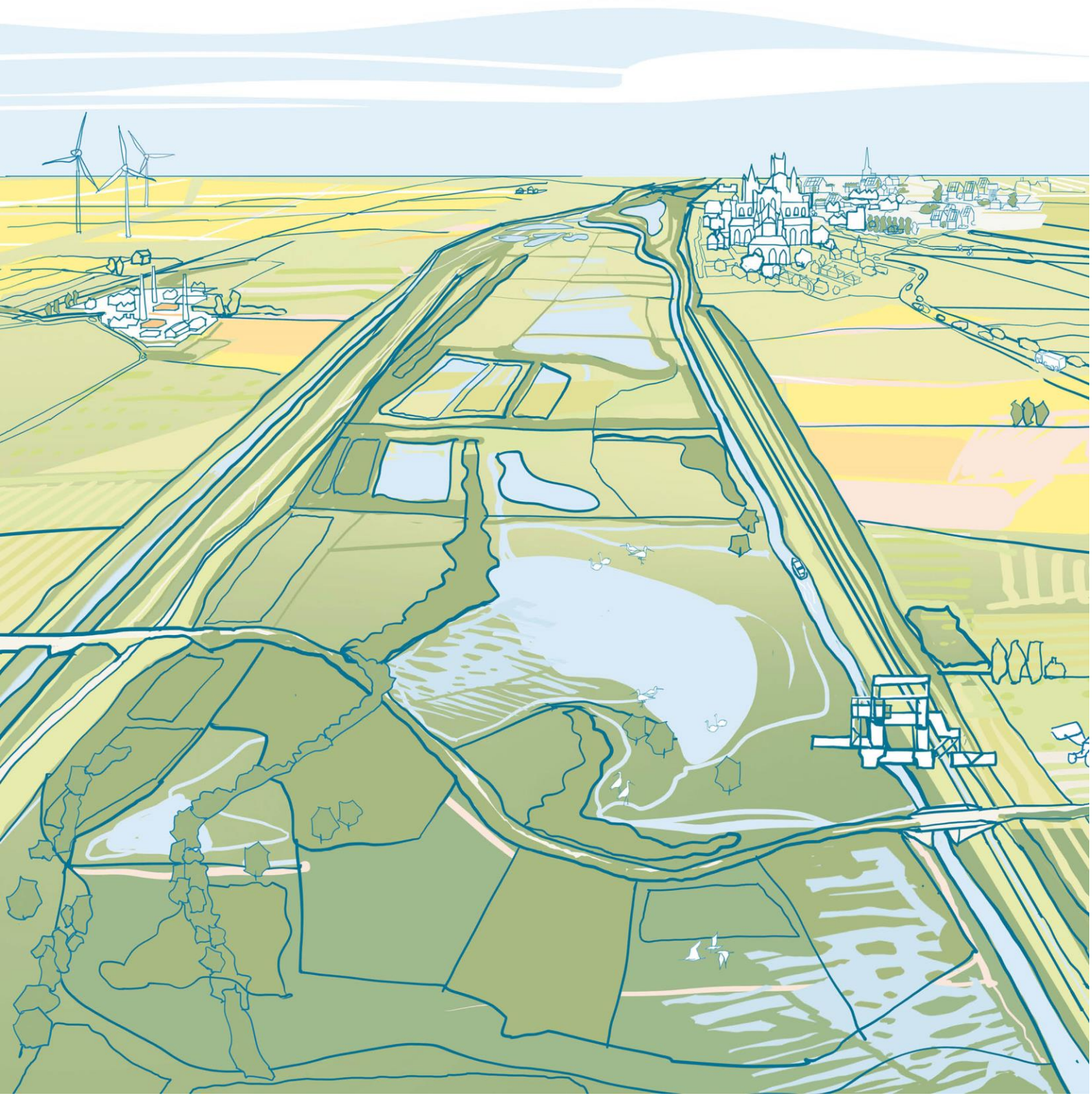


Lower Nene

Environmental and agricultural baseline

2025



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1. Introduction

1.1 Aim and purpose of this document

This document presents a catchment-scale environmental and agricultural baseline for the Lower Nene catchment. It is intended to support future choices, investments and actions for the Fens 2100+ programme (hereafter referred to as the “Fens 2100+”). The environmental and agricultural baseline covers the following disciplines:

- Landscape
- Agriculture
- Ground conditions (soils and resources)
- Water Environment
- Biodiversity
- Cultural Heritage
- Population and Health
- Air Quality

1.2 Usage statement

This document should be read alongside the Lower Nene baseline evidence report and associated appendices (including the Lower Nene Assets Baseline Appendix and the Lower Nene Flood Risk Appendix) and is intended to provide a strategic environmental and agricultural baseline which will inform the development of a future Sustainability Appraisal for the Fens 2100+. This document provides a proportionate level of detail required for a strategic catchment-scale baseline. A detailed baseline analysis may be required at project level to align with the Environment Agency’s Minimum Technical Requirements or Environmental Impact Assessment.

1.3 Catchment context

The Lower Nene catchment (hereafter referred to as “the catchment”¹) covers 553km² (55,300 hectares (ha)) of East Lincolnshire, located in the middle of the Fens 2100+ study area. The catchment stretches from Peterborough in the south-west to the Lutton Leam Sluice where it discharges to the North Sea. The Great Ouse catchment is located to the south and east, and the Lower Welland catchment to the north and west.

The catchment comprises a network of drains that feed into the primary Main River, the River Nene, which is operated and maintained by the Environment Agency. Morton’s Leam is also a Main River and together these watercourses represent a high-level carrier system that accepts water from surrounding low lying areas and conveys this water by gravity to The Wash.



Figure 1: Lower Nene catchment © Colin Park and licensed for reuse under this Creative Commons Licence

¹ The Lower Nene catchment is not strictly a hydrological catchment as there are movements of water both into and out of the area defined, that are not being considered in this report. However, the term ‘catchment’ has been used throughout the dialogue with the Environment Agency during establishment of the study areas and these areas are being defined for water management purposes. Therefore, the term catchment is used to describe the study area.

The Environment Agency have permissive powers to carry out flood and coastal risk management activities on Main Rivers as well as certain non-Main Rivers known as critical ordinary watercourses. In addition, the Environment Agency are responsible for producing a national strategy for Flood and Coastal Erosion Risk Management (FCERM). The latest strategy published in 2020 contains 'Measure 1.5.4'. This requires development of a long-term plan for managing future flood risk in the Fens. Ordinary watercourses are regulated by Internal Drainage Boards (IDBs) and the Lead Local Flood Authority (LLFA), which includes Lincolnshire County Council, Peterborough City Council and Cambridgeshire County Council for the catchment.

Internal Drainage Boards (IDBs) play a vital role in managing water levels and drainage across the catchment for agricultural and environmental purposes. The IDB drains discharge to the Main Rivers via various pumping stations and sluice gates.

An extensive network of drains are drained by three IDBs (The South Holland, North Level District and Fenland IDBs), with an extensive network of drains including the North Level Main Drain, South Holland Main Drain, New South Eau and the Little Holland Drain.

Water management in the catchment is supported by a system of pumping stations, sluices and locks, most notably the Stanground Lock and Sluice, Rings End Sluice, Dog-in-a-Doublet Sluice, Tydd Pumping Station, Sutton Bridge Sluice and Lutton Leam Sluice. The tidal limit of the river is controlled by the lock and sluice at Dog-in-a-Doublet. Downstream of this point, the River Nene is a highly engineered channel which includes tidal embankments along its 55km length. Critical flood management assets in the catchment include the Whittlesey (Nene) Washes, a flood storage area spanning 15km² (1,500ha) and extending 20km along the southern side of the River Nene.

Over a third of the catchment lies below sea level, with the lowest lying areas located in the vicinity of the Lowland Drain south-west of Tydd Saint Giles and the A47 between Thorney and Guyhirn.

The land use within the catchment is primarily agricultural, focused on arable and higher value cropping. It is a highly productive agricultural area with approximately 41% of the land classified as Grade 1 agricultural land.

Although largely rural, the catchment includes several key urban areas, such as Peterborough, Long Sutton and Wisbech.

Other key land uses are summarised below.



Figure 2: Delph Bank and agricultural land north of Sutton St James © Kate Jewell and licensed for reuse under this Creative Commons Licence

1.3.1 Settlements

The land to the west of the A1101 is sparsely populated with occasional farmsteads, with more frequent dwellings and farmsteads found to the east of the catchment, connected by main roads. The market town of Peterborough is located at the south-western edge of the catchment and is the largest settlement in the area. The catchment is home to several small settlements, including Wisbech, Holbeach, Long Sutton and Sutton Bridge.

1.3.2 Access and connectivity

The main arterial roads include the A16, A47, A151 and A1101.



Figure 3: Peterborough cathedral © Paul Bryan and licensed for reuse under Creative Commons Licence

Figure 4 illustrates the spatial distribution of transport and access routes in the catchment.

- The A16 runs north across the western portion of the catchment, connecting Peterborough with Spalding;
- The A47 runs east across the southern portion of the catchment, linking Peterborough to Wisbech; and
- The A1101 runs north across the eastern portion of the catchment, connecting Wisbech to the villages in the north.

Parts of the East Midland Railway network interfaces with the catchment. The railway network connects Peterborough with March and Spalding.

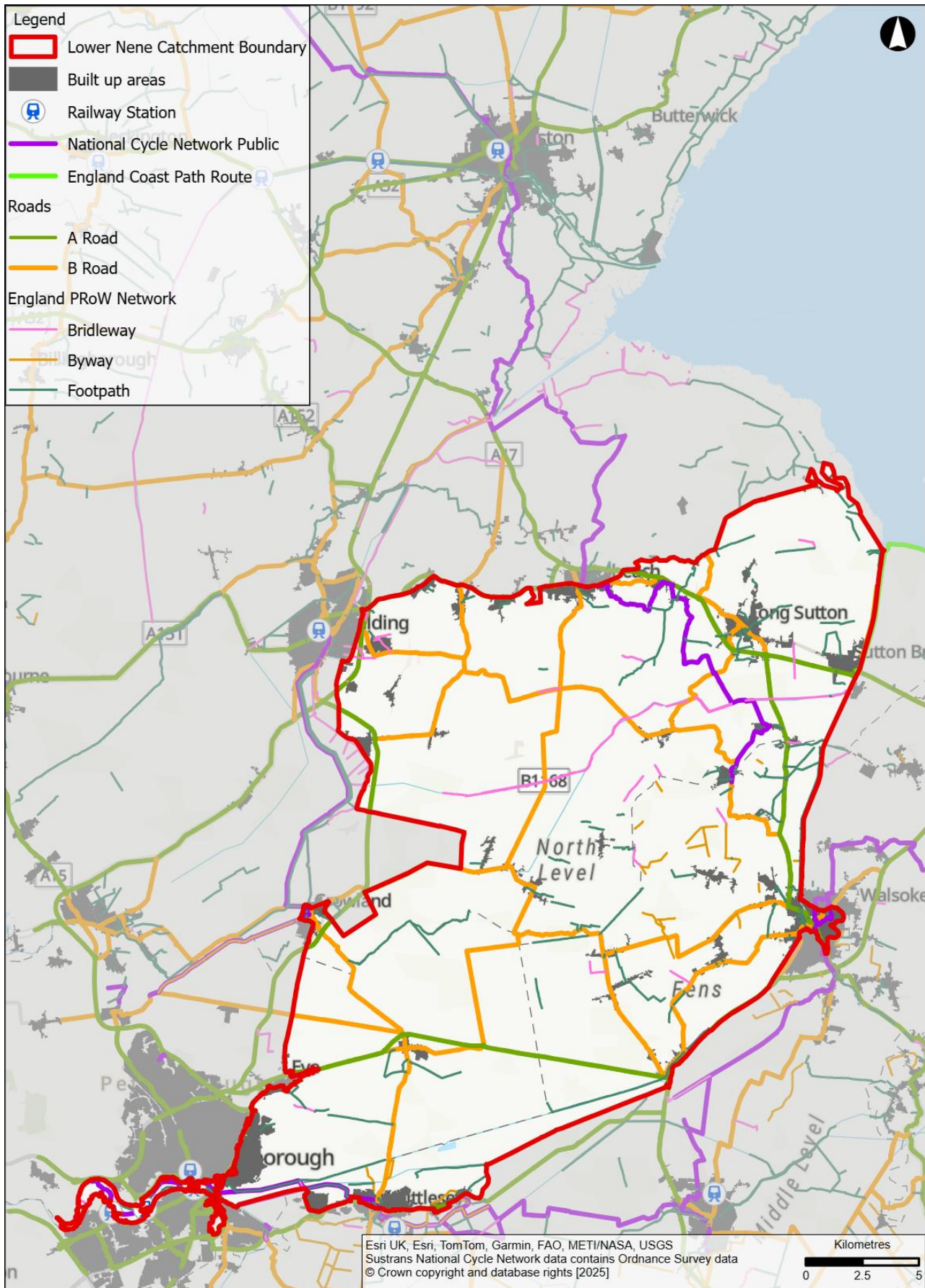
The River Nene allows for water navigation from Peterborough to the discharge of the river to the North Sea.

