catchment Flood Management Plans (CFMPs) and Shoreline Management Plans (SMPs).

- **Regulating water flow:** The NCA includes a large number of rivers that drain surrounding areas; high levels of drainage within the natural flood plains have increased the pressure on the river system, leading to a long history of flooding of farmland and flood plain properties. Currently, the Environment Agency flood risk map indicates that for the majority of the NCA the risk of fluvial flooding is high (an annual probability of flooding of 1 per cent or greater from rivers). Flood risk from the rivers comes from two main sources: (1) tidal locking, which occurs when rivers are unable to flow freely to the sea at high tide, with the potential to occur at Norwich (River Wensum) and at Hoveton and Horning (River Bure);[7] and (2) the overwhelming of pumping stations (notably at Aylsham, Martham, Thurne, Caister, Winterton-on-Sea and Stokesby).

  The lower reaches of rivers are almost entirely embanked and therefore rely on hard engineering solutions that limit flood storage capacity in the event of a major flood. The middle river reaches of five key rivers (Ant, Bure, Thurne, Yare and Waveney) are generally unembanked, and fen and wet woodland in the natural flood plain provide significant flood storage capacity following heavy rainfall, although increasing water levels and intermittent flooding (for example, in the River Yare fens) damages the Special Area of Conservation (SAC) features.

[6] Water for Life and Livelihoods: River Basin Management Plans – Anglian River Basin District, Environment Agency (December 2009; URL: www.environment-agency.gov.uk/wfd)

[7] The Broadland River Catchment Flood Management Plan Summary Report, Environment Agency (December 2009: URL: www.environment-agency.gov.uk/research/planning/33586.aspx)

- **Regulating coastal flooding:** Currently, the Environment Agency flood risk map indicates that for the majority of the NCA the risk of tidal flooding is high (an annual probability of flooding of 0.5 per cent or greater from the sea). There is a risk of tidal flooding when high tide levels combine with storm surges, as the hinterland is mostly at or below sea level. Tidal flooding is a threat to Great Yarmouth (adjacent to North East Norfolk and Flegg NCA), as the current flood defences become less and less effective against increasing storm frequency and intensity.[8] There is consequently a high risk of failure through the breaching/failing of river embankments (for example, at Norwich and Great Yarmouth), although flood defences are currently being improved along the River Yare.[9] The semi-natural dune flood defences between Eccles and Winterton-on-Sea shield the low-lying hinterland from coastal flooding, however, they are likely to require maintenance over the next 25 to 50 years in line with the guidelines contained in the north-east Norfolk (Kelling to Lowestoft Ness) Shoreline Management Plan, which proposes holding the current line for at least 50 years, with a review for the period beyond. This is likely to be increasingly challenging: technically, economically and environmentally.

- **Regulating coastal erosion:** Along the coast, soft cliffs and low-lying areas appear to be eroding at an accelerated rate as a result of sea level rise and the increasing unpredictability of high rainfall and storms. The soft cliffs are formed of heterogeneous (mixed) materials that provide little resistance to wave attack and regularly succumb to mass movements caused by undercutting. In addition, when the cliff material is saturated with groundwater, it becomes unstable. Although this is an entirely natural geomorphological process, it results in large-scale slumps and a general retreat of the cliff line. This whole length of coast is reliant on sediment eroded from the cliffs of north Norfolk for the beaches and other intertidal habitats to help support the reduction of flood risk to the NCA. However, in recent years this has been supplemented through recharging beaches along the Eccles to Waxham frontage to address any shortfall in material supply.

- **Pollination:** The meadow, marsh and field-margin habitats found in the NCA provide important nectar sources for pollinating insects. Where land management is dominated by arable crops, however, it is the interstitial, unmanaged habitats such as the edges of farm tracks that become the key sources of both pollen and nectar. These habitats are particularly important as they support the insects that pollinate commercial arable crops, including rape, as well as high-value vegetables. Agricultural intensification and improvement have in some places resulted in the loss of, and damage to, field boundaries, especially in the arable upper valleys and tops, limiting the service potential.

- **Pest regulation:** The semi-natural habitats such as meadows, field margins and fen provide important overwintering habitats for beneficial predatory invertebrates – for example, ground and rove beetles – that feed on many pest species. Careful management of agro-chemicals (through integrated pest management approaches) may reduce the need for chemical intervention, although these farming systems may benefit from further research. Financial support for farmers channelled through agri-environment schemes (for example, Environmental and Countryside Stewardship) can fund networks of these habitats in arable areas.

[8] The Broadland River Catchment Flood Management Plan Summary Report, Environment Agency (December 2009; URL: www.environment-agency.gov.uk/research/planning/33586.aspx)

[9] The Broadland River Catchment Flood Management Plan Summary Report, Environment Agency (December 2009; URL: www.environment-agency.gov.uk/research/planning/33586.aspx)

Cultural services (inspiration, education and wellbeing)

- **Sense of place/inspiration:** The Broads is a living and working cultural landscape that has been influenced over time, by patterns of human existence. To some extent, as a result of 20th-century tourism, the Broadland landscape has become the popular perception of the quintessential Norfolk landscape. The NCA's varied landscapes – including the dynamic coastline, expansive flood plain marshland, lush river valleys and broads, and enclosed upper valley pastoral landscapes, coupled with their diverse ecology, local vernacular and historic features – help to enrich the sense of place. Writers and naturalists such as Arthur Patterson and local author Ted Ellis, who referred to the Broads as 'the breathing space for the cure of souls' because of their capacity to refresh and restore through the power of escape from modern life, have been inspired by the area. Two of the children's Swallows and Amazons books were set in the Broads and John Betjeman recalled childhood holidays on the coast at Horsey in East Anglian Bathe. Daniel Defoe also used the treacherous and locally known 'shipwreck coast' off Winterton-on-Sea as the location for Robinson Crusoe's shipwreck. Influential painters (including John Crome and John Sell Cotman) and pioneering photographers (such as P.H. Emerson) were also inspired by the semi-natural beauty of the Broads.

- **Sense of history:** The area has a rich sense of history, with 24 designated conservation areas and nearly 1,000 sites worthy of inclusion on the Historic Environment Record, recognising the special architectural and historical interest of the area. The historic character is reinforced by notable landmarks, including the ruins of Burgh Castle at the mouth of the River Waveney; the medieval bridge at Potter Heigham; and striking parks and gardens (for example, Langley Park, Beeston Hall and Crown Point). The cluster of Saxo-Norman churches along the Yare and Waveney that possess round towers of unknapped flint – characteristic of the region's early medieval ecclesiastical architecture – and distinctive traditional farmsteads and domestic architecture are all prominent historic features in the landscape. In the larger towns such as Beccles, Dutch and Flemish influences on architecture are common.

  More recent military history dates from the Second World War and artefacts include concrete pillboxes, often located at key junctions of roads and rivers as well as along the coast. The coastline has its own particular landscape history, with the East Anglian coast having suffered many major floods since the Middle Ages. A 13 km concrete sea wall was constructed following the last major breach of the natural defences, on the night of 31 January 1953 and serves as a vivid reminder of this event. The pattern of the broads themselves is the consequence of historical flooding and of medieval and later peat extraction for fuel; this provides a strong and very vivid sense of history. A history of controlled drainage is evident in the drainage mills (such as Berney Arms Windmill), raised and embanked rivers, and drainage dykes. More recently, ploughing and drainage of large areas of marsh are evident.

- **Tranquillity:** The richness of wildlife and limited settlement mean that much of the NCA (particularly the relatively inaccessible flood plains of Halvergate and the Upper Thurne) retains a stark, remote and wilderness quality, with a scale and sense of space that is unusual in lowland Britain. These features are integral to the distinctiveness of the Broads landscape character, making it one of the most tranquil areas of Norfolk. The NCA has, however,

experienced a sharp decline in tranquillity levels since the 1960s. Areas suffering from intrusion are primarily associated with major road corridors including the A47, A143 and A146, especially where they cross the open lower flood plain marshland. It is recognised that in some areas where there is a concentration of holiday or leisure development, tranquillity and wildness are not appropriate and it is the bustling activity that gives the area its character. Control of visual intrusion, light pollution and noise is encouraged through planning policy and guidance on best practice, as well as through a range of schemes targeted at reducing disturbance from recreational water craft.

- **Recreation:** Some 52 per cent of the NCA has status equivalent to a national park. The ten National Nature Reserves and numerous other wildlife reserves support the area's ecotourism, which is underpinned by boating access to the network of rivers and broads. The hire boat industry is still key to the local economy, despite a decline since its peak in the early to mid-1980s, from around 3,000 hire boats to approximately 950 today. There are also 10,898 privately owned boats registered.[10] The annual value of tourism is estimated to be £400 million with 7 million visitors each year.[11] The network of public rights of way, which is sparse across the lower flood plain, totals 565 km at a density of 1.00 km per km^2. There is a small proportion of open access land (311 hectares, or just over 0.5 per cent of the NCA). There are three long-distance trails (Weavers' Way, Wherryman's Way and Angles Way). The Norfolk Coast Cycleway (Sustrans Regional Route 30) runs through the north of the area from Happisburgh to Winterton-on-Sea, while Sustrans National Route 1 runs through the south of the area from Norwich to Great Yarmouth. The open shoreline provides access and recreation opportunities while the coastline itself provides a valued resource for water-based recreation.

- **Biodiversity:** The Broads is a priority Wetland Vision area, reflecting the national importance of this wetland landscape. Key habitats that underpin the richest sources of genetic diversity are extensive in this accounting for 41 per cent of the area. Over 7,000 ha are nationally designated as Sites of Special Scientific Interest (SSSI), with international designations including three Special Protection Areas (SPA), two Special Areas of Conservation (SAC) and two Ramsar sites. Habitats include coastal and flood plain grazing marsh (12,288 ha), reedbeds (6,277 ha), fens (4,116 ha) as well as the most extensive tract of wet woodland (particularly alder carr) within eastern England. The coastal dunes represent the best example of an acid dune system on the east coast. The range of coastal habitats supports internationally important numbers of overwintering wildfowl and wetland birds and nationally important invertebrate and plant assemblages. A number of iconic species are present in the Broads, including the bittern, marsh harrier and otter, as well as 50 per cent of all UK fen orchids, 95 per cent of the UK population of Norfolk hawker dragonflies and the entire UK populations of the swallowtail butterfly, the dotted footman moth and the holly-leaved naiad (a species of aquatic plant).

[10] Broads Authority (2013; URL: http://www.broads-authority.gov.uk/broads/live/managing/broads-biodiversity-and-water-forum/Barbara_Greasley.pdf)

[11] Broads Authority (2013; URL: http://www.broads-authority.gov.uk/education/about-the-broads.html)

Statements of Environmental Opportunity

SEO 1: Conserve and enhance the distinctive historic landscape of the Broads, which is of national and international significance for its heritage and biodiversity interest, through securing and expanding the open water, riverine and estuarine habitats which are vulnerable to abstraction, flooding, vegetation succession and altered land management. Manage the provision and quality of water in the whole catchment for human and ecological benefit.

For example, by:

- Working with landowners, partners and communities to restore the connectivity of key habitats across the landscape, reinstating and extending wet grassland and grazing marsh for breeding waders (for example, lapwing, redshank and snipe) and overwintering wildfowl, and expanding and creating new habitats and ecological networks for species.
- Maintaining and, where necessary, improving the condition of the Sites of Special Scientific Interest (SSSI) and continuing to conserve and protect the valuable habitats and species in the Broads' three Special Protection Areas (SPA), two Special Areas of Conservation (SAC) and ten National Nature Reserves.
- Facilitating the ability of viable agricultural businesses to undertake more tailored agricultural and conservation management to support the range of riverine and estuarine wetland habitats and landscapes, incorporating uncultivated margins and established habitat to protect watercourses in order to support rare species such as the otter, bittern and holly-leaved naiad, together with milk parsley, ragged robin and meadow thistle which are vital food plants for the rare swallowtail butterfly.
- Enhancing the management of wetland habitats, including ditch systems and river corridors, through the adaptive management of the adjacent flood plain, managing water quality and availability to achieve a favourable ecological condition while securing their natural and cultural value and the associated benefits.
- Identifying and developing strategies to mitigate some of the impacts of saltwater incursion – for example, through the creation of washlands and new wetlands to moderate flooding of existing wildlife sites.
- Promoting initiatives that facilitate re-wetting the drained flood plain to create new fenland habitat at the upstream extent of the system, restore watermeadows, undertake flood plain planting of wet woodland, and restore the structure and function of river channels which in turn will maintain water levels.
- Working in partnership with the Norfolk Non-native Species Initiative to reduce threats posed by non-native species colonisation of the open water, riverine and estuarine habitats.
- Working in partnership with landowners and farmers to conserve and enhance the deciduous woodland, copses, plantations and hedgerows on the higher ground of the valley sides and tops and prioritise the management of fen carr wet woodland along the valley bottoms to benefit the provision and quality of water in the catchment, while securing their natural, cultural and economic value and the associated benefits.

SEO 2: Conserve and manage the nationally significant coastal landscape, including that within the Area of Outstanding Natural Beauty (AONB) – between Sea Palling and Winterton-on-Sea – by implementing strategies to adapt to coastal change and sea level rise that are consistent with the current north-east Norfolk Shoreline Management Plan. Work with coastal processes as far as possible, while enhancing people's enjoyment of the area through improving its unique assemblage of coastal habitats and increasing opportunities for sustainably managed access to support recreation and education.

For example, by:

- Establishing a programme of community engagement to explain the vulnerability of the Broads to climate change and the interdependence between the wetlands of the Upper Thurne and the Winterton–Horsey dune system, identifying local concerns and aspirations to inform adaptation planning, and encouraging and promoting local volunteering opportunities for people to become engaged with the natural environment.
- Promoting and delivering climate change adaptation measures, such as the Connecting Wetlands project, using the ecosystem services approach to develop wider understanding of the operation of natural processes.
- Ensuring that the coastal dunes are conserved and protected from damage resulting from recreational pressure, through the development of a strategy for coastal public access management, so that they continue to function as a natural coastal flood defence of the low-lying hinterland.
- Raising awareness of the important sensitive habitats and the wildlife that the coastal environment supports, through clear signposting and interpretation, to improve the quality of understanding and enjoyment of the coastal environments and associated habitats and species (such as coastal dunes, little tern, golden plover, and common and grey seals).
- Working in partnership with landowners and farmers to achieve mutually satisfactory objectives, managing and promoting opportunities for sustainable access and outdoor recreation on land adjacent to the coast, through clear signposting and interpretation for both local people and visitors, that improve health, wellbeing and enjoyment of the environment.
- Facilitating the Broads Flood Alleviation Project to adapt to coastal change and sea level rise and seeking new opportunities for access enhancements to the flood plain and river systems.
- Working in partnership, in line with the north-east Norfolk (Kelling to Lowestoft Ness) Shoreline Management Plan, to ensure that dynamic coastal processes continue and conserve the range of estuarine, coastal and wetland habitats that contribute to landscape character and support the wide range of wildlife.

Coastal dune heath and wet dune slacks provide a habitat for natterjack toads and great crested newts.

SEO 3: Maintain a sustainable and productive agricultural landscape while expanding and connecting semi-natural habitats to benefit biodiversity, and improve soil and water quality by promoting sustainable farming practices that are able to adapt to changing agricultural economics and the considerable challenge of climate change, and comply with regulations on nitrate vulnerable zones.

For example, by:

- Encouraging sustainable farming practices and the diversification of cropping and livestock to support the continued production of food supplied to local and national markets and the financial security of rural businesses.
- Encouraging increased uptake of agri-environment schemes and options that facilitate re-wetting the flood plain, to reactivate peat formation and promote carbon sequestration, and are targeted at expanding and connecting ecological networks to benefit biodiversity such as increasing farmland bird populations.
- Ensure that advice is provided to support and enable sustainable farming practices to be carried out efficiently, including follow-up monitoring and advice, to help inform future land management decisions.
- Working in partnership with farmers to encourage the uptake of agri-environment options that harvest and conserve water, protect watercourses and prevent water quality deterioration by reducing diffuse pollution and ensuring compliance with regulations on nitrate vulnerable zones to manage fertiliser inputs.
- Working in partnership with farmers to encourage the appropriate design and sensitive siting of new on-farm water storage, which will help to reduce the impact of water abstraction and enhance biodiversity and landscape character.
- Working in partnership with farmers to encourage soil management improvements in order to prevent deterioration of water quality caused by soil erosion and nutrient leaching (which will also have negative effects on the semi-natural habitats of the Broads).
- Continuing to bring derelict reedbeds and sedgebeds into regular management and promote use of fen litter for biomass and new commercial uses for hay and reed such as reed faggots.
- Reconnecting rivers and their flood plains and the restoration of marginal reedswamp and salt marsh, where appropriate, to increase the use of river valleys for the storage of floodwaters, aquifer recharge, and restoring and creating new wetland habitats where not at risk from saline incursion and where this will not compromise water quality in the ditch systems.
- Facilitating the ability of viable agricultural businesses to undertake more tailored agricultural and conservation management to support the range of drier habitats and landscapes of the hinterland, incorporating uncultivated margins to arable fields in order to support rare arable weeds and farmland bird species.
- Encouraging the management and, where necessary, the replanting of damaged field boundary hedgerows on the valley sides, upper valleys and tops to strengthen the traditional pastoral landscape character of this area of the Broads, which is known for its thick, mature hedgerows with dense rows of trees, and assisting the linking of semi-natural habitats to benefit biodiversity and improve water quality.

Continued on next page

SEO3 continued

- Encouraging the creation of new woodland to expand and connect semi-natural habitats benefiting biodiversity and water quality, where this does not compromise other, more ecologically valuable, habitat or result in the loss of valley flood plain transitions.
- Encouraging local farm businesses, isolated properties and small communities to increase appropriate-scale generation of heat, utilising woody biomass for woodchip boilers where it is sustainable to do so. This will in turn bring further opportunities for improved woodland management, while being mindful of locally valued landscape characteristics and sensitive landscapes, habitats and associated species.

SEO 4: Improve opportunities to enhance people's enjoyment of the area while protecting high levels of tranquillity by conserving intimate Broadland valleys and extensive coast and marshland views, which contribute to sense of place, and conserve and promote the geodiversity, archaeology and historical evidence of past human settlement and landscape change.

For example, by:

- Working in partnership with landowners, farmers, local businesses and the Broads Authority to promote the NCA as an area of natural beauty and one that affords opportunities for open-air recreation, focusing on ecotourism as a mechanism to reduce environmental damage caused by tourism pressure to ensure that the Broads is maintained as a unique and inspiring landscape with its own sense of place and historical significance.
- Strengthening opportunities to sustainably manage recreation in order to meet the demand of visitors wishing to enjoy water-based interest; which contribute significantly to the character and local economy of the area.
- Strengthening opportunities for visitors to enjoy natural and cultural heritage by providing them with a wide range of opportunities to experience, enjoy and understand the special natural environment and heritage of the Broads.
- Managing and conserving heritage assets as an integral part of the historic character of the area, through appropriate measures and seeking to reduce conflicting or unsympathetic management regimes while recognising the high potential in this landscape for undiscovered remains.
- Managing visitor pressures at popular and sensitive sites by investing in high-quality infrastructure and interpretation that is designed to provide equality of opportunity, meeting the different needs and levels of use of a range of visitors, including local communities, recreational day visitors and tourists, and enhancing the experience without being the cause of damage or degradation of the Broads' natural assets and tranquillity.
- Working in partnership with the holiday and leisure businesses to encourage best practice to ensure that measures are taken to control light and noise pollution to reduce disturbance, enhancing people's enjoyment of the area by protecting high levels of tranquillity where appropriate.

Continued on next page

SEO4 continued

- Managing and promoting public rights of way by linking existing public footpaths, settlements and long-distance paths (for example, Weavers' Way, Wherryman's Way and the Bure Valley Path) as well as supporting improvements for cycling in the NCA in order to enhance sustainable tourism and recreational opportunities and ensure a high-quality experience for all users.
- Maintaining and promoting the key physical, historical and cultural elements that provide local identity, amenity and aesthetic value to the area's historic landscape character (for example, traditional farmsteads and buildings, wind pumps, staithes and boatsheds), ensuring that these are retained and actively managed while allowing the landscape to continue to evolve and reflect the interactions between people and the environment.
- Promoting the links between the geological landscape evidence, the historical evidence of human activity and the biological interest of the area to achieve a wider understanding of the formation and the importance of the Broads landscape.
- Conserving features distinctive to the Broads that are highly rare and distinctive in a national context, including early brickwork, reed thatch, round church towers, windmills and the traditional riverside buildings, boatyards and other waterfront industry (and views to them) that often have a strong visual impact in the landscape.

The golden sand shoreline at Waxham with coastal defence structures and backed by dunes.

Additional opportunity

1: Encourage measures that lead to the enhancement of existing settlements and new developments providing more widely associated social and cultural benefits through the provision and management of high-quality green infrastructure networks.

For example, by:

- Conserving and appropriately managing the area's sense of place within the built environment and using this understanding, and the area's distinct patterns of settlement, to plan for and inspire new development.
- Ensuring that high-quality green infrastructure is considered in all new building projects, encouraging developers and planners to consider this aspect at the outset of scheme design with the aim of promoting space for wildlife and outdoor recreation.
- Promoting the use of traditional building materials such as flint, pebble and brick, and reed thatch in building restoration or new development, where this would be appropriate, to enhance the character of the local area.
- Supporting the use of historic and landscape characterisations to inform change, and encouraging their use in community-based planning to help to identify locally valued townscapes, rural landscapes and heritage assets.
- Establishing a planning and design approach that enables appropriate sustainable development within the Broads flood plain, including use of experimental and innovative techniques (for example, floating buildings) while maintaining the high levels of tranquillity associated with much of the area, especially where there is currently little settlement or infrastructure intrusion.
- Investigating ways of securing better management of heritage assets that contribute to the character of the area, particularly those that have been identified as 'heritage at risk'.

Supporting document 1: Key facts and data

Total area: 56,290 ha

1. Landscape and nature conservation designations

The Broads NCA contains 29,246 ha, or 52 per cent of the area, is land managed under the Norfolk and Suffolk Broads Act (1988) and is equivalent to a national park. The area contains 1,694 ha of the Norfolk Coast Area of Outstanding Natural Beauty (AONB), 3 per cent of the NCA.

Management plans for the protected landscape can be found at:

- www.broads-authority.gov.uk/
- www.norfolkcoastaonb.org.uk

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	Broadland Breydon Water	6,243	11
European	Special Protection Area (SPA)	Broadland Breydon Water SPA; Great Yarmouth SPA; North Denes SPA	6,256	11
	Special Area of Conservation (SAC)	The Broads SAC; Winterton-Horsey Dunes SAC	6,208	11
National	National Nature Reserve (NNR)	Mid Yare NNR; Hickling Broad NNR; Bure Marshes NNR; Ant Broads and Marshes NNR; How Hill NNR; Ludham & Potter NNR; Heigham Marshes NNR; Winterton Dunes NNR; Martham Broad NNR; Calthorpe Broad NNR.	2,410	4
National	Site of Special Scientific Interest (SSSI)	A total of 32 sites wholly or partly within the NCA	6,969	12

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.

Land covered by international nature conservation designations (SPAs SAC and Ramsar) totals 6,959 ha, or 12 per cent of the total land area. Land covered by national nature conservation designations (NNR and SSSI) totals approximately 7,000 ha.

There are 103 local sites in The Broads covering 1,624 ha or 3 per cent of the NCA.

Source: Natural England (2011)

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

1.1.1 Condition of designated sites

Condition category	Area (ha)	Percentage of SSSI land in category condition
Unfavourable declining	257	4
Favourable	2,632	38
Unfavourable no change	1,662	24
Unfavourable recovering	2,418	35

Source: Natural England (March 2011)

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

Postwick Marshes in the Yare Valley contain many historical sites including an early Saxon-aged round house.

2. Landform, geology and soils

2.1 Elevation

Elevation in the NCA ranges from - 0.2 m below sea level to a maximum of 48 m above sea level. The average elevation of the landscape is 5 m.

Source: Natural England 2010

2.2 Landform and process

The dominant landform features inland are wide valleys with open water (broads), fens and marshes, sloping valley sides with low relief, and the former estuary, saltmarsh and mudflats of Breydon Water. On the coast, the landforms range from; a narrow beach backed by dunes at Winterton-on-Sea; to a maintained coast through the Horsey Gap; and low elevation, soft sediment cliffs at Happisburgh that consist sometimes of ice-laid material and sometimes of Late Tertiary sands, muds and gravels. When attacked by waves these soft cliffs slump and slide onto the beach before being washed away.

The dominant natural processes are lacustrine processes in the broads including sediment deposition, estuarine processes and fluvial processes (both erosion and deposition) in the river valleys. All are affected by man-made processes, for example generated by river engineering and craft.

The coast experiences both mass movements and erosion of the soft clayey sediment cliffs, as well as sediment reworking along shore and aeolian processes in the dune systems at Winterton-on-Sea. The coast is also affected by manmade processes, namely onshore and offshore coastal defences and maintenance, in the area from Happisburgh through Sea Palling to Horsey.

The low elevation and relief valley sides have low potential energy for mass movement and slope processes; however, the soils and bedrock are soft and easily eroded. Within the river valleys peat formation and development of alluvium takes place where natural processes and habitats are maintained.

Source: The Broads Natural Area Profile, The Broads Countryside Character Area Description

2.3 Bedrock geology

The underlying geology of the area is a chalk basin filled with Crag and other Quaternary deposits. The Broads character area is dominated by shelly, muddy and sandy sediments known as 'Crag' (Norwich Crag and Wroxham Crag), which was deposited over a long period of time in shallow marine or estuarine waters, in cool or temperate climates in the late Tertiary and the early Quaternary.

Source: The Broads Natural Area Profile, The Broads Countryside Character Area Description

2.4 Superficial deposits

Major rivers flowed into the crag basin in the early Pleistocene, as shown by large deposits of sand and gravel, and far travelled material and land fossils within the crag. The Bytham River (an ancient river in Pleistocene Britain) was once one of the largest rivers in England, draining the Midlands and East Anglia. Its deposits can be traced from the Midlands into this NCA at Leet Hill near Beccles. The effects of the Quaternary glaciations, including the largest glaciation called the Anglian, 450,000 years ago, are shown by the existence of substantial quantities of outwash gravels and till, derived from Northern Britain and the North Sea basin, and deposited on land. Since the end of the last ice age the climate has continued to oscillate with varying sequences of peats forming in times of climatic amelioration.

Source: The Broads Natural Area Profile, The Broads Countryside Character Area Description

2.5 Designated geological sites

Tier	Designation	Number
National	Geological Site of Special Scientific Interest (SSSI)	3
National	Mixed interest SSSI	1
Local	Local Geological Site	2

Geological exposures are found along eroding sections of the coast and in active and disused extraction sites, for example, the disused gravel and sand pits at Bramerton Pits SSSI and the active workings Leet Hill SSSI. Bramerton Pits SSSI is critical to the interpretation of the Crag deposits of the NCA and region. It is the reference (type) locality for the temperate Norwich Crag and contains a marine and unique vertebrate fossil fauna.

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

Much of the NCA is underlain by peat, loamy and clayey flood plain soils with naturally high groundwater. These soils are moderately fertile and where sufficiently well-drained, support arable farming and grazing. The river valleys contain peaty often waterlogged soils. The valley margins in the north of the NCA have freely draining slightly acid loamy soils of low fertility. The soils in the south comprise acid loamy and clayey soils of moderate-high fertility. Grade 1 agricultural land is located in the northern half of the NCA towards the coast. Grade 2 agricultural land is mainly associated with the northern area of the NCA although some small pockets are associated with the higher ground in the upper reaches of the River Yare towards Norwich and south of the River Waveney. Grade 3 agricultural land is distributed through the majority of the NCA particularly the Halvergate 'triangle' and throughout the river valleys. Generally consisting of coastal and flood plain grazing marsh. Grade 4 agricultural land is located in the upper valleys of the rivers Waveney, Yare and Chet with a very few small isolated pockets in the north of the NCA.

Source: Natural England (2010), The Broads Natural Area Profile, The Broads Countryside Character Area Description

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

Agricultural Land Classification	Area (ha)	Percentage of NCA
Grade 1	6,004	10
Grade 2	7,701	13
Grade 3	31,078	55
Grade 4	3,036	5
Grade 5	0	0
Non-agricultural	6,795	12
Urban	1,676	3

Source: Natural England (2010)

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

3. Key waterbodies 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 Bure	59
River Waveney	12
River Ant	11
River Thurne	9
Hundred Stream	3
River Chet	1
River Yare	<1

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.

The tidal rivers and the tributaries of the Bure, Yare, and Waveney, together with the Wensum, drain almost two thirds of Norfolk and much of Suffolk into the North Sea. These plus the 43 broads in the character area form an area of 3,642 ha of open water. The slow flowing rivers are fed predominantly by calcium rich waters originating from the underlying chalky boulder clay.

The broads are extensive areas of open water; wet, low-lying complexes of flooded former peat workings of various form and size. Some are located in the principal river valleys, particularly those of the rivers Ant and Bure) while others are in the minor tributary valleys generally near to where these tributaries meet the main rivers.

The Broads rivers are far from natural. They have been considerably widened and deepened for navigation purposes, many of the reedswamp and saltmarsh margins have eroded, meanders have been removed and the river Thurne has undergone a flow reversal.

For much of their length the upper parts of the rivers are embanked narrow channels of fresh water, subject to tidal flooding. They sit above the level of the surrounding land which is drained by a network of drains and ditches (known locally as dykes), minor foot drains and pumps as well as numerous sinuous channels derived from natural creeks.

Breydon Water is the inland tidal estuary of the River Yare and its confluence with the rivers Bure and Waveney. The tidal reaches of the rivers are extensive, reaching as far upstream as Norwich, Wroxham, Martham and Lodden. The southern reaches of the River Waveney are adjacent to Oulton Broad estuary.

The estuary of Oulton Broad extends from the River Waveney, where it is adjacent to Breydon water and flows into the North Sea at Lowestoft. The estuary receives little tidal influence from the River Waveney. Much of the estuary is sub-tidal. The intertidal flats of the lower reaches of the estuary, known as Lake Lothing, were claimed many years ago. The upper reaches of the estuary are a narrow dyke which widens at Oulton Broad.

3.2 Water quality

The total area of Nitrate Vulnerable Zone is 47,060 hectares, or 84 per cent of the NCA.

Source: Natural England (2010)

3.3 Water Framework Directive

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

4. Trees and woodlands

4.1 Total woodland cover

This NCA contains 5,517 ha of woodland, 10 per cent of the total area of which 51 ha is ancient woodland (where woodland is over 2 ha in size). One third of the woodland has developed within the last 50 years.

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

4.2 Distribution and size of woodland and trees in the landscape

The areas of drained coastal and flood plain grazing marsh are an open landscape with limited tree cover.

Blocks of broadleaved deciduous woodland, hedgerows, copses and plantations are present on higher land in the upper reaches of the valleys giving an intimate pastoral character. Historically they accompany the village settlements and isolated farms and provided shelter as well as a supply of fuel, implements and building materials.

Flood plain wet woodland is mostly semi-natural carr woodland, dominated by alder, sallow and birch, with shrubs such as guelder rose, buckthorn, dog rose and brambles, rather than plantation. There are some small areas of poplar and withy beds and other stands of willow including cricket-bat willow plantations. These were managed as a resource for many centuries although have largely proved commercially unviable and are now, over-mature and form characteristic features of the wetland landscape.

The most valuable areas of carr woodland in the Broads are those which are mature, rather than former fen areas which have been neglected and turned to scrub. Over time, these neglected areas have the potential to age and develop into mature carr. Mature carr woodland is a largely undisturbed wilderness; a tangle of woody species, shade-tolerant herbs and lower growing plants.

In areas dominated by arable and particularly in the lower river reaches semi-natural woodland tends to be confined to the valley margins. In the middle and upper reaches of the valleys it occurs on the flood plain.

Willow pollards are typical of the wetter areas, such as the undrained peat fen and are particularly associated with roadsides.

Source: The Broads Natural Area Profile, The Broads Countryside Character Area description

4.3 Woodland types

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

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

Woodland type	Area (ha)	Percentage of NCA
Broadleaved	5,009	9
Coniferous	381	1
Mixed	47	<1
Other	80	<1

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

Area and proportion of ancient woodland and planted ancient woodland sites (PAWS) within the NCA:

Woodland type	Area (ha)	Percentage of NCA
Ancient semi-natural woodland	40	<1
Ancient re-planted woodland (PAWS)	12	<1

Source: Natural England (2004)

5. Boundary features and patterns

5.1 Boundary features

There are few fences as reed-fringed dykes and ditches divide fields in a rectilinear pattern. Mature thick hedgerows and rows of dense trees bounding small-scale fields are present in the upper reaches of the valleys. Pollard willows along roadsides are characteristic features. Widespread field boundary loss has occurred in the late 20th century, locally severe in the area north of Horning, in the Waveney Valley near Gillingham, and on the higher land to the north. In the open valleys nearer the coast river flood embankments, which are above the level of the surrounding land, form strong landscape elements. The open grazing marsh is on its fringes loosely contained by wet woodland containing alder and pollarded willows.