The King Charles III England Coast Path is located in the north-eastern part of the catchment following the coastline and is under construction south of Gibraltar Point. Additionally, three National Cycle Network (NCN) routes are located within the catchment:

- NCN Route 1: This long distance route in section from Dover to Scotland passes through the north of the catchment, connecting Holbeach with Whittlesey via minor roads.
- NCN Route 12: This long distance route runs in sections from Spalding to London and passes through the west of the catchment.
- NCN Route 63: This long distance route runs in sections from Burton on Trent to Wisbech. It runs roughly parallel with the River Nene connecting Wisbech with Whittlesey and Peterborough
- Renewable energy infrastructure

In common with other areas across the Cambridgeshire and Lincolnshire Fens, there is evidence of farm diversification to support renewable energy. Key developments include:

- Wyrde Croft Wind Farm, Thorney, 26MW;
- The Grange Wind Farm, Sutton Bridge, 14MW;
- Grange Farm Solar Park, Sutton St James, 12.7MW [1]; and
- Murrow Anaerobic Digestion (AD) plant, Murrow, 1,500kW [2].



There are also a number of new solar farm projects either in proposal or construction phase across the catchment.

Figure 4: Local transport and access routes

2. Overview of legislation and policy context

This section presents an overview of the legislative and planning policy that may be applicable to any future Flood and Coastal Erosion Risk Management (FCERM) intervention or project within the catchment. This includes national, regional and local policy which has been considered across the disciplines included within this document. A detailed baseline analysis may be required at project level to align with the Environment Agency's Minimum Technical Requirements or Environmental Impact Assessment.

2.1 Environment Act (2021)

The Environment Bill became an Act [3] (law) in November 2021, amending the Environment Act 1995 [4]. The Act provides targets and policy for improving the natural environment in relation to air quality, restoring natural habitats, increasing biodiversity, reducing waste and making better use of resources. Key aspects of the Environment Act 2021 which are relevant to the Fens 2100+ include but are not limited to:

- Provisions that require that at least a 10% net gain for biodiversity be demonstrated through a Biodiversity Net Gain assessment (using Defra's Statutory Biodiversity Metric);
- A new mandatory system of spatial strategies for nature through Local Nature Recovery Strategies (LNRS); designed as tools to encourage more coordinated practical and focused action and investment in nature;
- Measures to support new and existing internal drainage boards (amending the Land Drainage Act 1991); and
- Effective collaboration between water companies through statutory water management plans.
- Requirement for local authorities to report to Defra on local air quality and local air quality management within their local authority area. This also requires an assessment of compliance against the relevant air quality standards.

2.2 Agriculture Act (2020)

The Agriculture Act for England [5], represents a significant shift in agricultural policy post-Brexit. This legislation aims to reward farmers and land managers for delivering "public goods" such as improved air and water quality, thriving wildlife, and measures to tackle climate change. The Bill includes measures to the phase out of the of Basic Payment Scheme (BPS) by 2028, which is proceeding as planned.

Key features of the bill include:

- Environmental Land Management Scheme: Farmers will be incentivised to provide environmental goods and services alongside food production. There will be three schemes:
 - the Sustainable Farming Incentive (SFI) will pay farmers to adopt and maintain sustainable farming practices that can protect and enhance the natural environment alongside food production, and also support farm productivity;
 - Countryside Stewardship (CS) will pay for more targeted actions relating to specific locations, features and habitats. There will be an extra incentive through CS Plus for land managers to join up across local areas to deliver bigger and better results; and
 - Landscape Recovery will pay for bespoke, longer-term, larger scale projects to enhance the natural environment

- **Transition Period:** A seven-year transition period to move away from the EU's Basic Payment Scheme, which primarily rewarded the amount of land farmed, towards a system that rewards environmental benefits. This includes the phase out of the of Basic Payment Scheme (BPS) by 2028, which is proceeding as planned. In 2024, the payments are for the first time, delinked from land, meaning that farmers who were farming before 2024 will continue to receive the remainder of BPS through to 2027, even if they stop farming or dispose of land. These changes mean there will be a push towards farming being profitable at global market prices by 2028.
- **Support for Innovation:** Investments in new technology and research to boost productivity and sustainability in farming.

2.3 Flood and Water Management Act (2010)

The Flood and Water Management Act 2010 [6] is a significant piece of legislation in the UK aimed at improving the management of flood risk and water resources. Key aspects of this legislation include:

- **Risk Management Authorities:** The Act designates various authorities, including the Environment Agency, Lead Local Flood Authorities (LLFAs), and Internal Drainage Boards (IDBs), with specific responsibilities for managing flood risks.
- **Partnership and Cooperation:** It emphasises the need for these authorities to work in partnership and share information to effectively manage flood risks.
- **Sustainable Drainage Systems (SuDS):** The Act promotes the use of sustainable drainage systems to manage surface water and reduce flood risk.
- **Flood Risk Management Strategies:** Authorities are required to develop and implement strategies for managing flood risks, including mapping and assessing flood risks.
- **Reservoir Safety:** The Act includes provisions to improve the safety of reservoirs, ensuring they are regularly inspected and maintained.
- **Powers and Duties:** It grants new powers to authorities to carry out works to manage flood risks and imposes duties on them to maintain a register of structures or features that affect flood risk.

2.4 National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) [7] sets out the Government's planning policies for England and how these should be applied. It was last updated in December 2024. It aims to achieve sustainable development through a balanced approach that considers economic, social, and environmental objectives. Key aspects of Sustainable Development in the NPPF include:

- **Growth and innovation:** Ensuring sufficient land is available to support economic growth, innovation, and productivity.
- **Infrastructure:** Coordinating the provision of infrastructure to support development
- **Housing:** Providing a sufficient number and range of homes to meet the needs of present and future generations.
- **Community well-being:** Fostering well-designed, safe, and accessible places that support health, social, and cultural well-being
- **Natural and built environment:** Protecting and enhancing natural, built, and historic environments.
- **Resource efficiency:** Using natural resources prudently, minimizing waste and pollution, and mitigating climate change impacts

- Meeting the challenge of climate change, flooding and coastal change: Supporting measures that ensure the future health and resilience of communities and infrastructure to climate change impacts, including flooding.

2.5 Environmental Improvement Plan (EIP) (2023)

The Environmental Improvement Plan for England (EIP) [8] details how the Government will work with communities and businesses to improve the environment compared to its current state. It is the first revision of the 25 Year Environment Plan (25YEP), providing interim targets to measure progress for improving the environment. Key aspects of the plan which are relevant to the Fens 2100+ include but are not limited to:

- Supporting the management of 70% of the countryside to adopt nature friendly land management practices by incentivising farmers;
- Updating a Green Finance Strategy setting out steps to leverage private finance to deliver the goals of the 25YEP;
- Published the Land Use Framework in 2023, setting out how to balance multiple demands on land including climate mitigation and adaptation;
- Deliver investment plan to improve coastal and flood defences, including £100 million on the most frequently flooded areas; and
- Reward farmers for actions to reduce risks and impacts from floods, droughts, and wildfires through our new future farming schemes.

2.6 Summary of key legislation and policy

A wide range of legislation is relevant to the different aspects of the environment and agriculture for Fens 2100+. Table 1 present a summary of the relevant key legislation, policy and guidance. This summary is not intended to be exhaustive and should be reviewed as part of any future interventions or projects.

Table 1: Summary of key environmental legislation and policy

Topic	Relevant Legislation, Policy and Guidance	Summary
Landscape	Guidelines for Landscape and Visual Impact Assessment [9]	Protection of landscape character and quality and the creation of Green Infrastructure.
	The European Landscape Convention (2006) [10]	
Agriculture	Autumn Budget 2024 [11]	The changes to Agricultural Property Relief (APR) and Business Property Relief (BPR) were announced in the Autumn Budget 2024. APR will be extended to include land managed under environmental agreements with the UK government, devolved governments, public bodies, local authorities, or approved responsible bodies. The 100% relief rate for APR and BPR will apply only up to a combined allowance of £1 million. These changes will be legislated in the Finance Bill 2024-25.
Ground Conditions	Safeguarding our Soils - A strategy for England (2009) [12]	Protect best quality soils and agricultural land as well as the protection and restoration of peatland habitat.
	England Peat Action Plan [13]	

Water Environment	The Environment (Amendment etc.) (EU Exit) Regulations 2020 [14]	The key objectives of these acts/policies are to reduce and manage flood risk, improve water quality (so all water bodies achieve 'Good status' as set out in the Water Environment Regulations), prevent or limit groundwater pollution and promote the efficient use of water.
	Environmental Protection Act 1990 [15]	
	Water Resources Act 1991 [16]	
	The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (WFD) [17]	
	Land Drainage Act 1991 [18]	
	Water Act 2014 [19]	
	Water Resources (Abstraction and Impounding) Regulations 2006 [20]	
	Flood Risk Regulations 2009 [21]	
	Nitrate Pollution Prevention Regulations 2015 (as amended) [22]	
Biodiversity	The Conservation of Species and Habitat Regulations 2017 [23]	These pieces of legislation state the offences relating to protected species and the requirements for licenses to allow any damaging works to proceed. Specific actions which are prohibited by legislation can be made lawful on the approval and granting of a derogation license from Natural England (NE) and, or assent can be applied for when works are proposed within Special Site of Scientific Interest (SSSI) that could damage the interest features, or specific conditions are stated. In addition, the Habitats Regulations set out the requirement for the consideration of the potential effects of a plan or project upon European Sites through the Habitats Regulations Assessment (HRA) process.
	Wildlife and Countryside Act 1981 (as amended) (WCA) [24]	
	Natural Environment and Rural Communities (NERC) Act 2006 [25]	
	The Countryside and Rights of Way Act 2000 [26]	
	The Hedgerows Regulations 1997 [27]	
	Protection of Badgers Act 1992 [28]	
	The Salmon and Freshwater Fisheries Act 1975 [29]	
	The Eels (England and Wales) Regulations 2009 [30]	
	The Invasive Alien Species (Enforcement and Permitting) Order 2019 [31]	
Cultural Heritage	Ancient Monuments and Archaeological Areas Act (1979) [32]	Protect nationally important archaeological remains, historic buildings, historic landscape features and remains of military aircraft and vessels that have crashed, sunk or been stranded and of associated human remains
	Planning (Listed Buildings and Conservation Areas) Act (1990) [33]	

	Protection of Military Remains Act (1986) [34]	
	Hedgerows Regulations (1997) [35]	
	Treasure Act (1996) [36]	
Population and Health	Countryside and Rights of Way Act (2000) [26]	Promote sustainable and healthy communities and social inclusion and community participation. The policies and guidance encourage a 'whole system' approach to engaging planning and environmental agencies in support of health, well-being and social care provision.
	Health and Social Care Act (2012) [37]	
Air Quality	Air Quality Standards Regulations 2010 (amended in 2016) [38]	Defines the policy framework for twelve air pollutants known to have harmful effects on human health or the natural environment. The Secretary of State for the Environment has the duty of ensuring compliance with the air quality limit values. The regulation sets out the national air quality standards for NO ₂ , PM ₁₀ and PM _{2.5} . It also provides guidance on how air quality should be considered to comply with the NPPF.
	Planning Practice Guidance (PPG) 2014 [39]	
	Defra Clean Air Strategy 2019 [40]	

2.7 Local plans

The catchment is located within the Local Planning Authority boundaries of South Holland District Council, Peterborough City Council and Fenland District Council. Accordingly, the South East Lincolnshire Local Plan [41], the Peterborough Local Plan [42] and the Fenland Local Plan [43] cover the catchment (Figure 5). The respective Local Plans set out the vision and strategic policies for each area.

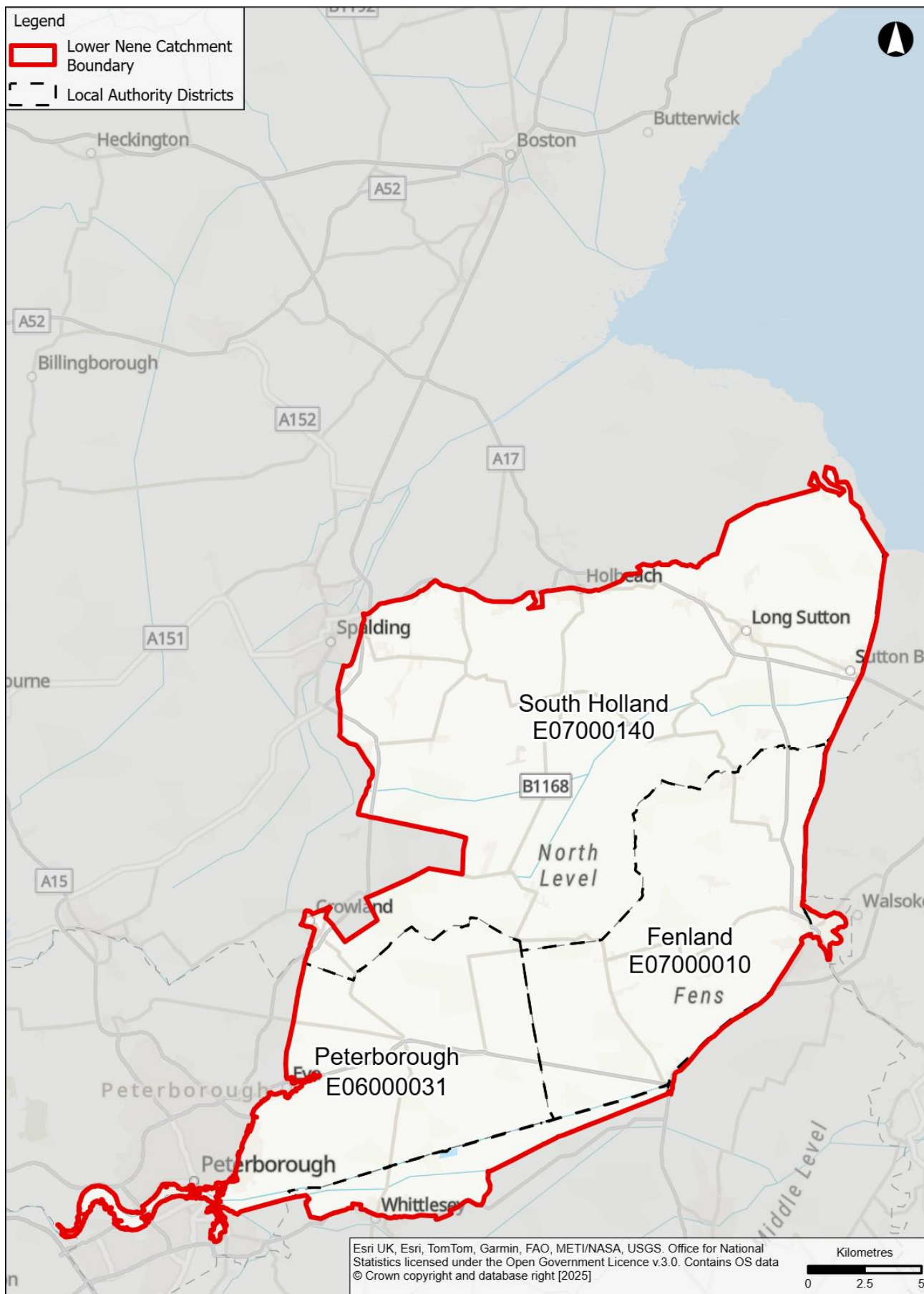


Figure 5: Local Authority districts for the catchment

2.7.1 South East Lincolnshire Local Plan (2011-2036)

The northern portion of the catchment is under the jurisdiction of South Holland District Council. The South East Lincolnshire Local Plan [41] was prepared jointly by Boston Borough Council and South Holland District Council, and adopted in March 2019. The following policies are considered key to environment and agriculture:

- Strategic Policy 3 – Design of New Development: outlines the requirement for new developments to respect and enhance the character of the landscape and the quality of an area. The policy also recognises the importance of using high quality and inclusive design and layout to make innovative use of local traditional styles and materials.
- Strategic Policy 4 – Approach to Flood Risk: outlines the requirement for development proposals to take account of flood risk issues and ensures that new development will be resilient to the potential consequences of flooding.
- Strategic Policy 28 – The Natural Environment: recognises the importance of protecting both national and locally-designated habitats and species; and the value of addressing gaps in the ecological network in the Local Plan area.
- Strategic Policy 29 – The Historic Environment: outlines the policy approach with respect to Listed Building and Conservation Areas within the Local Plan area. The policy also recognises the role of enabling development in securing improvements to heritage assets.
- Strategic Policy 30 – Pollution: outlines how new developments must account for environment impacts on surface and groundwater quality, in particular, adverse effects arising from pollution.

2.7.2 Peterborough Local Plan (2016-2036)

The south-west portion of the catchment is under the jurisdiction of Peterborough City Council. The Peterborough Local Plan [42] was adopted July 2019. Peterborough City Council are preparing a new Local Plan [44], which is currently under consultation as of August 2025. This plan will guide growth and regeneration in Peterborough up to 2044 and will replace the existing Adopted Peterborough Local Plan. The following policies from the current Local Plan are considered key to the environment and agriculture:

- Strategic Policy LP16 - Design and the Public Realm: outlines the requirement for new developments to positively contribute to the character of the landscape and the quality of an area.
- Strategic Policy LP19 - The Historic Environment: outlines the requirement for development proposals to respect and enhance the local character of the area, particularly in areas of high heritage value.
- Strategic Policy LP20 - Special Character Areas: outlines the policy approach to preserve the special character of Wothorpe, Thorpe Road and Ashton.
- Strategic Policy LP22 - Green Infrastructure Network: outlines the policy approach to maintain and improve the existing green infrastructure network in Peterborough. The policy also outlines the requirements for development proposals to ensure that existing and new green infrastructure is considered and integrated into the scheme design from the outset.
- Strategic Policy LP23 – Local Green Space, Protected Green Space and Existing Open Spaces: outlines the requirement to protect spaces from development unless there are no significant detrimental impacts on the character and appearance of the surrounding area, ecology and any heritage assets.
- Strategic Policy LP24 – Nene Valley: outlines the emphasis on low-impact development across valley and the support for developments which can enhance navigation, public access and ecosystems and protect biodiversity within the Nene Valley.

- Strategic Policy LP26 – Green Wedges: outlines the policy approach to granting planning permission within areas identified as Green Wedges. Planning permission will only be granted where it can be demonstrated that the development is not contrary to a list of functions and aims.
- Strategic Policy LP27 - Landscape Character: outlines the requirement for development proposals to retain, enhance or restore the distinctive qualities of the landscape character the development is situated in.
- Strategic Policy LP28 – Biodiversity and Geological Conservation: outlines the requirements to manage, protect, enhance and create habitats which can contribute to landscape character.
- Strategic Policy LP29 – Trees and Woodland: outlines the importance of maintaining, improving and expanding existing tree and woodland cover and seeking opportunities to expand woodland where appropriate to do so.
- Strategic Policy LP32 - Flood and Water Management: outlines the requirement for development proposals to take account of flood risk issues and ensures that new development will be resilient to the potential consequences of flooding.

2.7.3 Fenland District Council Local Plan

The south-east portion of the catchment is under the jurisdiction of Fenland District Council. The Fenland Local Plan [43] was adopted in May 2014. The following policies are considered key to the environment and agriculture:

- Strategic Policy LP14 – Responding to Climate Change and Managing the Risk of Flooding in Fenland: outlines the requirement for development proposals to take account of flood risk issues and ensures that new development will be resilient to the potential consequences of flooding. The policy also outlines the approach for developments to utilise renewable energy sources.
- Strategic Policy LP16 – Delivering and Protecting High Quality Environments across the District: outlines the requirement for development proposals to make a positive contribution to the local distinctiveness and character of the area.
- Strategic Policy LP18 – The Historic Environment: outlines the policy approach to protect, conserve and seek opportunities to enhance the historic environment.
- Strategic Policy LP19 – The Natural Environment: outlines the policy approach to conserve, enhance and protect the biodiversity and geological interest of the natural environment.

The Fenland District Council is currently preparing a replacement new Local Plan.

3. Methodology

This section presents an overview of the methodology used to develop the catchment-scale environmental and agricultural baseline. It has been produced using a desk-based review of publicly available information from a variety of sources.

3.1 Catchment study area

Figure 6 presents an overview of the study area used for the catchment environmental and agricultural baseline.

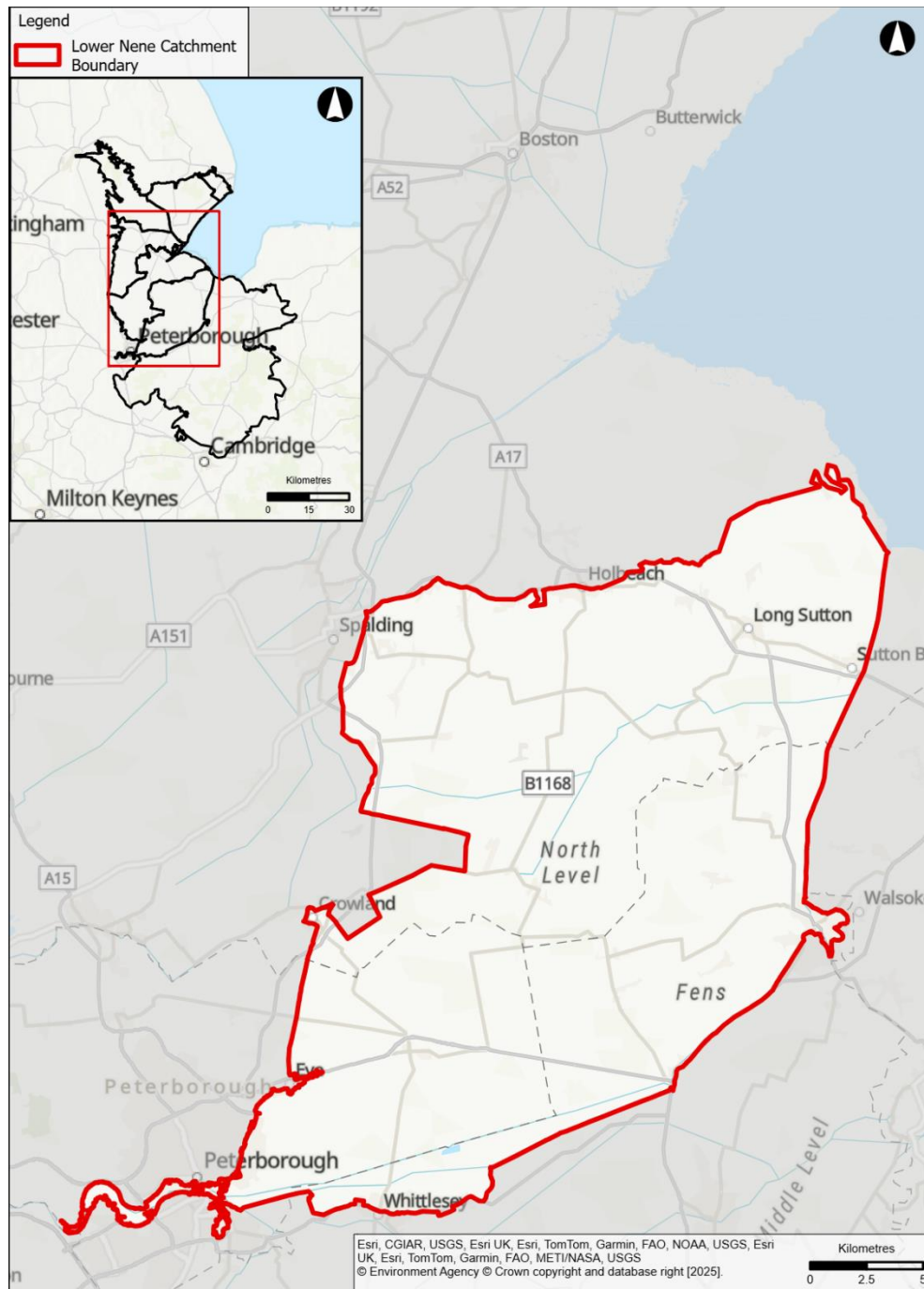


Figure 6: Lower Nene catchment

3.2 Limitations and Assumptions

The following limitations and assumptions have been made in the production of this catchment-scale baseline report:

- The baseline collated comprises a proportionate level of detail from publicly available data sources and it is reported at the geographical basis relevant to the data availability. Therefore, this report reviews and provides commentary of existing reports written by others. Arup accept no responsibility for any error or omission in this report which is due to an error or omission in the original documentation we refer to. Arup have not independently verified the information and have assumed it to be accurate, complete, reliable, and current as of the date of such information.
- This baseline assessment has not been informed or verified by any field surveys or site visits conducted by Arup.
- Due to the strategic nature of this baseline report, engagement and consultation with external stakeholders or statutory consultees has not been undertaken to inform this report.
- This baseline assessment is currently limited to the catchment boundary that has been defined for the Fens 2100+ project by the Environment Agency. It should be noted that the zone of influence for any future interventions or projects as part of Fens 2100+ may extend beyond the study area identified in Figure 6.
- Arup has used publicly available data to undertake a review of baseline conditions throughout the study area.

The following limitations and assumptions apply to the individual environmental and agricultural baseline chapters presented in this document:

- Landscape:
 - The landscape baseline excludes discussion on the significance of landscape and visual considerations.
- Agriculture
 - The agricultural baseline is based on the official data available which is produced at district level. There is no official data boundary that matches the catchment study area. Data reported within this baseline has been sense-checked against other sources such as published satellite data and been informed by local sector knowledge, to ensure that the estimates are as robust as possible.
 - As publicly available satellite derived data on land cover (and crops) improves over the next 5 years, the ability to analyse agricultural data at small spatial levels will improve. However, agricultural cropping is also subject to larger year to year variations, often due to extreme weather events, or longer-term changes in the market. Therefore, even if detailed data was available, e.g. for the 2023-'24 crop year, this would need to be treated with caution and averaged with other years.
 - The greenhouse and Controlled environment agriculture data resolution is poor at national as well as regional levels, as Defra withdrew from collecting this data in the early 2010s. This baseline therefore uses the limited Defra data to sense-check local knowledge of the larger greenhouse units. The output per hectare in this sector is also extremely variable from crop to crop and farm to farm. The approach taken was to use conservative averages derived from Defra national data and to check this against feedback from individual growers undertaken by Collison and Associates.
 - The main additional assumption is that farms in the catchments do not, on average, deviate much from regional and national averages of output for the enterprises they run. This is the only practicable way to produce the data, as individual farm level

data is not available or published by any source. Our working assumption is that, given the higher productivity in general of the Fens that this produces a conservative estimate of the true value of farm output in the Fens.

- Ground conditions:
 - This baseline does not provide a review of available ground investigation data (borehole data etc.) beyond those specifically outlined or comprise the development of a catchment level ground model. Further, this baseline excludes discussion on the significance of mineral safeguarding designations, their specific extents or resource volume capability.
- Water environment:
 - The water environment baseline excludes in-depth discussion on Water Framework Directive / Water Environment Regulations. Reporting of all Water Environment Regulations baseline data or delivery of any preliminary compliance assessments has been excluded.
- Biodiversity:
 - The biodiversity baseline excludes discussion on non-statutory designated sites (e.g. Local Wildlife Sites and Roadside Nature Reserves). Records of protected and notable species from Local Environmental Records Centres or flora or fauna records have not been obtained at this stage.
- Cultural heritage:
 - The cultural heritage baseline excludes discussion on the significance of heritage assets, the assessment of impact(s), and a detailed baseline analysis which would identify non-designated heritage assets and specific areas of archaeological potential.
- Population and health
 - The population and health baseline is based on the official data available which is published at different spatial boundaries. There is no official data boundary that matches the catchment study area. The baseline collated comprises a proportionate level of detail from publicly available data sources and it is reported at the geographical basis relevant to the data availability. Different classes of administrative unit each have their own datasets in terms of the geographical scale at which they operate and these have been used to inform the baseline:
 - Wards
 - Lower Layer Super Output Area (LSOAs)
 - Middle Layer Super Output Areas (MSOAs)
 - Lower Tier Local Authority Areas
 - Upper Tier Local Authority Areas
- Air Quality:
 - The air quality baseline will exclude discussion on consideration of pollutants other than NO₂, NO_X, PM₁₀ and PM_{2.5}. No dispersion modelling has been carried out at this time.