Source: The Broads Countryside Character Area description; Countryside Quality Counts (2003)

5.2 Field patterns

Field patterns are principally defined by drainage ditches, with a mixture of earlier curvilinear enclosure of marshland following the line of natural creeks. These survive along the middle Bure and Hundred Stream to the north, and the middle Yare and upper Waveney. Later planned rectilinear forms are mainly associated with the parliamentary enclosures of late the 18th and early 19th centuries and some 20th century enclosure. These drained rectilinear enclosures dominate the angle between the confluence of the Bure and Yare to the south. There is also some earlier, 16th to 18th century, enclosure present in the river valley broads area. The upper reaches of the enclosed river valleys contain small-scale fields. A mix of arable and pasture divided by a rectilinear framework of dykes and ditches and extensive areas of remote grazing marsh are present in the open valleys near to the coast.

Source: The Broads 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

The agriculture of the area is based on a long history of lowland livestock grazing interspersed with arable cropping. The agricultural landscape is dominated by pasture; drained grazing marsh and improved grass leys or pastures in the upper reaches of valleys. Arable cultivation creates areas of uniform texture and colour in this traditional pastoral landscape. Just less than three quarters, 73 per cent, of the open country is in agricultural use. In 2009 the total farmed area was 41,244 ha. This was comprised of a total of 469 holdings.

Source: Agricultural Census, Defra (2010)

6.2 Farm size

Farms in the largest size bracket (over 100 ha) are the most numerous accounting for 125 holdings, or 27 per cent, alongside farms in the size bracket 5 to 20 ha which account for 123 holdings, or 26 per cent. Overall, holdings over 100 ha make up 78 per cent of the total farmed area, compared to those under 5 ha which cover only 0.2 per cent of the farmed area. The trends in 'farm type', between 2000 and 2009 indicate a decrease in the number of smaller holdings, 27 per cent in farms less than 5 ha (95 to 69 holdings) and 7 per cent in farms between 5 and 20 ha. The largest size bracket (over 100 ha) also saw a decrease from 131 to 125 holdings, a 5 per cent decrease.

Source: Agricultural Census, Defra (2010)

6.3 Farm ownership

2009: Total farm area = 41,244 ha; owned land = 32,659 ha.
2000: Total farm area = 42,128 ha; owned land = 32,501 ha.

Seventy-nine per cent of the total farmed area is owner occupied, accounting for 607 holdings. There has been a general decrease in the number of owner occupied holdings since 2000 from 670 to 607, a 10 per cent decrease. Tenanted holdings have increased over the same period from 43 to 58 holdings, a 35 per cent increase.

Source: Agricultural Census, Defra (2010)

6.4 Land use

The dominant land use is cereals, accounting for 14,659 ha or (36 per cent of the total area farmed. This is followed by grassland including uncropped land, accounting for 14,325 ha or 35 per cent, and then by cash root crops covering 5,054 ha or 12 per cent of the area. Grassland and uncropped land is mainly found in the valley floors and cereals mainly on the higher ground. Between 2000 and 2009 there was a 28 per cent decrease in the area of land used for growing cash root crops, which has reduced by 1,394 ha. There was also a decrease in the area of land used for cereals, down by 180 ha. Grassland including uncropped land remained static with a small reduction of 74 ha. Land use for oil seed has increased by 415 ha or 48 per cent and glasshouses by 51 ha or 96 per cent.

Source: Agricultural Census, Defra (2010)

6.5 Livestock numbers

Pigs and cattle are the most numerous livestock within this landscape. There were a total of 18,200 pigs and 17,800 cattle in 2009. Sheep are the next most numerous with around 12,000 animals. Livestock numbers, which increased significantly during the 1990s, have been in decline within the NCA over recent years. Sheep numbers have decreased by 44 per cent or 9,600 animals, during the period from 2000 to 2009. Total pig numbers have significantly decreased, by 60 per cent or 27,200 animals, and cattle numbers have fallen by 20 per cent or 4,400 animals.

Source: Agricultural Census, Defra (2010)

6.6 Farm labour

Trends from 2000 to 2009 show a 9 per cent decrease in farm holders (principle farmers their spouses and business partners) whereas the number of salaried farm managers increased by 35 per cent. There has been a 31 per cent decrease in full-time farm workers while the numbers of part-time workers have remained static. Casual workers have increased significantly in the NCA by 206 per cent from 231 to 706 workers.

Source: Agricultural Census, Defra (2010)

Please note: (i) Some of the Census data are estimated by Defra so may not present a precise assessment of agriculture within this area (ii) Data refers to Commercial Holdings only (iii) Data includes land outside of the NCA where it belongs to holdings whose centre point is recorded as being within the NCA.

Arable farming is a important component of the Broadland landscape.

7. Key habitats and species

7.1 Habitat distribution/coverage

The Broads is the UK's largest protected wetland and an inland waterway, comprising a range of habitats, sometimes occurring as a wetland mosaic, that provide home for some of the rarest flora and fauna in the UK.

Open water, rivers and broads: A number of the broads and rivers are internationally important and support rich aquatic plant communities are dependent on good quality water. The critical importance of The Broads is illustrated by the presence of the aquatic plant; holly-leaved naiad as this is the only NCA in England where this plant occurs. All but one of the seven broads and rivers that support important plant assemblages, including an impressive community of stoneworts, lie within the Upper Thurne catchment; Heigham Sound, Hickling Broad, Horsey Mere, Martham South, Martham North and Blackfleet Broad. Important assemblages also occurs in Upton Broad situated in the Bure valley. Valued plant communities have also developed in the Trinity Broads system as well as Cockshoot Broad since its isolation and restoration. These open water habitats are of international importance for otters, occurring in high densities and across most of the watercourses. Within The Broads NCA there are two national key sites for water voles at Hickling Broad and Bure Marshes, where there are large numbers of viable breeding populations. Within 7 km of The Broads there is an internationally important site for barbastelle bats; the network of linear features and wetland habitats present within the NCA provide excellent foraging opportunities for these protected mammals.

Lowland fen, reedbed and purple moor-grass/rush pasture: The Broads NCA contains the largest expanse of species-rich fen in lowland England. The internationally important areas of purple moor-grass and rush pasture occur at several locations across the NCA, including on the Ludham to Potter Heigham marshes and the Bure marshes. The largest areas of lowland fen are found in the Upper Thurne, River Ant valley and Alderfen Broad area. These botanical communities can be found in areas known locally as 'ronds' which are strips of land that are found between the river bank and flood embankment, which can be periodically subject to inundation by freshwater or brackish water. Reedbeds are found in many areas across the NCA, with the most extensive expanses at Halvergate Marshes, the Upper Thurne area and the Bure Marshes, supporting an assemblage of birds including bittern. These habitats can occur in a dynamic mosaic, are heavily influenced by both management and hydrological regimes and hold critically important populations of a wide range of vascular plants, for example, fen orchid and milk parsley. Milk parsley is the sole larval food plant for the British sub-species of the swallowtail butterfly and The Broads NCA is the only location in the UK where this species can be found.

Flood plain scrub, carr woodland and wet woodland: The Broads contain large areas of flood plain scrub and wet woodland. This represents the largest area of floating forest and wet woodland in Britain and, along with other habitats, is of critical importance for crested buckler fern. The scrub and woodland habitat occurs mainly on the flood plain in the middle and upper reaches of the valleys; however, in the lower river reaches, it is confined to the valley margins, in the areas dominated by arable or grazed marshes.

Coastal and flood plain grazing marsh: The Broads NCA contains one of the largest area of coastal and flood plain grazing marshes in Britain (12,288 ha). These marshes range from brackish to freshwater along each river valley and across some of the marsh levels. A nationally important assemblage of breeding waders, including lapwing is associated with this wet grassland system. With the network of drainage ditches, these areas are also of significance for tubular water-dropwort. Wintering waterbirds occur in internationally important numbers, including Bewick's swan and gadwall. Although freshwater conditions predominate, there is a strong saline influence on the marshes associated with the lower valleys and the Upper Thurne. Saline grassland communities of national importance, including significant populations of sea barley and slender hare's ear are restricted to the marshes adjacent to Breydon Water.

Ditches and dykes: There is an extensive network of drainage ditches and dykes across the fen and grassland habitats that support species-rich and internationally important aquatic plant communities some of which have been lost from the broads. This NCA represents an area of critical importance for greater water parsnip, sharp-leaved pondweed and water soldier. Water soldier is of particular relevance for a rare dragonfly found in The Broads; the Norfolk hawker. Although the relationship between this aquatic plant and the dragonfly is not completely understood, female hawkers almost exclusively use this plant for egg laying. Along with the open water and fen habitats, the ditch network is of importance for a number of rare and threatened molluscs including the shining ram's horn snail.

Intertidal mudflats and coastal saltmarsh: Breydon Water is an embanked relic estuary at the mouth of the rivers Yare, Bure and Waveney. It is the only tidal mudflat on the east coast of Norfolk and covers an area of approximately 500 ha and includes saltmarsh and brackish marsh. Saltmarsh, both on the estuary and the ronds, makes up an estimated 20 ha of this area. This is an area of international importance for wintering waterbirds, with a high tide roost towards the northern end, which includes golden plover and avocet.

Coastal sand dunes: The low-lying coastal strip between Eccles and Winterton in the north-east of the NCA is fronted by a dune ridge with three internationally important dune habitats present; embryonic shifting dunes, dune slacks, and coastal dune heaths, representing the most easterly dune heaths in the UK. The dunes are also an important geodiversity feature illustrating dynamic aeolian sedimentation. The wider southern section demonstrates a sequence from mobile fore-dunes to fixed dunes including wet dune slacks with freshwater pools, dry dune heath and birch scrub. In the northern section, the coastal strip consists of a single line of dunes backed by scrub. The shallow pools provide suitably warm water for breeding natterjack toad and this is a nationally important area for this species. The coastal strip between Winterton and Horsey is also part of an internationally important site for breeding little tern. The mobile foreshore is also used as a haul-out area for common and grey seals both species of international importance.

Lowland heathland: Wet heath communities of national importance are limited in extent and are almost all confined to fen margins along the rivers Ant and Thurne and the coastal strip between Horsey and Winterton. Some areas of fragmented dry heath also remain, predominantly in the Upper Ant valley, fringing the Waveney valley and along the coastal strip.

Lowland mixed deciduous woodland: A small amount of broadleaved lowland deciduous woodland is present on higher land in the upper reaches of the valleys. In the Winterton-on-Sea area oak-birch scrub and woodland, invaded by rhododendron, is also present.

Source: The Broads Natural Area Profile

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 flood plain grazing marsh	11,563	21
Reedbeds	6,277	11
Fens	4,116	7
Broadleaved mixed and yew woodland (broad habitat)	1,410	2
Purple moor grass and rush pasture	1,153	2
Lowland meadows	866	2
Coastal sand dunes	297	1
Lowland dry acid grassland	189	<1
Lowland heathland	55	<1
Maritime cliff and slope	11	<1
Mudflats	8	<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 marshes are traditionally unsettled aside from isolated marsh farm sites, principally of late 18th and 19th century date, and drainage mill complexes along the main watercourses. Farmsteads are dotted around the edge of the marshes and timber chalets line some of the rivers in the north of the NCA.

The pattern of settlement away from the marshes is linear as well as clustered with a mixture of small towns, nucleated villages/hamlets and many individual farms.

Great Yarmouth, Lowestoft and Norwich mark the east and west boundaries of The Broads with Norwich being the cultural and economic centre of Norfolk (not in the NCA). Great Yarmouth and Lowestoft both have a long history as important sea ports. There influence on the hinterland, however, lies within the coastal area rather than the broads.

Beccles, on the southern edge of this area, as a market town has closer affinities with the arable claylands, but also has a riverside aspect characteristic of the Broads. It was formerly a Saxon herring port.

Wroxham is the centre of the boat-based tourism in the character area.

Source: The Broads Countryside Character Area description; Countryside Quality Counts (2003)

8.2 Main settlements

The main settlements within The Broads are; Norwich (eastern edge), Lowestoft (western edge), Beccles and Bungay. The total estimated population for this NCA (derived from ONS 2001 census data) is: 86,203.

Source: The Broads Countryside Character Area description; Countryside Quality Counts (2003)

8.3 Local vernacular and building materials

The Broads does not have a particularly distinctive building material, although tradition building materials do include flint, pebble and brick, often topped with dark, dense and flat reed thatch. Reed thatching is a distinctive roofing material of the area and one of the major cohesive factors in the local vernacular. Dutch and Flemish architectural influences in brick and pantile are common, especially in the larger towns such as Beccles on the southern edge of The Broads.

Source: The Broads Countryside Character Area description; Countryside Quality Counts (2003)

9. Key historic sites and features

9.1 Origin of historic features

Settlement is known from the Neolithic period on localised raised areas of the flood plain.

Romano-British settlement may have been extensive, as seen in the ruins of Burgh Castle, a Saxon Shore fort stand at the mouth of the Waveney.

A cluster of Saxo-Norman churches along the Yare and Waveney are a legacy of settlement along the upper valleys of these rivers. Many of these possess round towers characteristic of the region's early medieval ecclesiastical architecture.

Drainage has provided the key to successful agriculture over several centuries and the structures related to this process – raised and embanked rivers, wind pumps and later diesel and electric pumping stations – are important aspects of the marshland character.

The pattern of the broads themselves is a consequence of historical activity as they are largely an artificial construct; the result of the extraction of peat for fuel from the medieval period to the 19th century. The associated boatyards and other features related to the traditional life of The Broads and the early history of recreation are evident throughout the area.

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

9.2 Designated historic assets

This NCA has the following historic designations:

- 6 Registered Parks and Gardens covering 334 ha.
- No Registered Battlefields.
- 37 Scheduled Monuments.
- 1,228 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

- Five per cent of the NCA 3,073 ha is classified as being publically accessible.
- There are 565 km of public rights of way at a density of 1 km per km2.
- There are no national trails within the NCA.

Sources: Natural England (2010)

The following table 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	167	<1
Country parks	162	<1
CROW Access Land (Section 4 and 16)	311	<1
CROW Section 15	115	<1
Village greens	6	<1
Doorstep greens	<1	<1
Forestry Commission Walkers Welcome Grants	152	<1
Local Nature Reserves (LNR)	76	<1
Millennium greens	0	0
Accessible National Nature Reserves (NNR)	2,280	4
Agri-environment Scheme Access	9	<1
Woods for People	850	2

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) it appears that the lowest scores for tranquillity are at the boundaries of the NCA close to the urban centres of Lowestoft, Great Yarmouth and Caister-on-Sea on the coast and Norwich inland. The highest scores for tranquillity are within the marsh area of the Halvergate triangle, along the coast between Happisburgh and Winterton-on-Sea as well as through the river valleys of the Bure and Yare.

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

Tranquillity	Score
Highest value within NCA	149
Lowest value within NCA	-141
Mean value within NCA	8

Sources: CPRE (2006)

- More information is available at the following address: **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. This shows a similar pattern to the Tranquillity Map, with areas of disturbed land associated with the urban areas of Lowestoft, Great Yarmouth, Caister-on-Sea and Norwich together with the smaller rural towns such as Beccles and Bungay. Other areas of disturbance can be seen to be associated with the main transport routes linking these centres; the A47, A12 and the A149. There is also some disturbance along the rivers and broads most probably due to the prevalence of motorised pleasure boats particularly throughout the summer months.

Intrusion category	1960s (%)	1990s (%)	2007 (%)	Percentage change (1960s-2007)
Disturbed	9	29	39	30
Undisturbed	89	68	57	-33
Urban	2	2	4	2

Sources: CPRE (2007)

Notable trends from the 1960s to 2007 are an increase in disturbed or intruded land by nearly 30 per cent, which is matched by a reduction of around 33 per cent of undisturbed or un-intruded land over the same timescale.

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

Sailing on the River Yare.

12. Data sources

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

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

Supporting document 2: Landscape change

Recent changes

Trees and woodlands

- At the end of 1998 young trees approved for planting under a Woodland Grant Scheme agreement accounted for about 1 per cent of the mature woodland stock. Between 1999 and 2003 an area equivalent to 1 per cent of the 1999 total stock was approved for new planting under a Woodland Grant Scheme agreement (58 hectares). The limited area of new planting, suggests that the existing character has largely been retained. In 1999 about 10 per cent of the established eligible National Inventory of Woodland and Trees woodland stock was covered by a Woodland Grant Scheme management agreement. In 2003 the proportion of established, eligible National Inventory of Woodland and Trees woodland stock was about 7 per cent.

- There has been a small decline in copses, woodland and willow pollards through the lack of woodland management although some alder is re-coppiced, providing straight poles for piling to give a more natural edge to river bank restoration.

- Scrub woodland has also encroached on some areas of the NCAs peat resource.

- There is potential for creation of new woodland in some parts of the Broads, where the underlying geology and soils supports this and where this does not compromise other, more ecologically valuable habitat, or result in the loss of upland flood plain transitions.

Boundary features

- Agricultural intensification has in some places resulted in the loss and damage to hedged field boundaries in the upper valleys and tops. Gappy hedgerow boundaries weaken the traditional pastoral landscape character of this area of the Broads, which is known for its thick mature hedgerows, with dense rows of trees.

- Widespread field boundary loss has occurred in parts of the Waveney Valley and on the higher land to the north, although the removal of hedgerows has largely ceased and hedgerow replanting and management under Environmental Stewardship is increasing.

- The rectilinear framework of ditches and dykes that divides the small fields in the river valleys and the grazing marsh within the lower flood plain has remain largely undisturbed.

- Between 1999-2003 Countryside Stewardship agreements for linear features included fencing (2 km), hedge management (8 km), hedge planting and restoration (33 km) (data refers to land within the Environmentally Sensitive Area). The extent of agreements for re-profiled/reinstalled dykes and ditches was 60 km, and new/restored foot drains was 8km.

- The estimated boundary length for the NCA is about 1,929 km. The total length included in management agreements between 1999 and 2003 is equivalent to about 17per cent of this total.

- The length of hedgerows in Environmental Stewardship boundary management in 2011 was 444 km, with 0.8 km of woodland, 118 km of ditch, 263 km of ditches and 12 km of earth-bank.

Agriculture

- Marshland was mainly brought into arable management during the 1970s, but since the early 1990s a trend to arable reversion has been underway, driven by agri-environment schemes. For this trend to continue, these schemes need to be maintained.

- Between 2000 and 2009 there has been a 28 per cent decrease in the area of land used for growing cash root crops which has reduced by 1,394 hectares. There has also been a decrease in the area of land used for cereals, down by 180 hectares. Over this period of time the hectares of grassland has remained static.

- Livestock numbers have decreased significantly during the last decade as have dairy herds.

- Poultry units are common and there has been an increased use of flood plain land for free range-poultry, as seen at Waxham.

- The lighter, free-draining soils are attractive to outdoor pig producers and these are often let out to producers as part of an arable rotation. This practice has seen an increase of 31 specialist pig farm holdings in the period between 2000 and 2009. Intensive indoor and outdoor poultry rearing has also increased although overall pig numbers decreased by 60 per cent (an estimated 27,200 animals).

- In general livestock numbers which increased significantly during the 1990s significantly declined from 2000 to 2009. Sheep numbers have decreased by 44 per cent (9,600 animals), pig numbers decreased (as above) and cattle numbers fell by 20 per cent (4,400 animals).

- Land use for oil seed has increased by 415 hectares (48 per cent) and the small specialist area of crops grown in glasshouses has increased by 51 hectares (96 per cent).

Looking across the dyke at Rockland Broad to grazing pasture and wet woodland.

Settlement and development

- Development pressure has generally been low over the last decade, but there have been some locally significant developments such as close to Bungay and Kirby Row in the south, and a more general pattern of development and redevelopment in the hinterland of Great Yarmouth, Lowestoft and the peripheries of Norwich. Overall character has probably been maintained due to the low levels of development.

- Increased light pollution from major roads and conurbations detracts from the Broadland character.

- Tourist pressure on the Broadland villages has affected settlement character. The cumulative impact of permitted development in villages has also had a significant impact.

- Increased development and the popularity of the Broads as a visitor destination has resulted in negative impacts on the quality and quantity of water in the rivers and broads due to increases in pollution discharges into the river system and increased water usage.

- Recreational pressures from increased numbers of people using the Broads has had some detrimental effects on the sensitive habitats, for example the increased use of the few fragmented heathland sites in the area which have been popular for camping and golf course development.

- Although road congestion is not a significant problem in the Broads compared to other areas of Norfolk, a 2003 survey showed that 94 per cent of visitors to the Broads arrive by private car. This combined with the limited number of road river crossings means that there can be seasonal congestion particularly in and around 'honey pot' areas, resulting in increased pressure on the area in terms of demands for visitor attractions, accommodation, road space and parking. Transport monitoring data for targeted 'A' roads in the Broads area shows average growth in traffic per annum of 0.5 per cent over the five-year period to 2009, compared with 0.4 per cent for Norfolk as a whole.

Semi-natural habitat

- Half of the SSSI area is in favourable condition or recovering with 38 per cent classified as favourable and 35 per cent unfavourable but recovering.

- There has been an increase in conservation projects such as at Buttle Marsh that have taken land out of arable cultivation to reinstate wetland habitat, including reedbed, fen and marsh. This has benefited species including the swallowtail butterfly, bearded tit, otter, water vole and bittern.

- Fen restoration and management has taken place using novel techniques such as the fen harvester that has enabled large areas of wetland habitat to be enhanced for biodiversity.

- Non native species colonisation of the Broads with species such as mink which predates on water vole, signal crayfish which spreads disease to native white-clawed crayfish as well as non-native wetland plants including New Zealand pigmy weed, floating pennywort, parrot's feather and Himalayan balsam have been on the increase over recent years. A programme of works is being developed and implemented as part of the Norfolk Non-native Species Initiative to reduce the threats posed by non-native species colonisation.

- Along the coast artificial coastal defence offshore reefs and revetments are a feature. The reefs have rapidly developed a rocky-shore type habitat and the diversity of marine and intertidal habitat has been increased as a result of their presence. The new substrates have created more sheltered conditions than would ordinarily be found on open coast. Rocky shore type habitats are not native to this coast and while they have delivered some benefits, they also have impacts on geomorphology and the operation of active processes, therefore their creation should not be considered entirely beneficial to nature conservation.

Historic features

- The last Countryside Quality Counts assessed the overall Broads Character Area as 'enhancing', meaning that the landscape is changing in a way that is consistent with the vision for the area. For the 'historic features' theme, however, the Broads is assessed as 'neglected', with a gradual erosion of its historical assets and of the quality and distinctiveness of the built environment.

- The 2009 assets survey identified 272 listed buildings, 18 per cent of which are in a poor state and classified as being 'at risk', and over 70 surviving drainage mills – one of the iconic cultural features of the Broads landscape. Since 2011 good progress has been made in reducing the numbers buildings at risk through targeted conservation efforts.

Coast and rivers

- Water quality in parts of the Broads has improved markedly in recent decades, helped by improvements and new initiatives in sewage treatment, adoption of agri-environment practices and work with the boating industry. Water companies' forward plans are committed to continuing investment in protecting the most important habitats and species and encouraging biodiversity.

- Years of accumulated sediment in the rivers and broads has arisen from soil eroded from ploughed land, run-off from hard surfacing, bank erosion and leaf fall. These have resulted in broads and rivers becoming shallower as well as the sediment bringing nutrients from farmland, and pollutants

The Grade I Listed Waxham Great Barn which was built in the last quarter of the 16th century. Flint with brick dressings and thatching.

form roads and developed areas. A strategy of sediment removal (mud pumping) and a programme of large scale broad restoration by removal of sediment and development of bio manipulation techniques combined with phosphate stripping from main sewage works have led to the recovery of freshwater communities teeming with life. There are though continuing nutrient enrichment issues in grazing marsh ditch systems.

- Water quality has also improved through measures implemented under agri-environment schemes that have encouraged the implementation of vegetated buffer zones alongside watercourses and the reinstatement of river valley and flood plain grassland.

- Flood alleviation has has seen major change on landscape since 2001 – with the Broads Flood Alieviation Scheme setting back many of the floodbanks leading to, wider banks and wide soke dykes with increased reed ronds.

- The number of powered craft needed to satisfy tourist demand for boating holidays has lead to congestion, direct pollution and physical damage to the waterways. Bank erosion is a by-product of increased boat activity and is exacerbated by the effects of nutrient enrichment on the fen and reedbed vegetation.

- Coastal hard flood defences have restricted the operation of active processes and led to a reduction in sediment supply from the cliffs and hence reduced beach levels down drift. Sediments are distributed by waves, tide and wind to the beaches, sand dunes and near shore and offshore bank systems. The relationships between the beaches and the near shore bank systems are currently the subject of ongoing study.

- Salinity is reaching higher levels further up the waterways due to the frequency and length of tidal surge events, posing particular challenges for freshwater biodiversity.

- Increased water abstraction from groundwater supplies and rivers for public water supplies, agriculture and industry has lead to low river flows and groundwater supplies, increased incursion of saltwater and the drying out of fenland areas resulting in scrub communities taking hold.

Minerals

- Sand and gravel is and has been actively quarried on the margins of the Waveney and Yare valleys near Bungay and Norton Subcourse respectively. The existing Norton Subcourse quarry in Hales is a nationally important site for Pleistocene features (glacial, interglacial, pre-Anglian, including Palaeolithic archaeology) and there are proposals to extend this site providing a challenge as well as opportunity for geodiversity. Good-quality heathland restoration has taken place where the site has been restored. Further opportunities for restoration include acid grassland and woodland which could be beneficial ecologically. 3 geological SSSI's are also located within a quarry setting emphasising the importance of manmade sections to accessing and understanding the NCAs geological history.

Drivers of change

Climate change

- The biggest challenge to the Broads comes most probably from changes in sea level due to isostatic adjustment and global warming exacerbating this issue. The challenge is largely due to the fact that the area is predominantly flat and lies below sea level. Higher sea levels hold back water trying to drain from the rivers, which can cause flooding; if a combination of weather and high tides causes a surge, water pushes up the rivers, putting flood defences under threat.

- Higher sea levels along the north-east Norfolk coast will bring an increased risk of sea defences being overtopped or breached more often, with possible inundation and increasing incursion of saline water into the predominantly freshwater ecosystem. Increased tidal flooding of nutrient rich waters on to fens and ronds will result in wildlife communities of reduced variety.

- Flood risk following extreme weather events may affect river bank stability and habitats, particularly those that are vulnerable to the washing in of nutrients.

- The coastline is very exposed and this could mean that technically and economically it may become increasingly difficult to hold the present shoreline position in the longer term where this has been identified in the North-east Norfolk Shoreline Management Plan. Climate change will increase both sea levels and storm surge heights over the coming decades leading to further erosion and reshaping of sections of this dynamic coastline which will change and adapt over time. A range of coastal strategies including minimal and no active intervention are proposed for the majority of the coastline (between Happisburgh and Winterton-on-Sea) as the coast here has either never been defended or it has been shown to be not viable to continue to provide defence.[12] This provides valuable opportunities for geodiversity and active, dynamic processes.

- In the future coastal habitats along this coastline may become impossible to retain in their current position, even with continual re-nourishment, as they and other coastal habitats may become trapped between the increasing sea-level and coastal defences and hence lost as they are unable to roll back (coastal squeeze). The loss of coastal habitats in front of coastal defences will result in greater exposure of the structure to wave action.

- If the currently unprotected shoreline between Eccles and Happisburgh continues to erode at its current rate, the artificially protected stretch between Eccles and Winterton will become more prominent, and so block the sediment transfer from the north to the south. If the Eccles to Winterton shoreline is held beyond a certain time it is possible that it may never recover to reform as a natural dynamic system, which could accelerate erosion and compromise both defences and natural habitats to the south.

- Shoreline Management Plan policies will be key drivers for managing future coastal change – and managed change is likely to be more acceptable. There will be challenges in managing and responding to coastal change, working with partners and stakeholders will be vital.

[12] Kelling to Lowestoft Ness Shoreline Management Plan First Review Non Technical Summary, North Norfolk District Council et al (May 2010)

- Adapting to the effects of climate change may bring about increased opportunities to create new wetland habitats, improve grazing marsh quality and restore watermeadows, undertake flood plain planting of wet woodland, and restore the structure and function of the marshes and river channels.

- There may be limited opportunities in the Broads to recreate freshwater habitats as the area of suitable space declines; this will have to be elsewhere. However, there is significant scope within the Broads for the lower river valleys to support brackish, transition and inter-tidal habitats if this was agreed to be the right way forward.

- Salinity can be an issue in groundwater, especially in areas such as the Broads where the land is at or below sea level. Increasing drainage may even exacerbate saline incursion, which is likely to increase with sea level rise, reduced river flows at times of drought and the increase in storm surges.

- In the longer term, sea level rise will have an impact in reducing the accessibility upstream of low bridges. This may result in opportunities for scope to increase air draft or replace structures with swinging or lifting bridges.

- Freshwater availability for human use as well as for the ecology of the Broads will be a concern if water levels fluctuate under rising temperatures.

- Sustainable management of this unique and valuable landscape will depend upon recognising the inevitability of change and the need to create future landscapes as well as managing current ones. This may lead to opportunities to bring existing habitats and species into a healthy state and conserve them for the future by appropriate management, so that they have a greater resilience to climate change.

- A warmer climate may lead to changes in agriculture patterns and production with more resilience in crops and cropping patterns required, which may also lead to opportunities for the growing of new crops that are more suitable to the changing environment.

- Erosion and loss of peaty topsoils, as a result of reduced soil moisture and periods of drought leaving exposed ground, can be managed through appropriate land management although unseasonal high rainfall causing flash flooding, increased soil erosion and siltation rates and patterns may also be a product of a warming climate.

- The increased severity of storms and the associated intense rainfall may bring the threat of flooding from rainwater and damage to infrastructure. The installation of targeted buffers may be required to absorb land runoff.

- There may be a potential increased risk of damage to property and infrastructure caused by flooding events and differing patterns of wetting and drying could also impact on building foundations, although adapting to the effects of climate change may also bring about increased opportunities to introduce permeable surfaces in urban areas, helping to moderate flooding of agricultural land and wildlife sites.

- The area's geodiversity, archaeological and historic assets are also vulnerable to the impacts of sea level rise and climate change and to the

consequent changes in land use and land management. Their vulnerability and requirements in the face of these changes needs to be better understood and recorded to enhance their protection.

- Changes in the visual landscape and seascape character, including possible damage or loss of geological, archaeological and built heritage features may occur.
- There will most probably be changes in the distribution of habitats and species, with some net loss of native biodiversity and increasing pressure from invasive non-native species as well as the potential for the arrival of new diseases / invrtebrates as vectors of disease for livestock which could alter farming practices.
- As well as new detrimental pest species, some beneficial pollinators may prove more adaptable and successful in a changing climate.
- There is the potential for the loss of some drought intolerant species in areas that may become more prone to flooding.
- Changes in temperature will affect the timing of periodic phenomena such as flowering, breeding and migration, which are likely to affect species' populations and habitat composition.
- Wetter and warmer conditions will stimulate plant growth, which for semi-natural habitats such as fens, will require greater management to prevent incursion of scrub. This could also have implications for the conservation of geodiversity sites.
- A warmer climate may bring changes in tourism patterns and visitor numbers and new pressures on the development management process, as well as impacting on the landscape, geodiversity and biodiversity.

Artificial offshore reefs constructed since 2001 form coastal defences between Sea Palling and Waxham.

Other key drivers

- The Broads semi-natural habitats that are of national and international ecological importance contain many rare species some of which have population strong holds in the area. Conserving these habitats and species, along with the overall landscape character and historic legacy of the area, from the pressures of recreation and changing land management processes, will remain key concerns within the NCA.

- The need for food security may result in changing farming practices, which may impact on ecological habitats, networks and species, as well as landscape character. Agri-environment schemes provide opportunities to work with land managers to incorporate the Broads wetland habitats develop networks of linked habitats and enhance the character of the landscape. For example Catchment-Sensitive Farming can help reduce sediment loading through improved land management.

- A key issue is the proposed major housing and economic growth scenarios in surrounding NCAs, most notably those planned for the Greater Norwich Area, Great Yarmouth and Lowestoft in the constituent Local Development Frameworks. While growth is important for the region it could put pressures on the Broads water resources, water quality and the integrity of sensitive sites from resource demands,

- Potential growth in surrounding NCAs may increase the pressures from visitor numbers and increase the general disturbance of the area leading to an overall loss of tranquillity.

- Potential growth in surrounding NCAs may lead to benefits for the Broads, for example through an increase in the importance of the recreational and environmental value of its 'green heart' within the urban surround and the potential for green infrastructure funding.

- Settlement within the NCA itself is likely to be minimal, and marginal to the area (i.e. above the flood plain). The effects of development in neighbouring NCAs are likely to be indirect and centred on increased visitor pressure upon the recreational resource of the Broads and increased demand for water, which in turn may result in decreased water availability particularly for aquifer-fed fen sites, which include the internationally important Broads SAC sites.

- Development and tourist pressure may also take the form of conversion of redundant or uneconomic boatyards to residential accommodation, changing the character of these sites, and increasing Broads-based tourism and leisure activities, which will need to be carefully managed to avoid impact upon the sensitive wetland ecosystems of the Broads and the internationally important Broads SAC and SPA.

- Further development inside and within adjacent NCAs will further the decline in tranquillity that the area is noted for. Significant increases in road traffic (traffic levels are projected to increase by 30 per cent by 2015) and development close to the main centres of population (Norwich, Great Yarmouth and Acle) are likely to have a detrimental impact on tranquillity.

- Further impacts of population growth may arise through, for example increased discharge of phosphates and nitrates into rivers from Sewage Treatment Works and increases in acid deposition and air pollution the impacts of which on the fens could be great.