4. Catchment-scale baselines

The following sections provide an overview of the environmental and agricultural baseline.

4.1 Landscape

This section outlines the baseline landscape characteristics for the catchment. Table 2 outlines the key terminology used in this section.

Table 2: Glossary of landscape and land use terminology

Terminology	Summary Definition
National Character Area	A National Character Area (NCA) is a natural subdivision of England based on landscape, biodiversity, geodiversity, and economic activity. Their boundaries follow natural lines in the landscape, not county or district boundaries. This makes them a good framework for decision-making and planning for future change [45].
Landscape Character Assessment	The process of identifying and describing the unique variations in the character of the landscape. It aims to explain the distinct combination of elements and features that make one landscape different from another [46].
Green and Blue Infrastructure	Refers to a strategic network of natural and semi-natural areas designed to deliver a wide range of environmental, social, and economic benefits.

4.1.1 Landscape character

National Character Area

The majority of the catchment is located within the National Character Area (NCA) 46 The Fens [47] (See Figure 7). The Fens NCA is a distinctive, historic and human influenced wetland landscape lying to the west of The Wash estuary. The NCA is notable for its large-scale, flat, open topography with extensive vistas to level horizons. The level, open topography shapes the impression of huge skies which convey a strong sense of place, tranquillity and inspiration.

Vegetation cover largely comprises meadows, coastal and flood plain grazing marsh, purple moor-grass and rush pastures and sparse woodland. Given the flat and open landscape, new planting can introduce inappropriate and visually intrusive elements.

The NCA has a distinctive hierarchy of rivers, drains and ditches which strongly influences the dominant rectilinear/geometric landscape pattern which is a consistent feature of the area. The drainage infrastructure (including the network of drainage ditches, embankments and pumping stations) provides an evident reminder of the area's reclaimed past. Efforts to drain the area have resulted in much of the Fens area being predominantly utilised for arable agriculture (wheat, root crops, bulbs, vegetables and market gardening).

Statements of Environmental Opportunity (SEO) for the NCA have been identified by Natural England² based on the unique characteristics and properties of the Fens [47]. These priorities comprise the following which should be considered during future project stages:

- Manage the agricultural landscape and soils which allow the Fens to be a major provider of

² Statements of Environmental Opportunity are developed by Natural England and reflect their opinion on how best to secure environmental gains within each NCA.

food and horticultural produce, while seeking to enhance opportunities for biodiversity.

- Manage the core wetland complexes and increase their connectivity by enhancing the Main Rivers, waterways and their associated riparian habitats and improve recreational access opportunities to the Fens.
- Plan for the creation of new coastal landscapes in The Wash area that are adapted and resilient to the impact of climate change, for the benefit of people and wildlife.
- Conserve, manage and enhance the Fens landscape and increase educational opportunities to access its geodiversity, archaeology and cultural heritage to enhance enjoyment and understanding for those who live, work in and visit the Fens.
- Seek partners to aid in the development and future provision of new, distinctive, Fenland economies.

Peterborough, situated in the far south-west of the catchment, is located within NCA 88 Bedfordshire and Cambridgeshire Claylands [48]. The Bedfordshire and Cambridgeshire Claylands NCA is a gently undulating, lowland plateau divided by shallow river valleys that gradually widen as they approach The Fens NCA in the east. The landscape is predominantly an open, arable landscape of planned and regular fields.

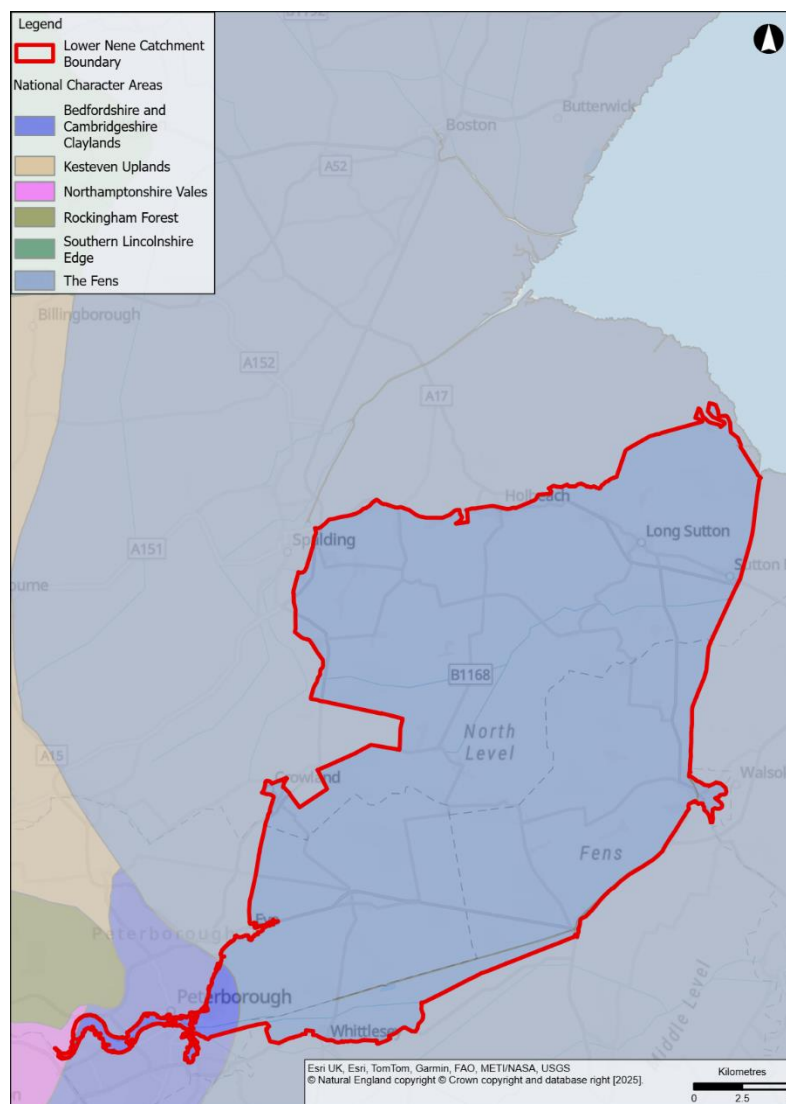


Figure 7: National Character Areas for the catchment

Landscape Character Assessment

The catchment falls within multiple administrative boundaries, as such, the most up to date Landscape Character Assessments (LCA) are detailed below in Table 3. These are used as a material construction when determining planning applications.

Table 3: Summary of Landscape Character Assessments for local authorities within the catchment

Local Authority	Date Published	Landscape Character Assessment
South Holland District Council [49]	2003	The catchment is spread across three Landscape Character Types (LCTs) defined by the study. • The Settled Fens LCT is a predominantly flat terrain with main roads, rivers, and drainage channels on raised banks. There are nucleated settlements with mature trees, and prominent church spires. Medium to large fields are present with intensive market gardening, strong hedgerows and views restricted by shelterbelts and woodlands. • The Peaty Fen LCT is a flat terrain with long, straight roads, rivers and drainage channels on raised banks. It features linear settlements with large, uninterrupted views and a sense of openness. The landscape is defined by geometric arable fields of cereals and root crops, bounded by drainage channels. • The Wash Marshes LCT is a flat terrain with winding creeks, drainage channels and drainage ditches. It features extensive open areas of salt marsh.
Peterborough City Council [50]	2007	The catchment is spread across three LCTs and three LCAs defined by the study. The three LCTs include Fen LCT, Fen Fringe LCT and River Valley LCT. The three LCAs comprise LCA1 Nene Valley, LCA4 Peterborough Fens and LCA5 Eye Fen Fringe. • The Nene Valley features the River Nene gently meandering through a broad valley, surrounded by pasture and flood meadows. Further from the river, large arable fields and scattered villages are present. • The Peterborough Fens is characterised by its low-lying, flat relief with large arable fields divided by artificial drainage channels and isolated farmsteads. • The Eye Fen Fringe is a gently undulating landform, showing evidence of former clay extraction. The landscape features isolated farmsteads, residential properties and large commercial buildings.
Fenland District Council [51]	2009	The catchment is spread across three LCTs and three LCAs defined by the study. The three LCTs include Settled Fen LCT, Extracted Clay Fen Island LCT and Drained Fenland LCT. The three LCAs include Wisbech Settled Fen LCA, Whittlesey Island LCA and The Fens LCA.

		• The Wisbech Settled Fen is a largely flat landscape with nucleated villages and market towns with historic cores. • The Whittlesey Island LCA is a slightly elevated clay island within the surrounding Fens, rising to a maximum height of 8mAOD. The landscape is relatively wooded and features a highly visible settlement edge, large industrial buildings and a historic core with grand buildings. • The Fens landscape is characterised by its low-lying, flat relief with large arable fields divided by drainage channels and a geometric road pattern. It features extensive vistas, sparse woodland, scattered farmsteads and isolated villages.
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4.1.2 Statutory designated landscapes

There are no statutory landscape designations (i.e. National Parks or National Landscapes³) within the catchment. The Lincolnshire Wolds National Landscape is located approximately 37km from the northern boundary. There are no local landscape designations within the catchment.

Heritage and nature conservation designations can contribute to landscape character and landscape value outside of statutory and locally designated landscapes. Please see Section 4.5 and Section 4.6 for further information.

4.1.3 Green and blue infrastructure

The north and north-east part of the catchment (South Holland District Council) is covered by The Wash and Fens Green Infrastructure Plan [52] identifying plans to enhance access to green infrastructure, promote biodiversity and proposals for the creation of new habitat networks. The Plan includes habitat network maps that identify potential opportunities to create and enhance habitat networks across the catchment and wider Fens landscape. Potential areas for habitat enhancement or creation within the catchment comprises:

- Coastal habitat enhancement or creation – an area located in The Wash, along the River Nene and an area located within 2.5km of The Wash;
- Grassland habitat enhancement or creation – an area located along the River Welland, an area located on the boundary of Spalding town centre and eight areas located within 23km of Spalding;
- Wooded habitat enhancement or creation – two areas on the boundary of Spalding town centre, an area on the outskirts of Crowland and four areas located within 19km of the Lutton Leam Sluice;

The south-western part of the catchment (Peterborough City Council) is covered by The Green Infrastructure and Biodiversity Supplementary Planning Document [53]. This document sets out a vision for how Peterborough's network of green infrastructure and associated biodiversity should be protected and enhanced during the next 20 years. The document includes priority green infrastructure areas and the identification of green infrastructure projects to take forward. Key

³ Following the government's Landscapes review of 2019, Areas of Outstanding Natural Beauty (AONB) became National Landscapes as of November 2023. A number of documents including legislation still refer to these as AONB. The statutory status of National Landscapes remains.

focus areas of The Green Infrastructure and Biodiversity Supplementary Planning Document identified within the catchment comprises:

- Nene Valley – The Nene Valley project aims to create a ‘Living Landscape’ by collaborating with farmers and landowners to connect habitats, manage land for wildlife, enhance public open spaces, and promote understanding of the area’s historical, archaeological, and geological significance.
- The Fens – The Welland Valley Partnership’s River Improvement Plan envisions a cleaner, healthier river valley that manages flood risk, supports wildlife, meets the needs of water suppliers and businesses, enhances public enjoyment and is sensitively managed by all stakeholders.
- John Clare Country – The John Clare Country aims to create a ‘Living Landscape’ by collaborating with various partners to connect and manage meadows, woodlands, wetlands and quarries for wildlife, while enhancing access routes and public open spaces.
- Urban & City-Wide Area – The Fens for the Future Partnership envisions restoring and reconnecting the sustainable wetlands across the Fens to benefit people, heritage and the rural economy, while mitigating climate change, supporting wildlife, enhancing tourism and creating local employment opportunities.

Green Infrastructure mapping undertaken by Natural England [54] indicates that the catchment comprises sparse tree cover, however there are areas of accessible woodlands within the catchment. Small areas of accessible woodland within the catchment are located within Peterborough, Swineshead, Whittlesey, Crowland, Wisbech, Sutton Bridge, Long Sutton, Holbeach and Spalding.

The catchment falls within the boundaries of the Greater Lincolnshire Local Nature Recovery Strategy [55] (LNRS) and the Cambridgeshire and Peterborough LNRS [56] which are currently being developed to identify priorities and opportunities for nature recovery. These strategies will help map areas of existing high-quality habitats or areas of biodiversity, outline opportunities to recover or enhance biodiversity and identify local priorities to provide broader environmental benefits. The Greater Lincolnshire LNRS and the Cambridgeshire and Peterborough LNRS are part of Round 1 of the national rollout.

4.2 Agriculture

This section outlines the baseline agricultural land uses and productivity of the catchment. Table 4 outlines the key terminology used in this section.