- New developments can provide opportunities to ensure a high standard of design and can make a contribution to green infrastructure increasing opportunities for people to access greenspace and countryside.

- The area is likely to remain attractive for recreation, with good access to nature along with opportunities for environmental education and understanding our heritage.

Wet woodland with a ground flora of ragged robin.

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.

The extensive open waters of Hickling Broad, formed by the flooding of former peat workings.

Statement of Environmental Opportunity	Ecosystem Service																	
	Food provision	Timber provision	Water availability	Genetic diversity	Biomass provision	Climate regulation	Regulating water quality	Regulating water flow	Regulating soil quality	Regulating soil erosion	Pollination	Regulating coastal erosion	Sense of place / Inspiration	Sense of history	Tranquillity	Recreation	Biodiversity	Geodiversity
SEO 1: Conserve and enhance the distinctive historic landscape of the Broads, which is of national and international significance for its heritage and biodiversity interest, through securing and expanding the open water, riverine and estuarine habitats which are vulnerable to abstraction, flooding, vegetation succession and altered land management. Manage the provision and quality of water in the whole catchment for human and ecological benefit.	↔ ***	↔ ***	↑ ***	o ***	↗ **	↗ ***	↑ ***	↑ ***	↔ **	↗ **	↑ ***	↗ ***	↑ ***	↗ **	↗ ***	↑ ***	↑ ***	↔ ***
SEO 2: Conserve and manage the nationally significant coastal landscape, including that within the Area of Outstanding Natural Beauty (AONB) – between Sea Palling and Winterton-on-Sea – by implementing strategies to adapt to coastal change and sea level rise that are consistent with the current north-east Norfolk Shoreline Management Plan. Work with coastal processes as far as possible, while enhancing people's enjoyment of the area through improving its unique assemblage of coastal habitats and increasing opportunities for sustainably managed access to support recreation and education.	↔ ***	↔ ***	↔ ***	o ***	↔ **	↗ ***	↗ ***	↗ ***	↗ ***	↗ ***	↗ ***	↑ ***	↑ ***	↑ ***	↑ ***	↑ ***	↑ ***	↔ ***
SEO 3: Maintain a sustainable and productive agricultural landscape while expanding and connecting semi-natural habitats to benefit biodiversity, and improve soil and water quality by promoting sustainable farming practices that are able to adapt to changing agricultural economics and the considerable challenge of climate change, and comply with regulations on nitrate vulnerable zones.	↑ ***	↔ ***	↗ ***	o ***	↔ **	↗ ***	↑ ***	↑ ***	↑ ***	↑ ***	↗ ***	↔ ***	↗ ***	↗ ***	↗ ***	↔ ***	↑ ***	↔ ***
SEO 4: Improve opportunities to enhance people's enjoyment of the area while protecting high levels of tranquillity by conserving intimate Broadland valleys and extensive coast and marshland views, which contribute to sense of place, and conserve and promote the geodiversity, archaeology and historical evidence of past human settlement and landscape change.	↔ ***	↔ ***	↗ ***	o ***	↔ ***	↗ ***	↗ ***	↔ ***	↔ ***	↔ ***	↔ ***	↔ ***	↑ ***	↑ ***	↑ ***	↑ ***	↗ ***	↔ ***

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
The peat, loamy and clayey flood plain alluvial soils that are moderately fertile, with naturally high groundwater levels.	■ 68 per cent of the land is classified Grade 2 or 3 Agricultural Land with the most fertile (Grade 1 soils) present in the rich loams on the tops of the valleys in the north. ■ Where drainage has been carried out the fertile soils support productive farmland that is a mix of grassland and arable cultivation mostly for cereals and market garden crops, especially on the drained marshlands towards the coast, while on wetter areas grazing marsh is common. ■ Agriculture is the third main economy in the Broads; the dryer valley sides and tops support cereal cultivation, creating areas of uniform colour and texture, which add to the NCAs sense of place. ■ The historical pattern of wetland creation and vegetation is broadly reflected in the various soil types. Clay and silt soils are typical of flood plain grazing marsh, while the peat soils support fen, reed-bed and wet woodland habitats which are found in the upper reaches of the valleys. ■ The flood plain fen peat soils, the undisturbed organic soils and the wet loamy and sandy soils with a peaty surface, offer a significant carbon storage resource.
Wide valleys containing winding waterways of the rivers Yare, Bure and Waveney, together with their tributaries the Thurne, Ant, Wensum and Chet and a mosaic of rich wetland riparian habitats of international significance.	■ The rivers and the tributaries of the Bure, Yare, Waveney and Wensum, play a vital role in draining almost two thirds of Norfolk and much of North-east Suffolk into the North Sea. ■ The rivers divide the flood plain, flowing between flood banks above the level of the surrounding land, contributing significantly to the landscape character and sense of place. ■ The riverine ecological character supports mosaics of semi-natural habitat (fens, reedbeds, grazing marsh, wet woodland, salt marshes and intertidal mudflats) that are designated as part of the Broadland Special Area of Conservation and combine to form one of the largest marshland complexes in the United Kingdom. ■ The rivers link semi-natural habitats assisting species migration throughout the area. For example the Broads is an internationally important site for barbastelle bats that use the network of linear features and wetland habitats as a foraging site. ■ The associated wildlife and particularly the ornithological richness draws in many visitors who utilise the 200 km of navigate able waterways for recreation, underpinning the hire boat industry and ecotourism that is vital to the local economy. ■ The proper functioning of the tidal river system is vital for the associated freshwater biodiversity which continues to face challenges from increasing salinity levels.

Landscape attribute	Justification for selection
The shallow lakes (former flooded peat workings), referred to as 'broads' that are contained within the river valleys.	■ The broads are the defining characteristic of the whole area. They vary in size, the majority are freshwater while others are saline supporting a diverse range of wildlife. ■ The Broadland SAC designation recognises the broads' ecological importance. Many are also designated as National Nature Reserves, such as Hickling Broad NNR and the Ant Broads and Marshes NNR. ■ A number of the broads particularly those in the Upper Thurne catchment support rich aquatic plant communities (including an impressive community of stoneworts). Their critical importance is illustrated by the aquatic plant the holly-leaved naiad as this is the only location in England where this plant occurs. The open water habitats are also of international importance for otter, while Hickling Broad is a national key site for water vole. ■ Historically the broads are important evidence of medieval peat excavations for fuel. ■ Since the 1950s the broads have assured a legacy of tourism as a popular destination for recreation, principally for boating holidays which is a significant contributor to the local economy. ■ Management is required to maintain the levels and quality of water within the broads to ensure that they continue to support biodiversity as well as contributing to the sense of place enjoyed by the many thousands of visitors annually.
The areas of broadleaf woodland present as copses and plantations.	■ Although broadleaf woodland is generally scarce in the NCA, the upper valleys are where it has a strong hold, making up thick hedges, copses and plantations, often associated with settlement. ■ Deciduous woodland contains some of the broads in the upper valleys leading to small scale contained views that provide contrast to the open lower flood plain.
Semi-natural fen carr woodland.	■ The NCA's wet woodland forms the most extensive tract of wet woodland (particularly alder carr) within eastern England and is designated as part of the Broadland SAC. ■ The damp and shady carr woodland is a largely undisturbed wilderness; a tangle of woody species that provide an important wildlife habitat. The branches and deadwood support an abundance of shade-tolerant herbs, mosses, liverworts, lichens, fungi and ferns including the crested buckler fern, which this habitat is critically important for. ■ Carr woodland softens the valley margins providing scale and a backdrop to the wetlands. ■ The wet woodland provides a significant carbon sink locking up carbon both in the soil beneath the trees as well as in the trees themselves.

Landscape attribute	Justification for selection
Wetland habitats including remnants of the traditionally wet grassland and expansive areas of reedbed, fen and grazing marsh.	■ Remnants of the traditionally wet grassland that was once common within the Broads is present in the middle valley reaches, and significantly contributes to the landscape character with potential for enhancement and expansion. ■ Vast open reedbeds and fen, especially those in the Halvergate Marshes, Upper Thurne, River Ant valley and Alderfen Broad area, are rich in texture, colour and rectilinear form, richly contributing to the sense of place. They combine to form 75 per cent of the remaining species-rich peat fen in lowland Britain and are designated as part of the Broadland SAC. ■ The lower valleys contain the largest area of coastal and flood plain grazing marsh in Britain (12,288 ha) that form a distinctive coastal flood plain landscape. They range from brackish to freshwater along each river valley and across some of the marsh levels. ■ Agricultural intensification has resulted in the loss of traditionally grazed marsh areas which in many places have been converted for arable production. ■ The fenland areas support critically important populations of vascular plants; for example, fen orchid and milk parsley. Milk parsley is the sole larval food plant for the British sub-species of the swallowtail butterfly that is confined to The Broads NCA. ■ The high amount of reed and sedge cover provides a valuable carbon sink. ■ The internationally important areas of purple moor-grass and rush pasture occur at several marshland locations including the Ludham to Potter Heigham marshes and Bure marshes which also are a nationally important site for water voles. Saline grassland communities of national importance, including significant populations of sea barley and slender hare's ear are restricted to the marshes adjacent to Breydon Water. ■ The marshland network of drainage ditches links wetland habitats and is of significance for rare plants including tubular water-dropwort, greater water parsnip, sharp-leaved pondweed and water soldier which itself is of importance for the rare Norfolk hawker dragonfly. ■ The open, treeless, productive landscape of today's open marshland is historically important resulting from relatively recent land reclamation from marsh which began in the 13th century. ■ These habitats support a nationally important assemblage of breeding waders, including bittern, lapwing and wintering water birds which occur in internationally important numbers. ■ These habitats are heavily influenced by both management and the hydrological regime of the broads and are subsequently vulnerable to the effects land management and climate change

Landscape attribute	Justification for selection
The coastline with its long sweeping stretches of shifting sand and shingle, coastal dunes, coastal dune heaths and soft cliffs.	■ The nationally important dynamic coastal landscape and seascape is semi-natural in character, contributing to the remote and wild sense of place. Its special qualities are recognised by approximately two thirds (1,694 ha) being designated as part of the North Norfolk AONB. ■ The coastline supports stretches of open sandy beach that provides an import recreational resource that is well used by local residents and tourists for walking and bathing. ■ The beach and coastal dunes are a natural coastal defence that helps protect the large area of low-lying hinterland from coastal flooding during storm events. ■ The coastal habitats including beach, soft cliff, embryonic shifting dunes, wet dune slacks, and coastal dune heaths are important for wildlife including; golden plover, little tern, natterjack toad and common and grey seal and are afforded a high degree of designation at both national and international levels. ■ The dunes represent the most easterly dune heaths in the United Kingdom and the best example of an acid dune system on the east coast. The Winterton–Horsey dunes are designated as a SAC and the Great Yarmouth North Denes dunes are designated as a SPA. ■ The dunes are an important geodiversity feature illustrating dynamic Aeolian sedimentation. The wider southern section demonstrates a sequence from mobile fore-dunes to fixed dunes. ■ The soft sediment cliffs at Happisburgh are ever changing geological exposures that demonstrate the stratigraphy of the area providing a valuable educational resource as well as containing internationally important archaeological evidence for the earliest human occupation. ■ Erosion of the soft cliffs provides a vital source of sediment that maintains the beaches and sand dunes further south at Horsey, which intern provide a natural coastal defence.
The sheltered, remnant embanked estuary of Breydon Water.	■ The estuary gives open views across the only tidal mudflat on the east coast of Norfolk. ■ The intertidal mudflats and coastal salt marsh are of international importance for wintering water birds including golden plover and avocet. Their importance for wildlife is recognised by the designations of Broadland Breydon Water Ramsar Site and Broadland Breydon Water SPA. ■ The intertidal flats help illustrate the long history of drainage that has helped shape the Broads landscape as they were reclaimed from the estuary many years ago.

Landscape attribute	Justification for selection
The traditional settlement pattern and historic built environment features.	■ There is a clear and visible connection between drainage of the land, the underlying geodiversity, topography and settlement patterns which add to the strong sense of place. ■ Dense clusters of small villages/hamlets (for example Langley, Hardley and Rockland) are characteristic of the slightly elevated drier land of the valley sides and tops, while the open marshes are traditionally unsettled. ■ Small boatyards and marinas such as at Somerleyton, Sutton and Ludham Bridge form part of the traditional riverside scenery, alongside extensive modern boatyard/marina developments (such as Brundall, St Olaves and Wroxham). ■ Traditional buildings constructed of flint, pebble and brick, often topped with Norfolk water reed thatch add to the picturesque nature of the NCA. ■ Dutch and Flemish architectural influences in brick and pantile are common, especially in towns such as Beccles adding to the sense of history and place. ■ The churches along the Yare and Waveney are a legacy of medieval settlement and form distinctive, vertical features on the higher land dotted around the vast expanse of the open marshes. They have considerable impact within the landscape providing a sense of distance, adding to the sense of history and place. ■ Traditional drainage pump complexes along the main water courses form strong landscape features and are an important part of the industrial archaeology of the area providing historic evidence of the mechanisation of the marshland reclamation and drainage.
Some parts of the Broads, especially the north of the NCA, retain a high level of tranquillity and a low level of intrusion from urban influences and light pollution.	■ The sense of tranquillity and wildness is integral to the distinctiveness of the Broads landscape character. The least disturbed areas are found within the vast expanse of the marshes (and particularly within the relatively inaccessible flood plains of Halvergate and the Upper Thurne). The large areas of semi-natural habitat combined with the limited settlement mean much of the NCA retains a stark, remote, wilderness quality, with a scale and sense of space that is unusual in lowland Britain. ■ The high levels of tranquillity benefit bird species such as the bittern as well as visitors attracted to the area that come to view the special wildlife, although the NCA has experienced a sharp decline in tranquillity levels since the 1960s with tranquillity and intrusion an issue through and around the main communication corridors as well as the main bustling tourist centres (for example Brundall, St Olaves and Wroxham).

Landscape opportunities

- Protect the open character of the marshland landscape with its long and expansive views and big skies as well as the character their more enclosed pastoral character.
- Protect areas with a strong sense of remoteness, 'wildness' and tranquillity, where intrusion, including light pollution, is low to ensure this valued resource is maintained. Such areas include the flood plains of Halvergate and the Upper Thurne and the coastal dunes and heaths between Eccles and Winterton-on-Sea.
- Manage development and recreation to reduce its impact on tranquillity. Protect identified existing rural areas where tranquillity and intrusion, including light pollution, are low to ensure this valued resource is maintained.
- Manage and expand the mosaics of wetland habitats, including fens, reedbeds, grazing marsh, wet woodland, salt marshes, and intertidal mudflats for their contribution to biodiversity and geodiversity.
- Manage and enhance the wet woodland in the valley bottoms and broadleaf plantations in the upper valleys for their contribution to the wooded landscape character, their wildlife value, and their contribution to retention of greenhouse gases.
- Plan to adapt agriculture in the river valleys to focus away from the river edge and to adopt complementary land management practices for wildlife, such as haymaking.
- Conserve, manage and expand semi-natural habitats that occur along the coast including embryonic shifting dunes, dune slacks and freshwater pools, coastal dune heaths including dry dune heath and birch scrub.
- Allow for the continuing dynamic natural coastal processes, and maintain and conserve the range of estuarine, coastal and wetland habitats that contribute to landscape character and support the wide range of wildlife.
- Ensure that the important network of ditches and dykes is managed to encourage emergent vegetation thus forming important landscape features and increasing habitat connectivity.
- Plan to reduce impacts of agriculture and development on the riverine systems, carefully managing water availability, water quality so that existing wetland habitats are protected from saline incursion, sedimentation and pollution.
- Seek opportunities to extend semi-natural habitats to help alleviate flooding while benefiting wildlife.
- Maintain the quality and knowledge of archaeological evidence and historic built features across the NCA, conserving and interpreting the historic landscape features, especially the derelict drainage pumps and mills that line the river banks.

- Plan for land management practices to be sympathetic to potential historic evidence in the area and enhance public awareness of the breadth of historic wealth of the Broads.

- Seek opportunities to interpret the particular landscape, seascape character and history, and provide opportunities for more people to understand and enjoy.

- Work with landowners, farmers and businesses to manage and enhance sustainable tourism and recreational opportunities for local people and visitors alike to enjoy the Broads' landscape and heritage assets, ensuring a high quality experience for all users and increase interpretation at key locations to help explain the Broads' landscape through time and the importance of its ecology.

- 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 soil erosion is a risk.

- 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 underlying geology and its history and functions.

- Promote the use of traditional, locally sourced building materials such as water reed thatch and the incorporation of vernacular styles in restoring traditional buildings and structures.

- Where new development is considered; protect the distinctive landscape qualities of the Broads ensuring that new development enhances landscape character and secures multiple benefits through the provision and management of high quality green infrastructure networks where possible.

- Plan for the challenges of climate change especially along the coast and across the marshes, in one of the lowest areas in England.