Table 4: Glossary of agriculture terminology

Terminology	Summary Definition
Agricultural Land Classification	A system used in England and Wales to assess and compare the quality of agricultural land. It categorises land into five grades based on its versatility and suitability for growing crops.
Countryside Stewardship (CS)	Countryside Stewardship is part of ELMS and recently has undergone changes in what in funds. It provides financial incentives to farmers, foresters, and land managers to improve and protect the environment. CS Higher Tier will open in summer 2025.
Entry Level Stewardship (ELS)	An agri-environment scheme in England under the previous Common Agricultural Policy (CAP) that provided funding to farmers and land managers for delivering environmental management on their land. This is now closed to new agreements.
Environmental Land Management Scheme (ELMS)	ELMS are part of the broader agricultural policy reforms in England, transitioning from the EU's Common Agricultural Policy (CAP). It provides financial incentives and support to landowners for making changes to their land that produce environmental benefits. These schemes aim to promote sustainable farming practices, enhance biodiversity, improve water and air quality, and contribute to climate change mitigation. There are currently three ELMS Schemes.
Gross Value Added	An economic productivity metric that measures the contribution of a corporate subsidiary, company, or municipality to an economy, producer, sector, or region.
Soilscape	A soilscape is a classification used to describe the broad regional differences in soil types and their distribution across a landscape. Soilscapes are helpful for understanding the general characteristics of soils in a region, including their carbon stock, which can inform land management, agricultural practices, and environmental conservation efforts.

4.2.1 Overview of soilscape within the catchment

Throughout the majority of the catchment, stretching down from The Wash the land is soilscape 21 [57], *'Loamy⁴ and clayey soils of coastal flats with naturally high groundwater'*, a soil with *'Lime-rich to moderate'* status. This soilscape depending on how light it is, can support different cropping, *'Lighter soils support a wide range of crops and are highly productive as they contain much available water and are stoneless and flat. Heavier soils are less easily worked and favour grass'*. Throughout this area, most of these soils, being either grade 1 or 2, are lighter and are therefore highly productive.

In the south of the catchment around Eye, Thorney, and the Nene Washes, there are a range of soilscapes, including: soilscape 20 *'Loamy and clayey floodplain soils with naturally high groundwater'*; and soilscape 22 *'Loamy soils with naturally high groundwater'*; as well as smaller areas of soilscape 8 *'Slightly acid loamy and clayey soils with impeded drainage'*; and soilscape 6 *'Freely draining slightly acid loamy soils'*.

There are also areas of peaty soils, namely: soilscape 23 *'Loamy and sandy soils with naturally high groundwater and a peaty surface'*; and soilscape 27 *'Fen peat soils'* adjacent to the Nene Washes.

⁴ Loamy soils are composed of a balanced mixture of sand, silt and clay, offering excellent nutrient retention and water-holding capacity. Its structure and fertility make it highly suitable for most plant species and agricultural applications.

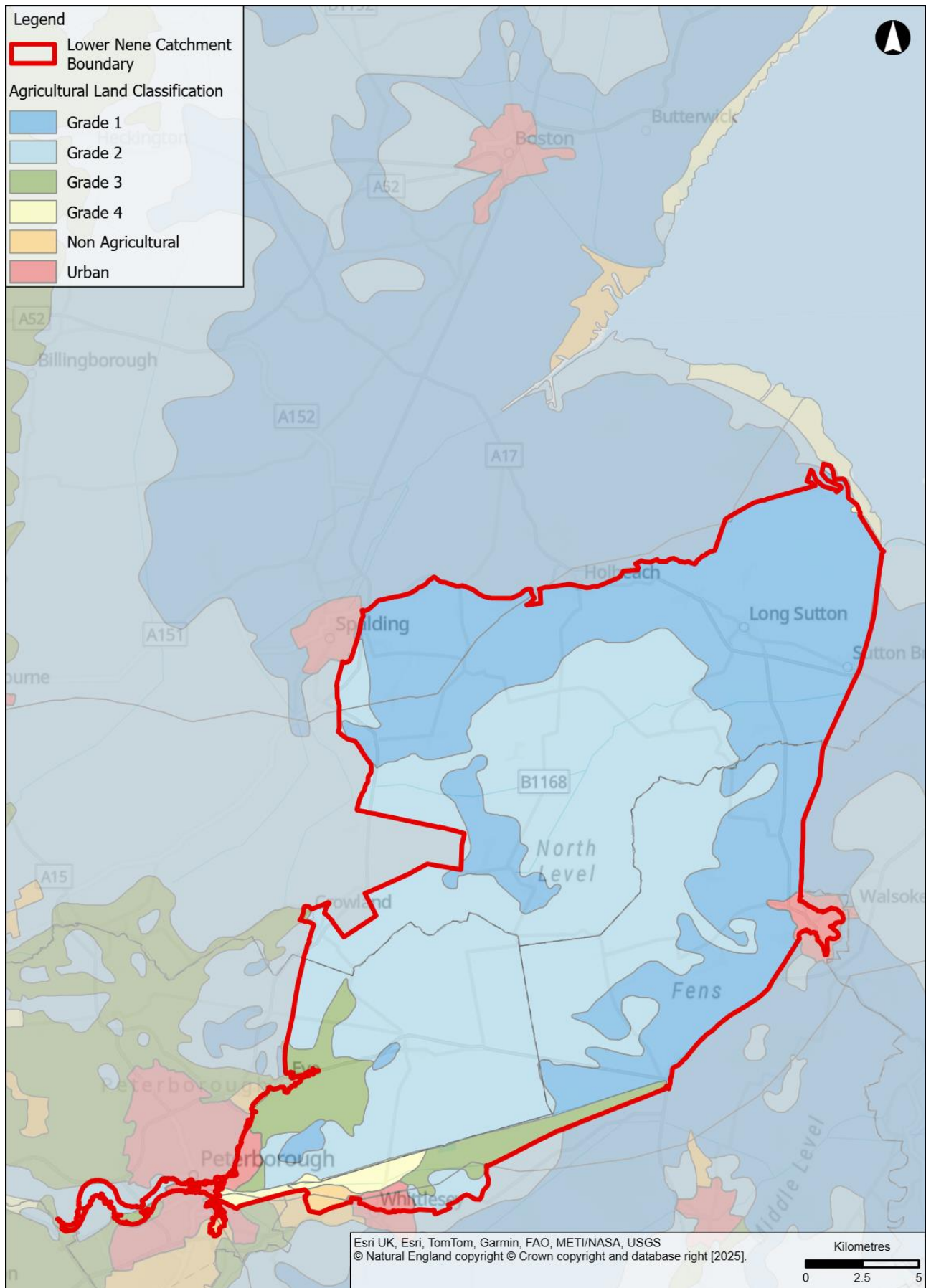
Natural England’s 2008 peaty soils locations layer [58], identifies 82km² within this area as peat Drainage of the lowland peat for agriculture has resulted in peat ‘wastage’ across the Fens. It is estimated that land levels have lowered by up to 5m over the last two centuries due to peat degradation [59]. The North Level IDB, partially covering the waterbodies in the catchment, has recorded an annual volume loss of 250,407m³/yr [59]. As such, most of this area can be assumed to have degraded to wasted peat soils, or to peat remnant mineral soils. The estimated carbon stock of peatland within the catchment is discussed further in the Natural Capital Technical Appendix. Natural England and DEFRA released an updated England Peat Map in 2025 which provides a national dataset of peat and peaty soils. The dataset was produced using remote sensing techniques and may contain local inaccuracies in data.

4.2.2 Overview of Agricultural Land Classification within the catchment

Across the catchment, around 505km² (91.4%) of land is classified as ALC Grade 1 and 2 land, with the majority of the Grade 1 land located to the north and east of the catchment (see Figure 8). Table 5 presents an overview of ALC classification.

Table 5: Overview of ALC classification within the catchment

	Grade 1	Grade 2	Grade 3	Grade 4	Non-agricultural
Area (km ²)	228.4	276.27	29.27	6.38	2.43
Percentage of catchment (%)	41.4%	50%	5.3%	1.2%	0.4%



4.2.3 Agriculture and water management

The Nene Catchment Abstraction Licensing Strategy (ALS) [60] governs abstraction throughout the Nene catchment. The ALS indicates that there may, on average, only be 76 days annually when abstraction may be available. In addition, the ALS states that water is available across the whole of the Lower Nene catchment at Q30 flows⁵ (except for the Feldale IDB area). There is restricted water available at Q50 flows, and no water available for abstraction at Q70 flows. Given the variability of water abstraction throughout the catchment, and the salinity constraints in the north of the catchment, a number of farmers have invested in recent decades in on-farm water storage reservoirs.

The catchment has a long history of flooding which impacts both properties and farming. Recent events include:

- 2013: A tidal surge, coinciding with spring tide, resulted in the highest tide in over 60 years , almost exceeding flood embankments and flooding major roads in the area of Wisbech;
- 2023: Prolonged heavy rain and elevated river levels in Storm Babet led to large areas of fenland and agricultural land being inundated and flooding experienced along the River Nene in the vicinity of Peterborough; and
- 2024: Heavy rainfall leads to flooding of the Whittlesey (Nene) Washes and other areas within the catchment.

Flooding has major impacts on crops and to a lesser extent areas of land utilised for livestock grazing. Flood events can restrict the ability to establish new crops, reduce crop yields and quality, or can destroy crops once ready for harvest leading to direct agricultural damages and wider economic consequences for landowners.

4.2.4 Value of agriculture in the catchment

The catchment is home to several UK leading agricultural and horticultural businesses, many of which are also engaged in food processing.

Approximately 432km² (78%) of land across the catchment is currently farmed. Land use is not published at catchment level, so the catchment's crop area has been proxied as its relative proportion [62] of the South Holland, Fenland and the City of Peterborough districts crop areas, and checked using satellite imagery of crop cover, to estimate the land use allocation as set out in Table 6.

Table 6: Estimated land use, crop areas and livestock populations on commercial agricultural holdings, 2022 data [61] (Rounded to nearest decimal place)

	Total farmed area	Cereals	Arable crops excl. cereals	Grassland	Fruit and vegetables
Lower Nene catchment (km ²)	432.09	218.96	118.92	28.79	33.25
Percentage of farmed land in the catchment (%)	n/a	39.65%	21.53%	5.21%	6.02%

⁵ The Environment Agency's Water Resources Geographical Information System provides a snapshot in time on water availability at four flow snapshots. From high to low, these are: Q30 (i.e. the flow of a river which is exceeded on average for 30% of the time, therefore you would expect the river flow to be lower than Q30 on 256 days in an average year, i.e. a higher flow), Q50, Q70 and Q95. These are calculated for each integrated Water Framework Directive waterbody and looks at the balance between the flow in the river, the quantity needed to support the ecology and the water that can be licensed for abstraction.

Crops produce direct economic output, whereas grassland does not directly create economic value but instead supports the grazing of sheep and cattle, or the production of livestock feed or (AD) energy inputs. It is estimated that the agricultural value of across crop areas (based on 2023 data) [63] is as follows:

- Cereal production – c. £31.5 million
- Poultry - £32.5 million
- Other arable – c.£27.7 million
- Fruit and vegetables – c.£63.6 million

Grassland does not directly create economic value but instead supports the grazing of sheep and cattle, or the production of livestock feed. The estimated overall economic output of crop and livestock is in the region of £187.4 million, highlighting the importance of the agricultural sector.

Within the catchment, there are a range of renewable energy enterprises in operation however, without the availability of accurate data on the revenues from the farm diversification enterprises in the catchment, the national average has been used to provide a conservative output figure. The annual agricultural output (including farm related diversification) in the catchment is therefore believed to be c.£208.7 million (in 2023 values).

4.2.5 Agriculture and the food chain

Farming is critical to the local economy within the catchment. The whole agri-food chain employs people at different stages of food production, from agriculture to food processing and packing and retail.

In the local authority areas that the catchment is located in, a total of 5,250 people were directly employed in crop and animal production, hunting and related service activities sector in 2022.

It is estimated that agriculture supports around 1,760 jobs across the catchment. These 1,760 jobs have a Gross Value Added (GVA) of £46,652 per job, whereas across the UK as a whole, with a total workforce of 462,000 people in 2023 [63] and agricultural GVA of £13.681 billion, agricultural GVA was only £29,613 per job. As such, it is estimated that agricultural workers in the catchment contribute GVA that is almost 58% higher than the national average, the highest level across the Fens.

Employment from direct agriculture also supports wider jobs across in the agri-food supply chain. In 2023, farmers purchased £21.086 billion of intermediate consumption (e.g. seeds); and invested £5.140 billion in fixed capital across the UK. Input and capital spending therefore was equivalent to £26.226 billion to generate £34.767 billion of gross output, or 75.4% of gross output. Spending by farmers in the catchment on inputs and capital can therefore be estimated as being £0.157 billion (2023). Given that approximately £300,000 of input spending is believed to support one FTE job in the agricultural input supply chain, this spending is equivalent to a further 525 jobs supported by farms.

Employment is also supported by the further processing, storage and distribution of food produced by agriculture. In 2022 Great Britain had employment in the wider food chain [64] of:

- Agriculture (and fishing): 469,000;
- Food and drink manufacturing: 445,000; and
- Food and drink and agricultural raw materials wholesaling: 250,000; and
- Freight logistics sector: 703,300 staff (road, rail and water freight), of which c.30% can be attributed to the food and drink supply chain.

As such 210,990 jobs were associated with logistics in the end-to-end food chain, of which 40% is believed to be focused on the manufacturing and farm to factory gate end of the food chain or c.84,400.

The UK produces around 60% of its food consumption [65] with imports c.40% of its food. Given, that a proportion of domestic food and drink manufacturing, wholesale and logistics is reliant on imported ingredients, it can be estimated that 75% of food chain employment depends on domestic production. Therefore, it is estimated that agriculture and fishing supported a total of $(75\% * (445,000 + 250,000 + 84,400))$ 584,550 jobs in the food and drink chain. As such every job on farm, supported a further 1.25 jobs in the further supply chain.