Conservation scrub clearance on the Bure Broads and Marshes SSSI, Bure Marshes National Nature Reserve.

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 the analysis and opportunities may change upon publication of further evidence and better understanding of the inter-relationship between services at a local level.

The 18m Hickling Tower Mill built in 1818.

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Food provision	Cereals Livestock grazing Market garden crops. High quality agricultural land Soils	This is productive agricultural land, with 10 per cent Grade 1, 13 per cent Grade 2 and 55 per cent Grade 3. Predominantly arable farming and livestock rearing with some dairy farming. There are no commercial fisheries in the NCA.	National	The soil quality, water availability and land drainage have supported high levels of agricultural produce in the NCA. Agriculture is mainly based around large farms producing cereals (36 per cent) and grassland (35 per cent). Some cash root crops are also grown (12 per cent). Livestock rearing is focused on pigs and cattle. Intensification of agriculture has led to the loss of semi-natural habitats within the farmed environment, especially through drainage of flood plains. Drainage and intense cultivation of the peat soils has also reduced carbon storage potential. Climate change impacts may lower rates of rainfall and lead to an increased drought risk, reducing soil fertility and altering the current pattern of food production. This may also increase stresses on other services i.e. water availability, water quality. Expansion of food production could exert further pressure on the space for semi-natural habitats, water availability and quality, as well as soil quality leading to increased erosion rates and increased diffuse pollution of watercourses. Further water abstraction may lead to decreased river flows leading to increases in saline intrusion and subsequent damage to freshwater habitats. Any increased drainage or deep cultivation of peaty soils will reduce their capacity to store carbon. Prolonged periods of stocking with free-range pigs can result in soil compaction, water logging and soil erosion, as well as the leaching of nitrogen and phosphorus leading to water pollution. Agriculture is strongly linked to the areas recreational function in terms of the significant role it plays in creating a countryside that residents and visitors wish to explore and enjoy. This supports the economic function of the landscape providing employment and increased demand for local services and products.	There are opportunities through working in partnership with farmers to consider an increased use of crops that have a lower demand for irrigation. Seek to reduce the demand for water abstraction through creating more on-farm water storage. Address water quality and conservation of wetland habitats within the farmed environment by adapting cultivation techniques i.e. minimum tillage and an increased use of infield analysis prior to the application of nutrients and minerals to ensure continued ecological diversity is maintained and enhanced.	**Food provision** **Water availability** **Regulating water quality** **Regulating soil quality** **Regulating soil erosion** **Sense of place/ inspiration** **Biodiversity** **Geodiversity** **Recreation**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Timber provision	Small deciduous woodland, copses and plantations Semi-natural wet woodland and carr woodland	Only 10 per cent of the NCA is wooded. There is minimal commercial timber production. The only timber provision is mainly from small deciduous woodland, copses and plantations that accompany settlements and farms. Most of the woodland is semi-natural fen carr woodland which dominates the wetlands. There are some small over mature poplar and cricket-bat willow plantations, which have largely proved commercially unviable.	Local	Woodland cover is sparse and confined to small woodlands and plantations. Further woodland planting in the NCA could increase opportunities for timber provision. There is potential to increase timber provision through bringing unmanaged woodland back under management. The situation of any new woodland planting would need to be carefully considered to maintain the landscape character. It should avoid the open marshland and wetland sites (except where new wet woodland is appropriate. There are possible opportunities in connection with existing copses, plantations and shelter belts around 'upland' farmsteads.	Increase native woodland planting in connection with existing woodland and copses to provide increases in timber and biodiversity, enhancements to the landscape, improve the ecological networks and increase the carbon storage potential.	**Timber provision** **Climate regulation** **Biodiversity** **Water availability** **Regulating water quality** **Sense of place / inspiration** **Biomass energy** **Timber provision**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Water availability	The Crag aquifer and Sand and gravel minor aquifer Rivers (the main rivers: Yare, Ant, Bure and Waveney) Surface waters (broads)	Abstraction of water from the underground aquifers from boreholes around the flood plain periphery is a major source of potable and irrigation water. Surface waters (rivers and broads) are also important water sources for agriculture and settlements. Over-abstraction of both ground and surface water is a continuing issue for the NCA. The integrated CAMs status for the River Waveney is now classed as 'over abstracted'; the Yare is currently 'over licensed' and the rivers Bure and Ant have 'no further water available'.	National	The groundwater resource of the NCA is predicted to be under pressure (of poor quantitative status) by 2015. As water supplies from the aquifers decline, low flows are becoming a regular feature and in the future will become a particular concern, (especially to designated wetland sites) resulting in reduced flushing of the system and the occurrence of algal blooms. Low flows will also negatively impact terrestrial ecology as wetland habitats become dryer and decline in their condition. Food provision will also be impacted as irrigation of crops will need to be reduced. Over abstraction can lead to impacts on aquifer-fed fen communities, low river flows, and saltwater ingress from the North Sea via the aquifer. Surface waters are also under significant pressure. Wetlands can also increase evapotranspiration, interception and infiltration. Reduced water availability will also impact upon recreation within the Broads as some rivers and broads will become shallower limiting access by boat.	Opportunities exist to improve the sustainable use of water by employing sympathetic land management practices which reduce the demand for crop irrigation (although it is recognised that many land managers already operate using environmentally sensitive practices). Expansion of water storage capacity on farms to enable farms to reduce the volumes of water abstraction from surface and groundwater sources, while ensuring that new large-scale agricultural features (for example irrigation reservoirs) safeguard the distinctive quality of the local landscape. Restore and increase areas of semi-natural habitats to increase infiltration such as grassland on the valley sides and wet grassland in the valley bottoms. There is an opportunity to continue to use agri-environment schemes to recreate low-input flood plain grazing marsh grassland benefiting landscape, habitat and aquifer re-charge, water quality, soil erosion as well as limiting flood risk.	**Water availability** **Biodiversity** **Geodiversity** **Regulating water flow** **Regulating water quality** **Climate regulation** **Food provision**
Genetic diversity	No information provided as not considered to be commercially important in this NCA					

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biomass energy	Woodland	Woodland cover is low (10 per cent) and the creation of new large plantations is unlikely. There are some small deciduous woodland, copses and plantations in the upper reaches of the river valleys. There are opportunities for both short rotation coppice (medium potential yields) and Miscanthus (high potential yields), but currently these are not planted in the NCA.	Local	There is some capacity for appropriately-scaled heat production existing in privately-owned woodland. Potential miscanthus and short rotation coppice (SRC) yields are medium and the potential for miscanthus yield is classed as high although the impact of biomass on the historic environment can be detrimental and any planting needs to be carefully sited. This is particularly the case with additional enclosure of the characteristic open landscape on the lower valley floors and in the flood plain, which are largely un-wooded. Currently standing biomass includes commercial reedbeds and sedgebeds, managed to provide roofing materials. Maintaining this traditional use, bringing neglected areas under management and developing new uses for these natural biomass materials, will in turn benefit other ecosystem services (for example biodiversity, climate regulation, sense of place).	There are possible valley-side opportunities for biomass production through the planting of miscanthus or SRC where the landscape impact is less intrusive than on the open flood plain. There is scope to use locally-sourced wood from existing under-managed woodland in order to provide heat from small and medium-sized boilers. Initiatives such as Woodfuel East, can aim to build capacity for renewable energy strengthening the link 'from forest to fire'. There are opportunities for using the woodland resource sensitively by thinning or coppicing and providing woodland owners with diversified income streams; this will reduce the NCA's carbon footprint and improve the small number of existing woodland habitats for future generations In high potential yield areas planting of miscanthus can be targeted to soften the edges of new development or where it may help alleviate flood risk while avoiding impacts on the provision of other services. Continuing to bring derelict reedbeds and sedgebeds into regular management and promotion of the use of (for example fen litter for biomass and new commercial uses for hay and litter, reed and sedge faggots (bundles of reed/sedge used for river bank stabilisation).	**Biomass energy** **Climate regulation** **Regulating water flow** **Sense of place / inspiration** **Biodiversity** **Regulating soil erosion**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Climate regulation	Soils Grazing marsh Wetlands Semi-natural vegetation Reedbeds Mudflats/salt marsh Woodland Hedgerows	The carbon content of soils in this NCA varies; they range from areas with low carbon content (0-5 per cent) associated with minerals soils to areas with higher content (5-50 per cent). High carbon soils are associated with the extensive areas of fen peat soils, the undisturbed organic soils of the coastal and flood plain grazing marsh and the loamy and sandy soils with naturally high groundwater and a peaty surface. Higher carbon levels may also be associated with the soils of the coastal flats where some variants may have organic-rich topsoils. Soil carbon will also be higher in areas of coastal and flood plain grazing marsh (11, 563 ha), reedbeds (6,277 ha), fens (4,166 ha) as well as areas of wet woodland.	National	Research carried out by The University of East Anglia for the Broads Authority estimated that nearly 40 million tonnes of CO^2 equivalent are sequestered in the NCA, of which a large proportion is stored in the fen peats. The ability of the fen peat to continue to store carbon and to lock up carbon in future depends upon the presence of appropriate vegetation cover (for example wet woodland, sedge or reed) and upon the hydrology and water table being at the right level (sufficiently high) so that the surface remains wet to assist peat formation to take place. Previously stored carbon in the peat-lands can also be released due to oxidation and erosion so that peat-land becomes a net source of green house gases rather than a sink. In all cases these peaty and organic-rich topsoils are a vital resource in climate regulation and the integrity of these should be retained. The standing biomass, which includes winter-green species such as sedge and the woodland itself, lock up carbon over a shorter timescale. A significant area of the mid flood plain of the northern broads and some of the flood plain ronds of the southern broads system, are occupied by commercial reedbeds and sedgebeds, some of which are managed to provide traditional thatching materials. Maintaining this traditional use and developing new uses for these natural materials will help to maintain and potentially increase the area of reed and sedge, increasing their capacity to store carbon. In agricultural areas carbon sequestration and storage can be increased by management that reduces the frequency of cultivation as well as by the type of cultivation, for example, shallow ploughing. The addition of organic matter to enhance soil structure will also increase carbon storage and provide increased benefits for biodiversity. Soils cultivated for arable crops in the marshland currently provide reduced carbon sequestration partly due to their regular cultivation and drainage. Reducing drainage and re-establishing permanent pasture on the alluvial soils, would increase their capacity to store carbon. Woodlands, particularly wet woodlands and those managed by coppicing, provide carbon sequestration. Woodlands also provide benefits for biodiversity, especially when part of a broader habitat network. Any new planting would need to be sensitively located to maintain landscape character. Existing copses, plantations and shelter belts could be extended.	Reduce frequency of cultivation and seek opportunities to add organic matter to the soils for example through use of green manure crops within rotations and increase the coverage of uncultivated field margins. Opportunities exist to promote initiatives which facilitate re-wetting the flood plain, to reactivate peat formation and promote carbon sequestration. Seek opportunities to restore and expand semi-natural habitats (for example wet woodland, sedge or reed) and bring them under sympathetic management to increase carbon storage. In the case of reed and sedge there is the opportunity to increase sympathetic commercial management for renewable building materials. Conserve and expand areas of flood plain grazing marsh and wetland and grassland habitats which will benefit wildlife and increase the carbon storage potential of the flood plain. Seek opportunities to restore and expand native broadleaved woodland where appropriate and bring back into management under-managed woodland to increase carbon storage.	**Climate regulation** **Biodiversity** **Geodiversity** **Water availability** **Regulating water quality** **Biomass energy** **Regulating soil erosion** **Regulating soil quality**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating water quality	Wetlands Rivers Aquifers Geomorphology and the operation of active processes	The NCA's groundwater chemical status is poor. The surface water chemical status is generally good. The ecological status of river waters, canals and surface waters in the NCA is varied and ranges between 'poor' and 'good'. The biological and chemical river water quality ranges from very good to fair depending upon the location and / or proximity to sources of point source pollution. The poor ecological quality of the Bure, the Ant and Muckfleet, Yare and Waveney catchments means that they are prioritised under the England Catchment Sensitive Farming Delivery Initiative (ECSFDI). None of the coastal and estuarine waterbodies achieve either good or potentially good status.	Regional	Watercourses suffer from high nitrate and phosphate levels, associated with the discharge from sewage treatment works, agricultural practices, industrial processes, surface water drains and pleasure boats. The recent installation of phosphate stripping equipment on the main Sewage Treatment Works is improving water quality. The implementation of actions listed in Diffuse Water Pollution Plans for all the main catchments will also help improve water quality by helping to reduce diffuse pollution. Improvement can, however, be compromised by low flows during prolonged periods of low precipitation (winter and summer) which are predicted to increase as a consequence of climate change. In CSF priority catchments watercourses suffer from high rates of nitrate and phosphate pollution associated with agriculture which may be associated with excess farmyard manure and slurry applications, nutrient leaching, inefficient crop nutrient management and soil erosion. There is also some localised diffuse pollution from pesticides and soil erosion leading to sedimentation of watercourses. There are opportunities on agricultural land through Countryside Stewardship and Catchment Sensitive Farming measures to help improve water quality. Catchment Flood Management Plans (CFMPs) and Shoreline Management Plans (SMPs) may result in some improvements in river valley, coastal and estuarine waterbodies helping to reduce saline incursion.	There are opportunities through working in partnership with farmers to encourage different remedies to improve water quality such as by reducing water abstraction to increase flow rates in rivers and limit saline incursion. Encourage agricultural practices and the uptake of agri-environment options (for example grassland margins on slopes) to minimise soil erosion from land at risk of generating diffuse pollution in catchments such as the Bure, Ant and Muckfleet, Yare, Waveney and Wensum. Create buffer areas between nutrient input and sensitive riparian habitats, areas high in biodiversity and watercourses. Ensure the use of fertiliser and pesticide is more informed and associated with good in–field analysis to ensure additional inputs are more closely married to the requirements of individual crops to reduce diffuse pollution. Ensure continued improvement is made to waste water treatment works, to improve the quality of water being returned to the system. Ensure continued efforts are made to ensure that all pleasure boats using the water ways do not impact upon the quality of the water through the discharge of effluents and engine oil/fuel.	**Regulating water quality** **Biodiversity** **Geodiversity** **Sense of place / inspiration** **Recreation**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating water flow	Inflowing rivers Breydon Water Broads Wetland habitats Wet woodland	Fluvial flood risk in this NCA is associated with the open, flat flood plain that the major river systems of the Yare, Ant, Bure and Waveney flow into from the higher ground of surrounding NCAs which they drain (NCAs 78,79,83,84). Some land is at or below sea-level. Here agricultural land and grazing marsh is maintained by drainage pumps. These high levels of drainage have increased the pressure on the Broads river system, leading to a long history of flooding; particularly notable events occurred in 1878 and 1912. More recently, river flooding occurred across much of the NCA in 1993. The lower stretches of the rivers are constrained between flood banks to prevent flooding of adjacent land. Currently, the Environment Agency flood risk map indicates that for the majority of the NCA the risk of flooding is high (an annual probability of flooding of 1 per cent or greater from rivers[13].	Local	The majority of the NCA is at risk from fluvial flooding, exacerbated by combinations of the extensive catchments of the rivers which extend into neighbouring NCAs draining much of Norfolk and Suffolk, a low-lying level flood plain at or below sea level, high tides and potential storm surges combined with rising sea levels. Flooding is a natural process within the Broads flood plain. It can disrupt wildlife habitats and where development has occurred within the flood plain it can cause significant damage. Subsequently flood risk is a major constraint on sustainable development in the Broads and on its social and economic viability. Rivers can become heightened for a number of reasons including: i) rivers unable to flow freely to the sea at high tide. This so called 'tide locking' has the potential to occur at Norwich (River Wensum) and at Hoveton and Horning (River Bure); ii) the overwhelming of pumping stations (notably at Aylsham, Martham, Thurne, Caister, Winterton and Stokesby); and finally iii) the breaching/failing of river embankments (for example. at Norwich and Great Yarmouth). The lower reaches of rivers rely on hard engineering solutions (embankments) which limit flood storage capacity in the event of a major fluvial or sea surge event. Alternative, 'softer', solutions (for example flood meadow wet grassland) could increase the natural storage of water, restore river channels, watermeadows and the natural flood plain, improve the landscape, biodiversity and recreation opportunities while simultaneously protecting riverside and flood plain property from flood damage. The middle reaches and upper flood plains can help alleviate flooding in the future if managed appropriately (for example the middle river reaches of five key rivers - Ant, Bure, Thurne, Yare and Waveney are generally unembanked and the broads, fen and wet woodland in the natural flood plain provide significant flood storage capacity following heavy rainfall). Increasing the flood storage capacity by enhancing and extending these features and through the creation of new washlands will further help to alleviate flooding. Increasing water levels and intermittent flooding should be actively managed to mitigate against the potential damage this could cause to features within designated Special Areas of Conservation.	There are opportunities for providing a degree of flood resilience through the creation of flood plains and washlands, ideally located through consultation with stakeholders impacted by floods. Optimise design and implementation of future flood storage areas to create new wetland habitats, such as flood plain grazing marsh, creating links with existing semi-natural habitats. There are opportunities to adopt alternative, 'softer', solutions to flood prevention through restoring previously engineered river channels to their natural profiles (for example through bank setback and the removal of pilings) allowing reinstatement of natural marginal vegetation to attenuate flows. Adopt strategic approaches to increasing the capacity of catchments to retain water, including addressing river management upstream to reduce impacts on landscapes downstream. Manage the network of ditches and drains to ensure that while operating effectively to drain land where required, they also make a positive contribution to the landscape and to biodiversity, reducing sediment transfer rates into major river systems and acting as links between other semi-natural habitats. Protect and manage the fen habitat resource and plan for further sustainable restoration work through the adaptive management of the adjacent flood plain to increase its contribution to flood alleviation.	**Water availability** **Regulating soil quality** **Regulating soil erosion** **Biodiversity** **Geodiversity** **Sense of place / inspiration**