This national figure however ignores differences between food types, with vegetables and fruit supporting higher supply chain multiples. Similarly, some 'other arable crops' such as potatoes or sugar beet, also disproportionately support more supply chain jobs.

Therefore, in the catchment, as across the Fens as a whole, given the over-representation of vegetable production, and that of higher value crops such as sugar beet or potatoes, this supply chain job multiplier is believed to be higher, at 2 jobs per job supported on farm. Therefore, agriculture in the catchment can be estimated as supporting 3,520 food processing, distribution, storage and wholesale jobs locally and nationally.

The reliance on local employment in food processing, and related industries is demonstrated across the catchment with a number of small and medium food supply chain businesses present.

4.2.6 Agriculture and the environment

Within the catchment there is a large amount of land entered into various countryside stewardship including mid-tier Countryside Stewardship agreements and higher tier agreements (see Figure 9). As well as Countryside Stewardship agreements in the new ELMS framework, a small number of farms still have historic Entry (ELS) or Higher-Level Stewardship (HLS) agreements which are yet to close. It is believed many farms will replace these historic schemes with new ELMS agreements in the future.

These stewardship areas are not however evenly spread in the catchment, with the area surrounding Long Sutton having notably fewer areas under stewardship. This aligns with the urban land use associated with villages in the northern portion of the catchment.

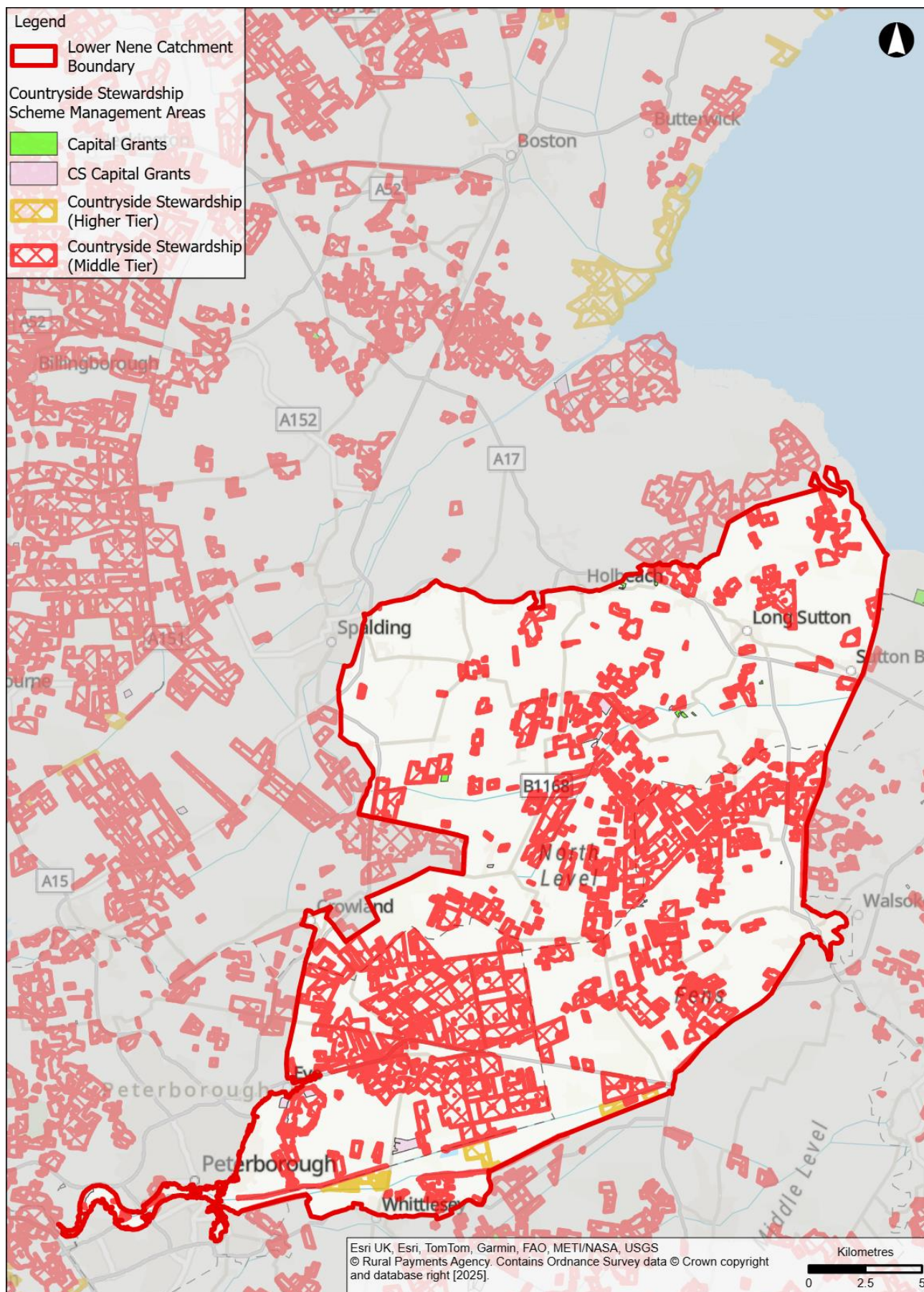


Figure 9: Overview of current environmental stewardship agreements within the catchment

4.3 Ground conditions

This section outlines the baseline ground conditions in the catchment. Table 7 outlines the key terminology used in this section. It should be noted that superficial deposits of a coastal or marine origin can be highly variable and complex in their composition, deposition and extent. Those presented here are intended to provide an insight into a variety of deposits that may be encountered within the catchment and may not represent the full variety and complexity of such deposits.

Table 7: Glossary of ground conditions terminology

Terminology	Summary Definition
Source Protection Zones (SPZs)	SPZs are defined areas around large and public potable groundwater abstraction sites to protect and safeguard drinking water quality. They constrain the proximity of any activities that may impact upon drinking water abstraction [66].
Nitrate Vulnerable Zone (NVZs)	NVZs are areas designated as being at risk from agricultural nitrate pollution and include just over half of all land in England [67]. Nitrate pollution poses a risk to water quality through eutrophication which is harmful to aquatic life, disrupts biodiversity and damages sensitive habitats and has the potential to affect drinking water.
Engineered materials	Earthworks where the ground has been artificially realigned or adapted. These materials can be poorly sorted, containing an undefined mix of silts, sands, gravels and peats and other organic materials.
Palaeochannels / Roddons	A remnant reach of river bed representing areas of incised channel and tidal creek systems, cut contemporaneously into the underlying clay deposits and filled with “fossilised” silt and sand.
Buried valleys	An ancient, abandoned river or drainage network which has become partially or completely buried by more recent sediment.
Faulting	The process of rock masses breaking and moving along fractures in the Earth’s crust causing displacement.

4.3.1 Catchment-scale designations

Source Protection Zones (SPZ)

None of the catchment is regarded as being within a SPZ [66].

Nitrate Vulnerable Zone (NVZ)

The majority of the catchment is not regarded as a Nitrate Vulnerable Zone (NVZ), with the exception of some small areas centred along the River Nene within Peterborough and immediately to the east of the city. These are areas designated as being at risk from agricultural nitrate pollution and include just over half of all land in England.

Radon

The risk from radon is significantly influenced by the underlying bedrock geology. There is no apparent risk from Radon in the catchment as the entire catchment falls within the less than 1% of homes at or above Action Level [68].

4.3.2 Geology

The geology of the catchment is covered by the following geological maps:

- 1:50,000 Spalding Sheet 144 Solid and Drift Geology [69]
- 1:50,000 King’s Lynn and The Wash 145 Solid and Drift Geology [70]
- 1:50,000 Peterborough Sheet 158 Solid and Drift Geology [71]

- 1:50,000 Wisbech Sheet 159 Solid and Drift Geology [72]

The strata identified within the catchment including those designated as engineered materials, superficial deposits and bedrock geology are described below:

Engineered materials

The catchment is predominately an artificially drained and heavily engineered landscape with a significant reliance on the use of the Nene Washes for controlled flooding and the operation of many sluices. It has also experienced extensive reclamation activities associated with The Washes, some of which were carried out as recently as the 1970s on Trihe Wash Frontage [73]. Much the catchment has been altered by artificial realignment or adaption of pre-existing watercourses or the formation of new cuts and drains. This has resulted in the creation of many associated earthwork flood embankments but also areas of cuts and adaptations to local infrastructure.

It is commonly observed that many raised flood embankments originate from the 1800s, if not earlier, and are dredging bunds. For some, they have also been adapted and now support roads and access tracks but have not necessarily been strengthened to accommodate for modern traffic loads.

Similarly, the composition of these earthworks is often of poor quality and identified as comprising of locally sourced materials, commonly from channel “digout” or from deepening and widening exercises. Material from subsequent dredging activities is also locally incorporated to raise the embankments or spread out on the land as natural fertiliser. These materials can be poorly sorted, containing an undefined mix of silts, sands, gravels and peats and other organic materials. The cradge bank along the Nene Washes is also periodically raised by placing dried out dredging materials. These materials also present several engineering risks including settlement and shrinkage, a susceptibility to scour and can be prone to seepage, all of which can contribute to failures. For example, a ground investigation was conducted in 2022 [74] on a portion of the landward side of the River Nene near Peterborough to investigate undulation and cracking in the surface of the Riverside Walk cycle track and footpath. The investigation identified that the embankment was composed of variable materials including highly plastic cohesive material and locally contained silts, peats and organic material. A combination of all the aforementioned materials would likely contribute to deformation and settlement and ultimately impact the quality of the pavement. It should also be noted that the catchment also makes extensive use of sheet pile retaining walls such as those used along the Nene in Wisbech.

Areas of the catchment such as that at Whittlesey (Nene) are designated as Washes. The Washes also act a significant influence on the nature and distribution of superficial materials, particularly when materials such as silts that are able to fall out of suspension when flood waters become stationary or the energy drops sufficiently.

The catchment is also likely to be impacted by shifts in the tidal limit. The current tidal limit is currently downstream of the Dog-in-a-Doublet Sluice but until the 1930’s the tidal limit extended as far in land as Peterborough. Changing climate conditions, particularly rising sea levels are likely to have an impact on this and will likely impact on sedimentation and its associated management but also potentially introduce more brackish waters.

Superficial deposits

The catchment exhibits a range of superficial deposits but is heavily influenced by the extensive covering of Tidal Flat Deposits. The catchment, more predominantly towards Peterborough shows mapped areas of marine gravels, alluvial materials and broader areas of peat.

It should be noted that superficial deposits of a coastal or marine origin can be highly variable and complex in their composition, deposition and extent and may represent frequent episodes of reworking and deposition. An overview of the superficial materials that may be encountered within the catchment is presented in Figure 10, with a more detailed insert for the area surrounding

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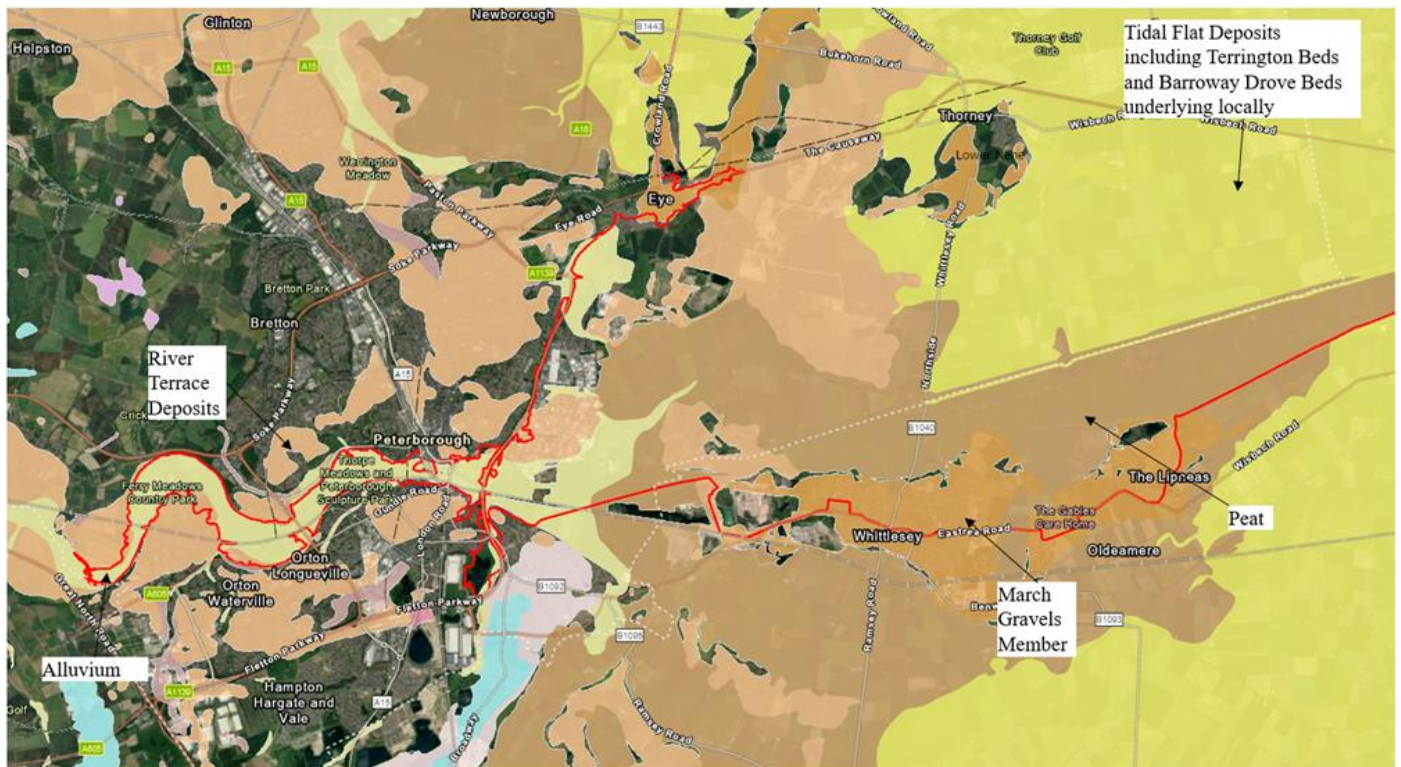


Figure 11: Insert for the superficial deposits from the BGS 1:50K geological mapping in the Peterborough and fluvial River Nene area

Alluvium

Alluvium or Alluvial materials, derived from fluvial sources are commonplace across the catchment and will be subject to frequent periods of deposition and reworking. Alluvium is often grey or brown in colour but can be locally variable and is predominantly composed of cohesive materials including significant proportions of clay and silt. Alluvium may also locally contain sands and gravels and varying quantities of organic materials and shell fragments. All materials may be laterally restricted and may only be present as isolated lenses and horizons. The depth and thickness of Alluvium is also likely to be highly variable. Boreholes in the region such as TF30SE5 (adjacent to the River Nene and due southwest of Ring's End) and TF40SW6 (on the A47, northeast of Ring's End) describe Alluvium to an approximate thickness of 2m to 4m below ground level (bgl), which was described as a "black and grey silts with organic matter".