[13] The Broadland River Catchment Flood Management Plan Summary Report, Environment Agency (December 2009; URL: www.environment-agency.gov.uk/research/planning/33586.aspx)

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating coastal flooding and erosion (continued on next page)	Tidal stretches of all the main rivers Natural sand dune defences Beaches Coastal sand dunes Soft cliffs Intertidal mudflats and coastal salt marsh Beach and offshore manmade defence structures Geomorphology and operation of active processes	There is a risk of tidal flooding when high tide levels combine with storm surges as the hinterland is mostly at or below sea level. The natural dune flood defences between Eccles and Winterton-on-Sea protect the low-lying hinterland from coastal flooding although the area between Happisburgh and Winterton has suffered a series of catastrophic floods over several centuries through the breaching of the natural defences. Floods in 1287 reached Hickling. In 1604 most of Eccles village was washed away and in more recent times the dunes were breached at Horsey in 1938 and Sea Pauling in 1953. The dunes are themselves now pinned by artificial offshore reefs, onshore groynes, beach nourishment, revetments and a concrete wave return wall and apron. Flood defences are currently being improved along the River Yare[14]. Currently, the Environment Agency flood risk map indicates that for the majority of the NCA the risk of flooding is high (an annual probability of flooding of 0.5 per cent or greater from the sea).	Local/ Regional	Sea level rise and climate trends show that the low-lying landscape of the Broads is at risk from tidal flooding in the event of flood defence failure. Wetlands and coastal habitats offer essential buffers to safeguard human life and property during extreme flooding events that are predicted to increase as a consequence of climate change. Natural defences to coastal flooding are an essential and cost-effective way of safeguarding life and property in the face of substantial, medium-term threats. Wetlands contribute significantly to the regulation of river flooding and the maintenance of water quality. Wetlands are also characteristic of the area and consequently contribute significantly to the distinctive landscape and sense of place. Grazing marshes support traditional livestock enterprises, producing high value products as well as supporting biodiversity, employment and rural income. The current policy is to retain robust coastal defences (the natural dune defences and manmade defence structures) along the Eccles to Winterton frontage that hold the current line, and actively work alongside the Broadland Flood Alleviation Project to improve and maintain river flood protection. At the same time effort must be put into developing strategies for adaptation, as the technical and financial and environmental challenges of maintaining those defences into the future will continue to increase. This should be in line with guidelines contained in the Shoreline Management Plan which proposes holding the current line for ~50 years with a review of that policy longer term.	Seek opportunities to expand inter-tidal habitats along the shores of Breydon Water and the tidal rivers near to the coast to offset coastal squeeze. Protect the coastal dune system from damage resulting from recreational pressure by for examples; the development of a strategy for public access management. There are opportunities to develop a more natural coastal hinterland through the conversion of areas of arable and grazing marsh to fen, open water and salt marsh and expanding traditional coastal grazing management in order to create habitats to buffer against coastal flooding while benefitting wildlife. The development of strategies to mitigate some of the impacts of saltwater incursion (for example through the creation of washlands and new wetlands to moderate flooding of existing wildlife sites). Ensure flood risk management evolves to provide solutions that result in the protection and retention of the special assets of the Broads including its history and biodiversity as part of meeting society's needs. To interpret the importance of the Broads geodiversity in understanding past and future environmental responses to climate change.	**Regulating coastal flooding and erosion** **Water availability** **Regulating water flow** **Climate regulation** **Biodiversity** **Geodiversity** **Sense of place / inspiration** **Sense of history**

[14] The Broadland River Catchment Flood Management Plan Summary Report, Environment Agency (December 2009; URL: www.environment-agency.gov.uk/research/planning/33586.aspx)

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating coastal flooding and erosion (continued from previous page)		The north-western part of the coastline (Happisburgh to Eccles) is elevated with soft low elevation, clay cliffs. Sections of these cliffs are highly subject to coastal erosion. The stretch of coast between Eccles and Winterton on Sea is much flatter and is fronted by extensive dunes and broad sandy beaches. This section of the coast is liable to beach loss and erosion and flooding as the land behind the coastal strip is at or below sea level. Climate change will likely increase both sea levels and storm surge heights over the coming decades leading to further erosion and accelerating change on some reaches of unprotected coastline. The North-east Norfolk Shoreline Management Plan currently proposes holding the current line for up to 50 years, with a period beyond to see if the policy is still appropriate.		Eastern England has been gradually sinking since the last glacial period ended about 11,000 years ago (isostatic readjustment), and as a result of changing climate rising sea levels will only increasing pressure on existing defences, and in the long term could lead to a loss of beaches and sand dunes, and have impacts on other parts of the coast, where the line of defence is held. However a policy of not defending will have more immediate impacts on local communities and the local economy. As well as the risks of erosion of the soft cliffs in the northern part of the coastal area, there are large areas where coastal flooding could occur in the absence of a sea wall and a healthy, naturally functioning dune system - between Eccles and Winterton. The Shoreline Management Plan details how hard defence of existing positions will prevent the natural movement of sediment, and structures will become increasingly difficult to maintain or justify over time, as the coastal system retreats. This whole length of coast is at least partly reliant upon sediment eroded from the cliffs of North Norfolk for beaches to provide natural defence, although in recent years this has been supplemented through recharging beaches along the Eccles-Waxham frontage, to address any shortfall in material supply.[15] To mitigate the impacts and help adapt to the impacts of coastal change, particularly on coastal communities; social adaptation measures may include limited works to existing defences to slow erosion and delay the impacts of change.	Reflecting the priorities of the Shoreline Management Plan, promote the natural adaptation and regeneration of coastal habitats as sea levels rise[16]. Maximise the ability of natural habitats along the coast to absorb wave energy and provide soft defences against coastal storm erosion. Ensure that realignments are managed to enable inter-tidal habitats to develop and expand effectively. Monitor coastal processes and work with partners to find solutions that enable dynamic coastal processes to continue. Seek opportunities for intertidal habitats to expand and the creation of compensation habitats (freshwater habitats and brackish waterbodies) to mitigate those lost through rising sea levels. If and where existing flood defences are reinforced, work with partners to ensure that there are no adverse impacts on features of biological and historic interest, ensuring that the open character of the area, the long views and access to the shoreline is maintained. Seek to ensure that ancient dune systems are not damaged by recreational use leading to fragmentation and erosion. Work closely with partners and local communities in the identification and development of social mitigation measures such as limited works to existing defences to slow erosion. Seek solutions that allow the needs of wildlife and people to go forward hand in hand.	

[15] Kelling to Lowestoft Ness Shoreline Management Plan First Review Non Technical Summary, North Norfolk District Council et al (October 2011)

[16] Kelling to Lowestoft Ness Shoreline Management Plan First Review Non Technical Summary, October 2011. (North Norfolk District Council et al).