Tidal Flat Deposits

Tidal Flat Deposits can include the following: Terrington Beds, Barroway Drove Beds and Nordelph Peat.

Terrington Beds

The Terrington Beds cover a broad extent of land along the coastal edge of The Wash and are noted to extend in land as far as Thorney and due northeast of Peterborough. They typically comprise of pale brown silts, fine grained sands and interlaminated reddish-brown clays. They are often extensive, near to horizontal and can facilitate the creation of marshy land and areas of unconsolidated sediment, mainly of mud and/or sand [75]. In borehole TF31SE15 (near Topcross Drain, west of Wisbech) they are described as thin brown silts and grey silt with occasional mention of peat.

Barroway Drove Beds

The Barroway Drove Beds may underlie the Tidal Flat Deposits or crop locally in the catchment, and are widespread between Peterborough and The Wash. They frequently comprise primarily of clay and silt but can locally contain peats and organic materials such as roots and rootlets as shown in historical boreholes TF30SE41 (Elm Tree Farm, south of the A47) and TF40NW11 (adjacent to Mill Lane, west of Wisbech). Whilst the Barroway Drove Beds may contain Peat, they can also be sandwiched by Peat above (the Upper Peat) and Peat below (the Lower Peat) which can also display repeating smaller layers or lenses of Peat [76].

Peat and Nordelph Peat

Peat is mapped locally in the catchment, particularly along the edge of the River Nene near Peterborough but is generally not shown to crop across much of the rest of the catchment, although it may be more absent in the northern extents of the catchment. However, it is likely to be locally present, either underlying the material grouped as Tidal Flat Deposits or intermixed within these deposits. but given the regional setting, it could be encountered. It is frequently evidenced in borehole records such as TF30NW3 on Sutton St Edmund's Common and in TF41SW6 (near Highside Drain). It is identified across the catchment but may not be continuous and may be absent locally. In the Peterborough area, proximal to the Nene where it is noted to crop, it is described in TF30SW8 (south of the River Nene, northeast of Whittlesey) as "black to dark brown, compact and fibrous" with a thickness of 1.35m. The Nordelph Peat (sometimes referred to as the Upper Peat), is reported as up to 3m thick in places [77].

Marine Gravels

Marine Gravels are reported within the catchment including marine sands and gravels of the Abbey Sand and Gravel Member and the March Gravels Member. Borehole TF51SW13 (northeast of Wisbech and adjacent to the A47) likely represents both of these gravels, with marine sands and alluvial material described from 2.50mbgl to 11.70mbgl and older marine deposits from 11.70mbgl to 17.00mbgl.

Glacial Deposits

Glacial Till and Glaciolacustrine deposits are locally present across the catchment but concealed beneath the Tidal Flat Deposits and the Marine Gravels and unlikely to be present at the surface. They may not be continuous across the catchment and may have localised lateral extents. Glacial Till and Glaciolacustrine Deposits are both identified in borehole TF51SW13 (northeast of Wisbech and adjacent to the A47) in alternating layers of firm to very stiff greyish brown slightly gravelly to gravelly silty clays and stiff brown, thinly to thickly laminated clays respectively.

4.3.3 Bedrock Geology

Beneath the superficial soils, the catchment is underlain by a variety of differing bedrock geologies that typically range from the Middle to Upper Jurassic. Within Peterborough, the catchment boundary follows the River Nene and is underlain by Middle Jurassic mudstones, limestones and clays but as the catchment boundary broadens out to the northeast, the catchment is predominantly underlain by formations that typically comprise of clays and mudstones such as the Oxford Clay, the West Walton Formation and the Ampthill Clay Formation, and the Kimmeridge Clay Formation furthest east to The Wash.

The anticipated bedrock geology of the catchment is presented in Table 8. A simplified geological map is presented in Figure 12, with a more detailed insert for the area surrounding Peterborough presented in Figure 13.

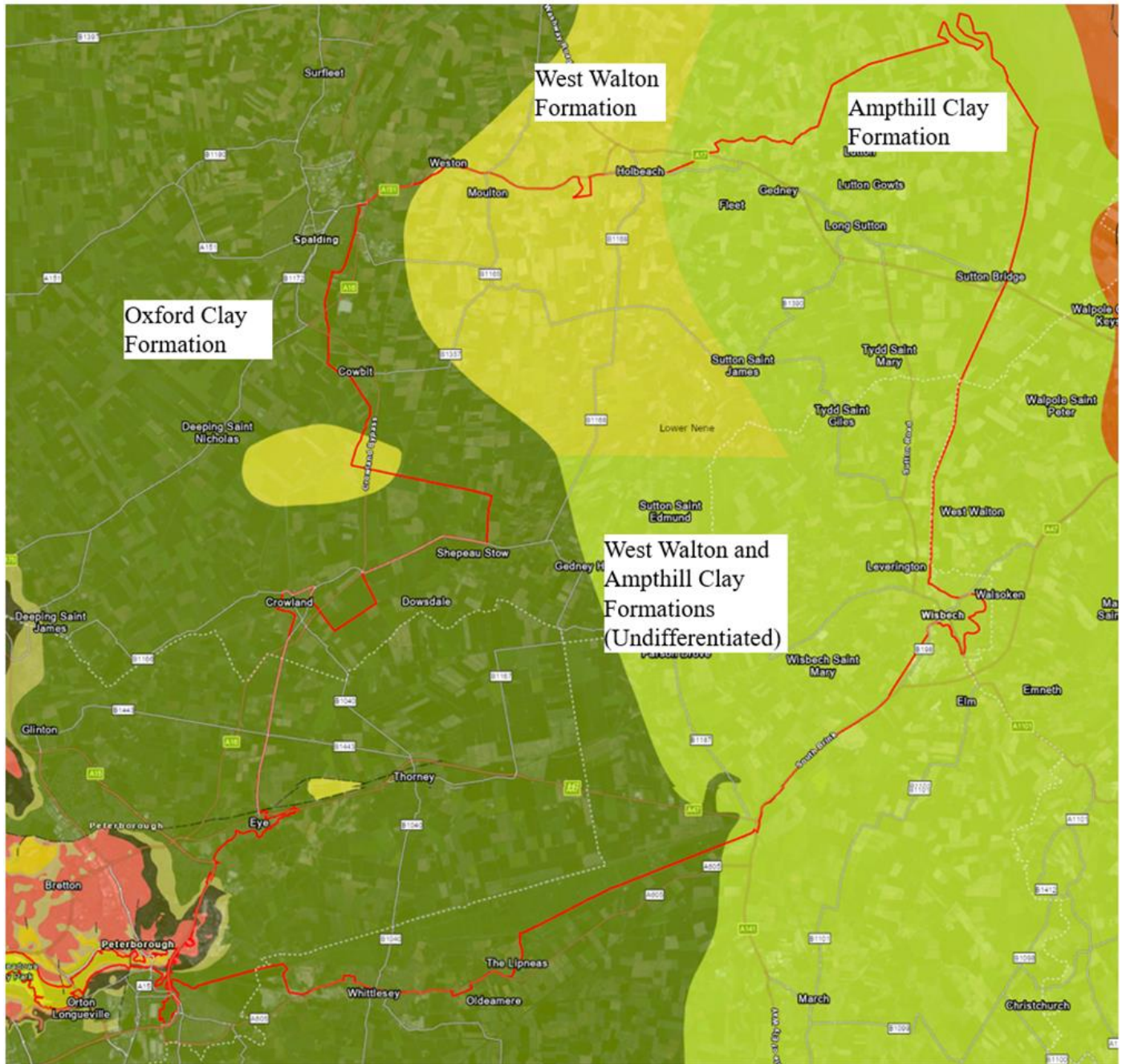


Figure 12: Simplified overview of the bedrock geology underlying the catchment from BGS 1:50K geological mapping

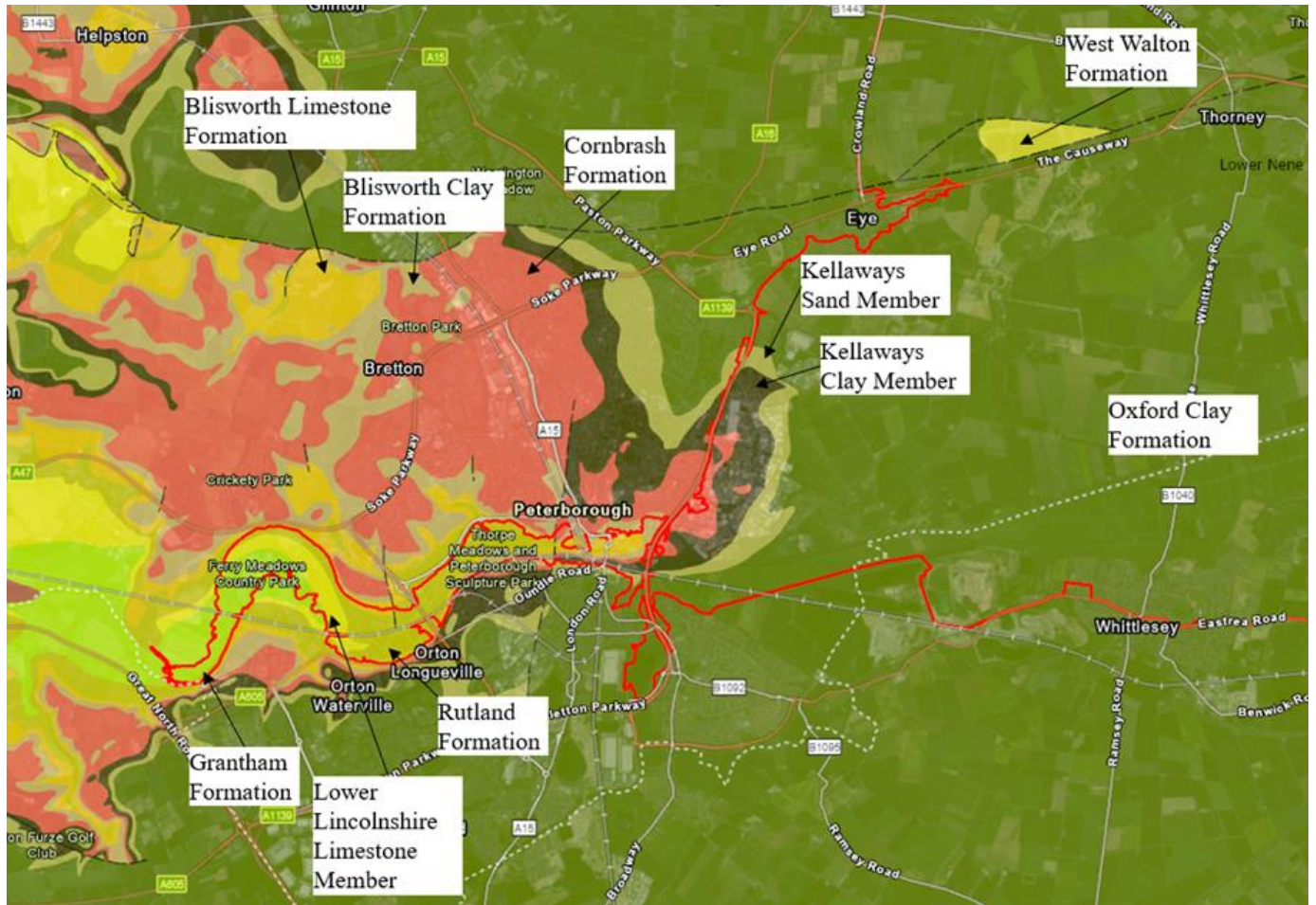


Figure 13: Insert for the solid geology from the BGS 1:50K geological mapping in the Peterborough and fluvial River Nene area

Table 8: Summary of bedrock geology within the catchment

Formation	Members (if applicable)	Description [78]
Kimmeridge Clay Formation		Mudstone, siltstone and cementstones, may be calcareous or kerogen-rich and locally fossiliferous [79].
Ampthill Clay Formation		Mudstone, often argillaceous limestones and marls [80]. Fossiliferous material can also be expected. Overconsolidated, high plasticity, frequently fissured and susceptible to shallow slope angle failure.
West Walton Formation		Mudstone, often calcareous or silty with argillaceous limestones and marls [80]. Fossiliferous material can also be expected. Fissured clays are also expected with selenite (gypsum) crystals reported.
Oxford Clay Formation	Weymouth Member	High to very high plasticity brown, grey, green and blue-grey shelly over-consolidated clay and organic-rich (bituminous) weak

	Stewartby Member	mudstones, prone to seasonal shrink-swell movement. Laterally persistent limestone bands and cementstone concretions may be present resulting in locally stronger horizons [81].
	Peterborough Member	
Kellaways Formation	Kellaways Sand Member	Grey sands, and calcareous siltstones and sandstones, the latter may be relatively hard.
	Kellaways Clay Member	High to very high plasticity over-consolidated clay, it can also contain discreet or frequent sand/sandstone beds and partings.
Cornbrash Foundation		Often thin (less than 1m locally), very hard fine grained limestone. Can be very hard. Difficult drilling, excavation or refusal for piled structures. The Cornbrash, although thin, weathers to a rubble of small blocks that were easily exploited for aggregate and rough road material [82].
Blisworth Clay Formation		Grey silicate-mudstone, with variations of purplish red, yellow and green, poorly bedded to blocky. Commonly contains fossil rootlets and sideritic ironstone nodules.
Blisworth Limestone Formation		Pale grey to off-white or yellowish limestones with thin marls and mudstones, fossiliferous, bioturbated peloidal, ooidal and shell-fragmental more-or-less argillaceous packstones and wackestones.
Rutland Formation		Grey marine mudstone passing up into non-marine mudstone and siltstone, with a greenish-grey rootlet bed at the top. The basal beds comprise mainly fluvial and lacustrine sandstones.
Lincolnshire Limestone Formation	Lower Lincolnshire Member	Limestone, typically calcilutites, and peloidal wackestones and packstones.
Grantham Formation		Mudstones, sandy mudstones and argillaceous siltstone-sandstone, which is commonly ferruginous, and containing generally abundant plant debris, interpreted as both non-marine and marine facies [78].