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating soil quality	Moderately fertile to highly fertile soils	There are 8 main soilscape types in this NCA: ■ Loamy and clayey soils of coastal flats with naturally high groundwater, covering 29 per cent of the NCA; ■ Freely draining slightly acid loamy soils (29 per cent); ■ Fen peat soils (17 per cent); ■ Slightly acid loamy and clayey soils with impeded drainage (7 per cent); ■ Freely draining slightly acid sandy soils (5 per cent); ■ Slowly permeable seasonally wet acid loamy and clayey soils (4 per cent); ■ Loamy and sandy soils with naturally high groundwater and a peaty surface (3 per cent); and ■ Lime-rich loamy and clayey soils with impeded drainage (1 per cent). These soils are moderately fertile and where sufficiently well-drained, support arable farming and grazing. In the south the uplands have poor-draining stagnogley soils, while the small valleys in this area contain a mixture of fertile sandy loam soils and poor gravel soils. The valley margins comprise acid loamy and clayey soils of moderate-high fertility. The valley margins in the north of the NCA have freely draining slightly acid loamy soils of low fertility.	Regional	The most fertile soils are the rich loams present on the higher ground in the north of the NCA that support high value agricultural production. The loamy and clayey soils of coastal flats have a naturally high groundwater, are moderately fertile and a 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 (locally some soils are saline and at risk of structural damage where drained). The fen peat soils (17 per cent) are at high risk of loss of peat through oxidation, water and windblown erosion, with peaty layers reducing long term and becoming thinner over underlying mineral layers (in some locations mineral material is within plough depth). This can reduced the long term agricultural value of the land in addition to reducing its ability to store carbon. The freely draining slightly acid loamy soils have potential for increased organic matter levels through management interventions. They may be valuable for recharge of the Crag aquifer requiring the maintenance of good soil structure to aid water infiltration and the matching of nutrients to needs to prevent pollution of groundwaters. Where there is a high silt/fine sand content compaction and / or capping may be an issue. This may be reduced by increasing soil organic matter content. Where peaty soils are located over marine alluvium, drained soils may be extremely acid (pyritic) impacting on land use and management while, where drained, sporadic iron rich layers (dummy layers) are difficult to wet. Deep drainage of the flood plain soils can result in high acidity and sulphate levels, peat shrinkage and changes in soil structure.	In those areas with high groundwater, seek opportunities to revert cultivated land back to semi-natural habitat. Seek ways of reducing demand for water abstraction by selecting crops and / or increasing storage of water on farms, to reduce the degree of saline intrusion and the damage this can cause in terms of soil quality. Adopt cultivation practices that increase organic content of soils, such as introducing fallow into rotations, over-winter stubbles, direct drill and grass leys. Avoid overstocking or using machinery where and when it would lead to the compaction of vulnerable soils.	**Regulating soil quality** **Regulating soil erosion** **Regulating water quality** **Climate regulation** **Biodiversity** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating soil erosion	Moderately fertile to highly fertile soils	The majority of the NCAs soils are freely draining soils which include the slightly acid loamy soils (covering 29 per cent of the NCA) and the slightly acid sandy soils (covering 5 per cent). The peaty soils include the fen peat soils (17 per cent of the NCA) and the loamy and sandy soils with naturally high groundwater and a peaty surface (covering 3 per cent). Soils with impeded drainage cover 8 per cent of the NCA. The loamy and clayey soils of coastal flats and the wet acid loamy and clayey soils cover 33 per cent of the NCA. Three river catchments (the rivers Bure, Ant and Muckfleet, Yare and Waveney) have been prioritised by the England Catchment Sensitive Farming Delivery Initiative (ECFSDI) in order to reduce the impact of agriculture on the environment. Accelerated soil erosion, whereby more soil is removed than can be created, has been identified as an issue within the Yare and Waveney catchments.	Regional	Free draining, coarse textured variant soils are prone to erosion (both wind and rain) on moderately or steeply sloping ground where cultivated land is left bare especially in spring. Erosion of these soils is exacerbated where organic matter levels are low after continuous arable cultivation or where soils are compacted. The undisturbed peaty soils have good integrity and infiltration (the ability to soak up water) and therefore when wet and supporting vegetation they are at low risk from water erosion (except where cultivated land is susceptible to flooding). These soils do have a high risk of wind erosion (blowing) especially where spring sown crops are grown and when the soils have become dry. Drainage and cultivation is leading to ongoing loss (wastage) of peat through shrinkage and oxidation. Minimum cultivation and the retention of soil cover and organic content can prevent this. Soils with impeded drainage are easily compacted if accessed when wet and may be prone to capping / slaking, increasing the risks of soil erosion by surface water run-off, especially on steeper slopes. Ensuring that these soils are not compacted by livestock, farm machinery and recreational access to limit rates of erosion. The loamy and clayey soils of coastal flats and the wet acid loamy and clayey soils are at low risk of soil erosion although they are increasingly under threat from sea level rise. The impact of climate change (particularly increased rainfall intensity on bare arable soils and lengthy water-logging of grassland), will increase the potential for soil damage. Livestock can cause significant soil erosion along the edges of dykes with a subsequent decline in water quality. On the Broads themselves, the wash from water-borne traffic and with motor powered vessels the direct cutting action of engine's propellers increases soil erosion along the banks. Increasing boat numbers (from 4,789 in 1975 to 12,459 in 2012) have exacerbated this erosion, although the last decade has actually seen a slight decline in boat traffic, reducing this threat (12,923 in 2003 to 12,459 in 2012). Speed limits for water-borne craft are also used along sections of rivers and across broads to help limit bank erosion.	Replant hedgerow boundaries where appropriate to protect free draining soils from wind erosion. Ensure that on peaty soils agricultural practices encourage minimum cultivation and avoid leaving surfaces exposed, for example by introducing fallow into rotations, overwintering stubble, or reversion to permanent grassland. Encourage agricultural practices that retain cover and build up organic matter especially on free draining soils. Ensure that soils with impeded drainage are not compacted by ensuring low rates of stocking where grazing takes place or by encouraging conversion to semi-natural habitat. Maintain and conserve salt marsh and other inter-tidal habitats to create a buffer between the sea and agricultural land, providing a cost effective defence against soil erosion in the coastal flood plain.	**Regulating soil erosion** **Regulating water quality** **Biodiversity** **Geodiversity** **Regulating soil quality** **Food provision**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Pollination	Areas of semi-natural habitat, hedgerows, wet grassland, grass margins, salt marsh, fen, reedbed, woodland	The semi-natural habitats in the area (reedbeds 6,277 ha, fens 4,166 ha) support a variety of pollinators which are an essential component of the ecology and to agricultural production in the NCA. Interstitial habitats (such as the edges of farm tracks and ditches and dykes) that remain in the spaces between crops are also key sources of both pollen and nectar for insects that pollinate commercial arable crops such as rape.	Local	Pollinating insects are generally supported by a range of semi-natural habitats, in particular species rich grasslands. Good networks of pollinator habitat assist the ability for pollinators to supply this service aiding food production, particularly in the upper and middle reaches of the river valleys. Networks are more limited across the open marshland and within core the arable areas on the valley tops particularly in the north of the NCA. Increases in habitat for pollinators such as creation of areas of semi-natural habitat, hedgerow improvement and increases in field margins will increase the delivery of this service. These measures would create important corridors and habitat mosaics for pollinator species. A strong pollinator population supports production of a wider variety of food products and supports food production in the future.	There are opportunities to protect and extend the semi-natural habitat mosaics, particularly for wet grassland and fen species that provide early and late nectar sources for native pollinators that in turn will pollinate commercial food crops and so will benefit food provision. Work with local land managers to protect areas of salt marsh and other semi-natural habitats, buffering existent habitats where this may be possible. There are opportunities to increase pollen and nectar resources in arable areas through the creation of (ideally species-rich), grass margins and bespoke pollen and nectar strips creating and connecting links with other semi-natural habitats.	**Pollination** **Biodiversity** **Sense of place/ inspiration** **Food provision**
Pest regulation	Areas of semi-natural habitat/ wet grassland, fen, hedgerows/ grass margins	The habitats in the area support a variety of species, such as beetles, which can regulate the populations of pests such as aphids.	Local	Interstitial habitats provide important overwintering habitats for beneficial predatory invertebrates (for example ground and rove beetles) that feed on pests. Integrated pest management approaches may in some cases remove the requirement for chemical intervention, although evidence of efficiency is patchy. Financial support for farmers channelled through agri-environment schemes (for example Countryside Stewardship) can assist with increasing the network of these habitats in arable areas.	A stronger and wider network of semi-natural habitats could afford benefits for pest regulation, as well as pollination and biodiversity. Take opportunities to increase and manage appropriately semi-natural habitats. Seek opportunities to increase diversity of structure and composition within areas of semi-natural habitat to support a variety of pest regulating species. Seek opportunities to increase field margins, species rich hedgerows and beetle banks to encourage a network of habitats for pest regulating species close to areas of agricultural production.	**Pest regulation** **Pollination** **Biodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Sense of place / inspiration	A landscape of varying scales – closed and intimate in the upper valleys and open and large across the drained marshes A low-lying farmed landscape with large areas of semi-natural wetland habitat An extensive network of rivers, broads, ditches and dykes Variation introduced by slight changes in elevation on the valley sides Expansive views, big skies Quiet rural areas Remote locations Undeveloped coastline (apart from artificial sea defence structures) with long views	The sense of place is created by the area's four distinct character zones: the coast, the marshland, the river valleys and broads and the valley tops; thus reflecting the underlying geodiversity. The low-lying river valleys, broads and marshland define the character of the area, consisting predominantly of a contrast between large, open, grazing marshes and low-lying wetland which is made up of an intricate mix of broads, rivers and waterways, reed beds, fen and wet woodland. In the upper reaches of the river valleys, deciduous woodland, copses and hedgerows are present. The open coast consists of remote golden sand and shingle beaches, vegetated dunes, crumbling cliffs of Quaternary deposits, salt marsh and mudflats maintained by dynamic processes. The wetlands are rich in biodiversity and support internationally important populations of breeding and wintering birds, while other assets that create a sense of local distinctiveness and contribute to the local character. Features include embanked rivers, traditional wind pumps, marsh cottages, agricultural buildings, boatyards and boatsheds, historic craft, bridges, staithes and dark, dense, flat water reed thatch on traditional buildings.	Regional	A very strong sense of place is provided by the historic landscape character and the interconnected network of rich biodiversity and habitats which are an important component of the local identity. As a result of 20th-century tourism, these characteristics of the Broads provide the popular perception of the quintessential Norfolk landscape. The open marshland, the coast and some of the more hidden broads can also provide inspiring experiences because of their sense of remoteness and 'wildness'.	There are opportunities to protect the rural mosaic of pastoral landscapes and habitats characteristic of the Broads that are essential for the feelings of space and the inspiration. Retain the contrasts with the local differences in landscape character, between the coast, open marshes, river valleys and broads and uplands. New and redevelopments should be sympathetic to the historic settlement patterns and where possible the materials used should aim to reflect or compliment the traditional settlement character. Retain long views and the experience of big skies. Seek to 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. Protect and enhance the biodiversity interest of the Broads, so that more people can enjoy the rich ecology and experience the sights and sounds of overwintering birds, booming bitterns, marsh harriers, swallowtail butterflies, coastal little terns and common and grey seals, together with all the plant and animal communities associated with the semi-natural habitats. Improve understanding of the landscape and its functions including its wildlife value and geomorphological processes especially the active coastal processes.	**Sense of place / inspiration** **Sense of history** **Food provision** **Biodiversity** **Recreation** **Tranquillity** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Sense of history	Broads, embanked rivers, wind pumps, marsh cottages, traditional agricultural buildings, drainage pumps, boats, boatyards and boatsheds, historic craft, bridges and staithes Archaeology Palaeoecology Geology	The varied historic features within the NCA are an important part of its character. Breydon water and the ruins of Burgh Castle provide a sense of history of the once extensive Great Estuary that covered the lower flood plain. The visible courses of ancient estuarine salt marsh creeks also provide a sense of the past landscape. A sense of history is revealed through the broads themselves which are flooded peat pits excavated for fuel during the middle ages. The Bure Valley's Saxo-Norman churches reflect the manorial structure of the middle ages, serving as a reminder of the area's populous past. Traditional settlement patterns in the area have been dictated largely by historic social and economic need, with groupings round a parish staithe, riverside common, ferry or bridge. The waterways and river network were once important communication and trading routes with wherries that used to export goods to the port of Great Yarmouth. Wherries, although now used for pleasure, can still be seen sailing on the rivers, providing vivid connections to the areas trading past. A sense of history is revealed with the sight of historic sailing craft, reed thatched boat sheds and boatyards, which portray the history of Broadland recreation. There are also many features associated with the reclamation and control of the drainage of the wetlands such as; ditches and dykes, raised flood banks, bridges, wind pumps (for example the four-storey high, red brick Horsey Windpump) as well as later diesel and electric pump stations. There are nearly 1,000 sites worthy of inclusion on the Historic Environment Record, recognising the special architectural and historic interest of the area. These include traditional agricultural buildings; including the 16th century thatched Great Barn at Waxham, Norfolk's longest barn. The coastline with its isolated settlements on top of crumbling cliffs and behind windswept dunes, which although tranquil reveal a history of storms, flooding, smuggling and shipwrecks. The 6 registered Parks and gardens provide a vivid sense of history (for example Somerleyton Hall with its garden features designed by Sir Joseph Paxton, Langley Park, Beeston Hall and Crown Point).	Local	Maintaining, conserving and enhancing the sense of history, through promoting the links between historical sites, archaeological evidence of human activity and the biological interest of the area, would achieve a wider understanding of the importance of the NCA. Increased opportunities to interact with history, may have potential to increase the service. This may lead to increased recreation and tourism, although management would be needed to ensure this is sustainable and does not have a negative impact on the assets themselves. The reinforcement of the sense of history of the area could contribute strongly to sense of place in the landscape. Loss of traditional village patterns through new infill development and the use of non traditional building materials in renovation work have been seen across the NCA which leads to a gradual erosion of historical assets and of the quality and distinctiveness of the built environment.	There are opportunities to conserve, enhance and promote the historic evidence of past human settlement, historic landscapes and their features, such as parkland where they are assessed as a priority in the area and wildlife habitats, particularly where these include historic drainage networks (for example former creek patterns, marsh dykes), woodland and wetland. Balance the need to protect the historic environment with aspirations for environmental enhancement condition while increasing the opportunities for sustainable recreation and tourism. Protect, maintain and restore historic buildings that are assessed as a priority in the region. Provide a sense of history through promotion of the archaeological record, as well as the value of geological sites in preserving a record of past landscape and climate change and evidence for early human occupation of the landscape. This will provide insights into (and opportunities for learning about) techniques of sustainable resource use and habitat management used in the past. Use local evidence of past climate change (such as the pollen record) to reconstruct past environments and gain insights into the potential impacts of future climate change on the landscape. Increase the sense of history by protecting the character and historic resource of the registered parks and gardens for the cultural history they contribute to the landscape character of the Broads. Where new developments are proposed there are opportunities to strength the historic settlement patterns across the NCA as a whole. Where the restoration of historic features is proposed encourage the use of local materials and the respect for local vernacular styles.	**Sense of history** **Sense of place/ inspiration** **Recreation** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Tranquillity	Geomorphology Topography Some of the broads Open marshes River valleys (Bure and Yare) Coast	57 per cent of the NCA is classified as undisturbed. Characteristics of the landscape that are particularly important in conveying a sense of tranquillity are the marshes of the Halvergate triangle, the coast (Happisburgh to Winterton) and through the river valleys of the Bure and Yare.	Local	Tranquil areas have fallen sharply from 89 per cent in the 1960s to 57 per cent in 2007. This is primarily due to increases in traffic. Areas of disturbance are associated with the urban areas of Lowestoft, Great Yarmouth, Caister-on-Sea and Norwich (in adjacent NCAs) together with the smaller rural towns such as Beccles and Bungay and the main road corridors linking these centres. Levels of disturbance activity vary widely between one area and another, from the bustling social and boating environment of Wroxham to the low-key tranquillity and wildness of the Waveney and Upper Thurne Valleys and the coast and marshes. The richness of wildlife and limited settlement lends a stark, remote, wilderness quality to these areas. Longer term, the decline in tranquillity is likely to continue. Traffic levels are projected to increase by 30 per cent by 2015 and development close to the main centres of population (Norwich, Great Yarmouth and Acle) will have a detrimental impact.	Ensure that remote broads, marshes and coastline continue to provide a significant tranquillity resource offering silence and feelings of escapism, especially in winter. Manage wild and remote areas and protect from further intrusion and development, including unnecessary night lighting to preserve tranquillity so that they continue to provide solitude and inspirational views. Increasing tranquillity by conserving and extending areas of semi-natural habitat, along with extending these habitats where possible will also provide benefits for biodiversity.	**Tranquillity** **Recreation** **Sense of place/ Inspiration** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Recreation	Rivers and broads Coast Public rights of way network National Trails Local Nature Reserves National Nature Reserves Wildlife	Diverse visitors include ramblers, artists, anglers, bird-watchers, ecotourists, boaters and other visitors. The Broads and the seven navigable rivers have been a boating holiday destination and an important centre for racing yachts since the late 19th century. The Broads remain a popular UK holiday destination worth £400 m p.a. to the local economy. Increasing numbers of visitors now engage in ecotourism rather than the more traditional 'broads boating holiday' and are drawn by the diverse wetland avifauna and scenic value of the flood plains. Rights of way total 565 km (1km/km^2) with some open access (311 ha). Footpaths typically follow the flood banks but include access between rivers and 'upland' areas. Two long distance trails, the Norfolk Coast Cycleway and Sustrans Route 1 also provide access. The shoreline provides access and recreation opportunities. The coastline itself provides a valued resource for water-based recreation and attracts a diverse range of activities including jet-skiing, motor cruising, angling and bird-watching. 52 per cent of the NCA has status equivalent to a National Park in which the Broads Authority promotes sustainable tourism, striving to ensure that recreation does not harm the natural environment.	National	Access and recreational opportunities exist to benefit local people and visitors. These areas contribute to feelings of relaxation and well-being. There is potential to increase routine engagement with the natural environment to further benefit physical and mental health. Recreation makes a significant contribution to the tourism income of the area, particularly the distinctive tourism opportunities offered by sailing and boating holidays. Remote broads provide a significant tranquillity resource offering silence, inspiration and feelings of escapism, especially in winter. Habitats contribute to earning opportunities, for example for birdwatchers; although conflicts do exist between wildlife conservation and the popularity of the area for recreation relating to wildlife disturbance and boat related pollution of the broads and waterways. Despite the extent of the navigable network in the Broads, very little use is made of the water as a means of public transport. Access to the area is mostly by car, often causing congestion at popular sites. Along the coast, areas of high use are located where the beach is accessible by road, including Eccles-on-Sea, Sea Palling and Winterton-on-Sea.	Identify areas where access is currently poor. Increase people's routine engagement with the natural environment to further benefit physical and mental health by developing improved public access that contributes to feelings of well-being. Provide interpretation of the history, biodiversity, geodiversity and other aspects of the landscape in well visited locations. Improve people's understanding of the farmed environment through educational access. Link public footpaths, settlements and long distance paths, especially on rising ground so as to be resilient to rising water levels. Create new routes adjacent to water to replace river bank routes that may be lost as a result of managed realignment and the development of a more natural flood plain. Extend access while meeting the goals of the Broads Flood Alleviation Project. Avoid adverse impacts of access (for example disturbance, erosion and littering). Avoid developing new access into quiet refuge zones for overwintering birds. Assess the likely increase in visitor numbers resulting from future development and population increase, identifying areas most at risk from the negative impacts of recreation and maintain tranquillity levels by creating 'quiet zones/areas'. Work in partnership to promote ecotourism as a mechanism to reduce environmental damage to waterways due to tourism pressure. Support well planned green infrastructure to provide sustainable access routes that enhance community safety, foster community cohesion and contribute to physical and mental health. Maximise the recreational benefits provided by the coastline, particularly the feelings of wilderness and freedom provided by the shoreline. During the development of coastal access, ensure that the coastal dune system is protected from damage resulting from excessive recreational pressure (for example by the development of a strategy for public access management).	**Recreation** **Sense of place / inspiration** **Sense of history** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biodiversity	Semi-natural habitats including: open water, rivers and broads, coastal and flood plain grazing marsh, reedbed, fen, flood plain scrub, carr woodland and wet woodland, ditches and dykes, lowland heathland, coastal dune, maritime cliff and slope and mudflats Geomorphology and operation of active processes	Land covered by international nature conservation designations (SPA, SAC, and Ramsar sites) totals 6,959 ha (12 per cent of the total land area). There are 2 Ramsar, 3 SPA and 2 SAC sites. Land covered by National Nature conservation designations (NNR and SSSI) totals approximately 7,000 ha, 12 per cent of the total land area. There are 10 NNR and 39 SSSI sites. There are also 103 Local Nature Reserves in the Broads covering 1,624 ha. In 2011 over 70 per cent of the SSSI area is in either favourable or unfavourable recovering condition.	International	Wetland habitats including fens, reedbeds, grazing marsh, wet woodland, salt marshes, intertidal mudflats and various coastal formations form one of the finest and largest marshland complexes in the UK, which provides important habitats for a extremely diverse range of animal and plant species, some rare and others restricted in their UK distribution to the Broads. Iconic species include the swallowtail butterfly, holly-leaved naiad, fen orchid, bittern, marsh harrier and otters. The coast is also important for little tern, and common and grey seals. Key to the success of these habitats is the quality of water in the appropriate quantities. Increasing threats to biodiversity come from non-native species, seasonal variability in river flows, depleted groundwater resources, incursion of saltwater from tidal flooding and diffuse pollution from land management. Climate change and rising sea levels add further challenges. The biodiversity provides high value landscapes, improvements in connectivity and benefits to other ecosystem services. Where in favourable condition. Where in unfavourable condition the landscape condition is generally lower.	Protect and safeguard the Broads internationally-significant resource of rare and protected species. Improve the health and resilience of the habitat network and associated biodiversity to safeguard against the consequential impacts of sea level rise and climate change. Identify opportunities for a more naturally functioning river and flood plain. Promote initiatives which facilitate re-wetting the drained flood plain, to maintain peat resource and promote carbon sequestration. Create new fenland habitat at the upstream extent of the system and plan for further sustainable restoration work through the adaptive management of the adjacent flood plain. Reinstate and extend wet grassland for breeding waders (for example lapwing, redshank, and snipe) and wintering wildfowl. Facilitate agricultural businesses in being able to undertake more tailored conservation management, through the encouragement and support provided by agri-environment schemes for example encourage the reinstatement of permanent pasture from arable within the drained marshland, to help extend and link marshland habitats. Use the spatial planning system to maintain adequate land for the natural environment. Identify research needs and commission appropriate studies to increase the effectiveness of strategies when implemented.	**Biodiversity** **Geodiversity** **Regulating water quality** **Regulating soil erosion** **Sense of place / inspiration** **Recreation** **Water availability**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Geodiversity	Coastal geomorphological processes Geological exposures (coastal cliffs) River valley exposures Quarry exposures Geomorphology Archaeology Palaeo-environments	There are 2 Local Geological Sites within the NCA. Notable features are the soft sediment cliffs at Happisburgh that consist of Quaternary sediments underlain occasionally by Late Tertiary deposits. The foreshore at Happisburgh contains evidence of the earliest human occupation of Britain over 800,000 years ago. Norwich Crag formation exposures at Bramerton Pits SSSI and Leet Hill SSSI and along the edges of the Bure and Ant Valleys and the Yare and Waveney Valleys. Isolated deposits of glacial sands and gravels are present in the northern uplands and along the edges of the Yare and Waveney Valleys. The geology of the south of the NCA is dominated by chalky boulder clay (Lowestoft Till) deposited by the Anglian ice sheet.	Local	When attacked by waves the soft cliffs slump and slide down on to the beach before being washed away. The cliffs and the continuing succession of exposed sediments are central to understanding the quaternary climatic and environmental 'history' across the wider NCA, which may well, have implications for our understanding of the impacts of future climate change.	Ensure that sand and gravel extraction sites are restored to contribute to local landscape character and enhance biodiversity and geodiversity opportunities, providing improved access where possible. This should be reflected in quarry restoration plans. Use geological sites to attract visitors of all kinds including those interested in archaeology and history, those interested in the local area and people interested in geology. Use these sites as an educational tool for local people and also the wider community. Ensure that geodiversity sites continue to be protected, and improve these sites so that their status doesn't decline. Utilise opportunities to emphasise the integral role of geodiversity in underpinning the landscape and influencing the character of the NCA. Maintain and enhance the geological and geomorphological resource through implementation of the Norfolk Geodiversity Action Plan, specifically through maintenance of natural fluvial and coastal processes together with the development of local geological conservation strategies and assessment of educational/ research value of new sites. Identify opportunities for geodiversity (and biodiversity) enhancement which might develop through the reinstatement of natural flood plain and coastal functioning.	**Geodiversity** **Biodiversity** **Recreation** **Sense of place / inspiration** **Sense of history**

Photo credits
Cover photo: Grassland, arable and woodland combine to form the Broads historic landscape character. © Jonathan Dix/Natural England
All photos © Jonathan Dix/Natural England, except:
Page 4, 40 & 43 © Eric Dix
Page 5 © Paul Glendell/Natural England
Pages 12 & 60 © Peter Wakely/Natural England
Page 28 © Lesley Marsden/Broads Authority

NATURAL ENGLAND

Natural England is here to secure a healthy natural environment for people to enjoy, where wildlife is protected and England's traditional landscapes are safeguarded for future generations.

Catalogue Code: NE449 ISBN: 978-78367-006-2

Natural England publications are available as accessible pdfs from **www.gov.uk/natural-england**. Should an alternative format of this publication be required, please contact our enquiries line for more information: 0845 600 3078 or email **enquiries@naturalengland.org.uk**