4.3.4 Regional structure

Palaeochannels / “Roddons”

An influential feature of significance in the Fens, is the presence of palaeochannels which are locally referred to as “roddons” or “silt-filled creeks” such as those well documented in the Peterborough district. These are however not well recorded on neighbouring district sheets. The influence of anthropogenic changes and involvement such as agriculture and engineered drainage, has caused these former channels to become positive topographical features [76]. As the land surrounding, which is notably cohesive and susceptible to shrink, the more granular material infilling the former channel remains proud. These features, whilst subtle, can form ridges up to 1m high. It is also noted that the roddons would not be able to facilitate or be re-used as

channels in the event of future transgression events, and due to compaction, settlement and peat wastage that has occurred between them, they may be capable of funneling or concentrating water flow between them [76].

Roddon structures are identified in the catchment on the available 1:50,000 geological mapping for sheet 158, Peterborough [71] and shown in the extract on Figure 14. They are shown as “silt-filled creeks in Marine alluvium” and can be seen cutting into the widespread Tidal Flat Deposits and are present over a vast area and display a variety of scales.

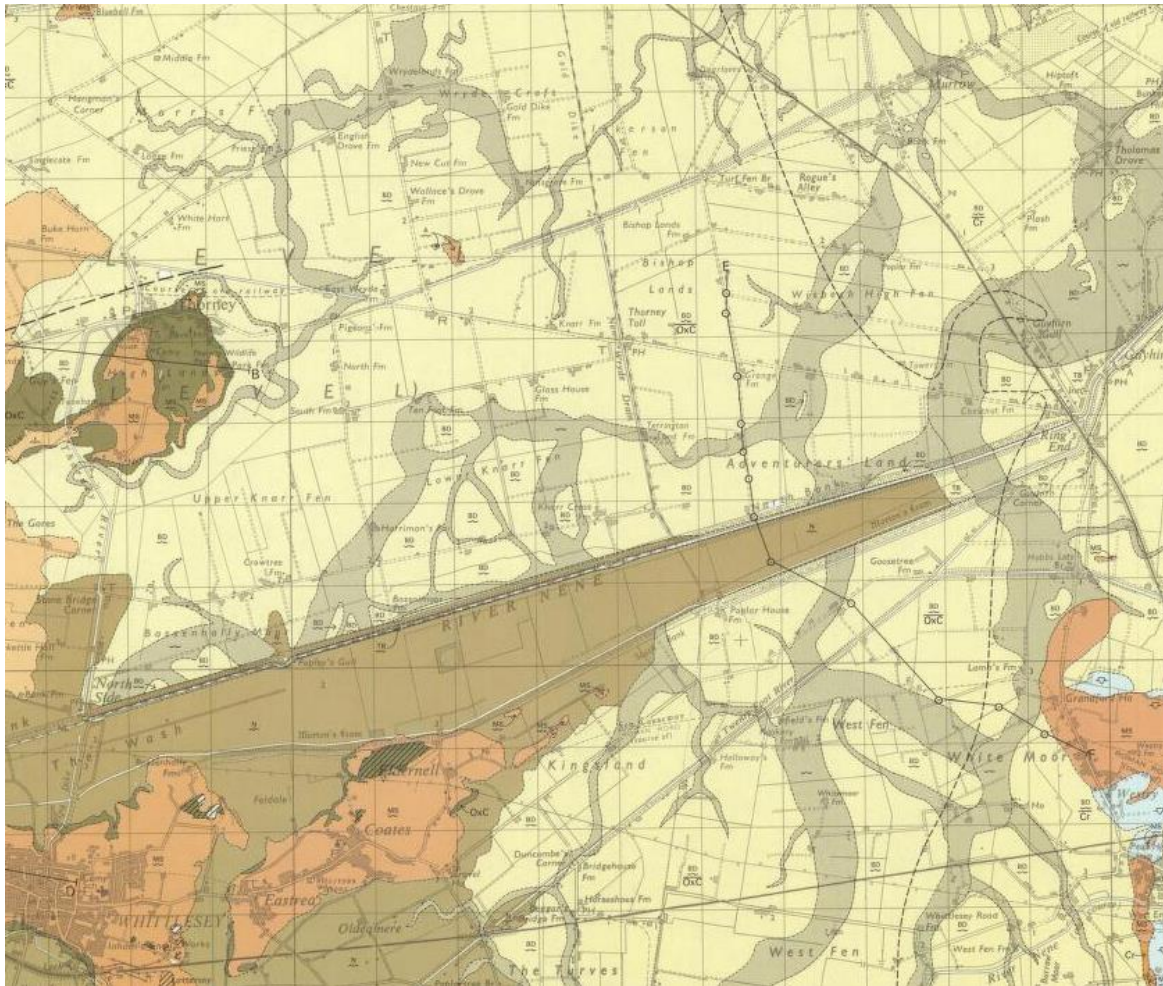


Figure 14: Extract from the available BGS geological mapping [71] for Peterborough that shows the distribution of 'silt-filled creeks' or roddons

A summary of the encountered roddon structures scale across the Fens is provided in Table 9.

Table 9: Summary of the identified roddon hierarchy

Roddon Hierarchy	Dimensions	Description
Major “Trunk” Roddon	2m to >1km	Predominantly fine sand, consistent of grain size from mouth to upper extents, likely representative of being deposited under uniform depositional conditions.
Tributaries	1m to >10m	Predominantly silt.
Minor Tributaries		Predominantly clay.

Buried Valleys

There is potential for buried valleys to be present within the catchment, with several identified east of Peterborough and to the northeast, onwards into The Wash [83]. These are also shown on Figure 10.

The buried valley here is suggested as being preglacial and would likely be infilled with a mix of materials potentially including a mix of sands and gravels and Glacial Till. Buried valleys present the risk of encountering much deeper than anticipated superficial materials which in themselves, may be influential on settlement or act as preferential pathways for groundwater migration. Thick till sequences (up to 80 m) are confined to deep valleys in the rock-head surface in the King's Lynn area and beneath Fenland and The Wash [83]. A historical borehole, TF41SE6 was undertaken as part of the West Walton Highway works potentially proves such thickness of glacial material, reporting a mix of grey, "chalk-rich" tills and varved clays to a depth of 44.21mbgl.

Faulting

Faulting is typically absent across the wider catchment but a few faults are identified in and around Peterborough as shown on the available 1:50,000 geological mapping [71]. The presence of faulting is likely to be subtle across the region and with a relatively subdued and flat topography, the identification of faulting at the surface is low. Faulting could also be present at depth or masked by superfcials.

4.3.5 Hydrogeology

A summary of aquifer designations for geologies at outcrop and underlying the site have been summarised using information from the GeoIndex [78], Magic Maps [84] and hydrogeological Mapping [85].

Superficial Geology Aquifers

A summary of the superficial aquifers is presented in Table 10.

Table 10: Summary of encountered superficial deposit aquifer designations within the catchment

Formation	Superficial Aquifer Designation
Alluvium	Secondary A. Very small yields and often poor water quality.
River Terrace Deposits	
Marine Gravels including March Gravels and Abbey Sand and Gravels	
Silt-infilled creeks	Secondary (Undifferentiated). Very small yields and often poor water quality.
Glacial Till	
Tidal Flats Deposits including Terrington Beds and Barroway Drove Beds	Unproductive. Low permeability that can however confine underlying aquifers.
Glaciolacustrine	
Peat	

Bedrock Geology Aquifers

A summary of the bedrock aquifers is presented in Table 11.

Table 11: Summary of encountered bedrock geology aquifer designations within the catchment

Formation	Bedrock Aquifer Designation
Blisworth Limestone Formation	Principal
Lincolnshire Limestone Formation	
Kellaways Sandstone Formation	Secondary A
Cornbrash Formation	
Rutland Formation	Secondary B
Grantham Formation	Secondary (Undifferentiated)
Blisworth Clay Formation	Unproductive. Low permeability that can however confine underlying aquifers.
Kellaways Clay Member	
Kimmeridge Clay Formation	
Ampthill Clay Formation	
West Walton Formation	
Oxford Clay Formation	

4.3.6 Geotechnical appraisal – engineered structures

Earthworks

Earthworks constructed within the catchment to facilitate the transportation and containment of surface waters may be locally subject to failures and degradation. Many earthworks are not built to modern engineering standards, commonly composed of dredgings and localised digout and in many cases they perform as required despite this. The composition and distribution of the materials can be highly variable and as a result can present the risk of localised failures. These include:

- Slope failure under extreme groundwater conditions where slopes are formed out of low shear strength materials are steep gradients on poor foundations;
- Settlement due to consolidation of the foundation soil and internal deformation due to self-weight consolidation and external loading;
- Excessive seepage;
- Overtopping; and

- Animal activity.

Earthwork slope instability

Slope instability of the embankments side slopes could take the form of shallow surface slips where the embankment is not particularly high and the slopes are steep, or deeper, rotational failures where the embankments are taller with slopes that are less steep and poor foundation soils (i.e. peat). The cause of slope instability is due to high groundwater conditions within the embankment and the foundation soil during flood conditions coupled with the embankments being built out of low strength soils with overly steep side slope angles over poor foundation soils also with low strength.

Poor vegetation cover can also present a risk to shallow slope instability. If vegetation was well-maintained vegetation, it can help to stabilise the shallow soils through root cohesion and control of moisture content. For example, a ranker sward comprising of shallow or predominantly tap-rooted vegetation offers poor resistance compared to a species-rich grass sward.

Slope instability is often a very localised feature and where it does occur it might only impact a few metres to a few 10s of metres of linear embankment. It can result in potential loss of containment by increasing the risk of seepage due to the reduced seepage pathways through the embankment. Also, further scour or erosion of the embankment can occur where bare soil is exposed either on the riverward face or the landward face.

Settlement and deformation

Settlement can occur from a range of causes. The embankment can settle due to consolidation of the foundation soil due to ongoing drainage activities and long-term creep settlement of organic rich soils. Settlement can over time lower the crest and where the foundation soil comprises contrasting soils which consolidate by different amounts, differential settlement can occur across the embankment.

Settlement may occur due to internal consolidation of the embankment where this was inadequately compacted. At a shallow depth with embankments where clay soils are present, these can be susceptible to changes in moisture and can readily change in volume leading to shrinkage and swelling. Overtime this can lead to differential settlement at the surface and becomes particularly obvious where embankments support roads in the form of cracking and undulation of the pavement.

Seepage

Seepage can occur in earthworks or structures that are composed of granular soils or have more permeable layers such as sands and gravels. It can also occur where there are palaeochannels beneath the embankment or where there are burrowing animals. The composition of earthworks in the region can be variable, so the risk of seepage can be highly variable.

Seepage essentially undermines the effectiveness of any structure designed to retain water and can result in the removal of material, particularly fines ultimately leading to reduction in mass soil strength with the potential to induce slope failure or ultimately, breaching.

Overtopping

Overtopping of embankments is identified as a risk, particularly if low spots are present due to settlement. Where embankments are poorly vegetated (either a lack of soil binding vegetation or surface cover), there is additional risk from scour during an overtopping event which could lead to a breach and effective loss of containment.

Animal Activity

Animal activity presents several risks to earthworks including the establishment of burrows through and within earthworks but also from the frequent trafficking and trampling of surface soils and

vegetation. Burrowing can encourage instability and promote seepage whilst animal movement on the surface, can lead to the removal of protective vegetation.

Burrowing, particularly from badgers was mentioned by the operations team to be particularly challenging to manage and had many additional costs and repairs associated with it. The operations team made specific mention of badgers being noted as problematic to the existing earthwork assets.

Aggressive groundwater conditions

Acid groundwaters could be encountered in areas that are rich in pyritic minerals such as the fossiliferous strata, such as the Oxford Clay, West Walton and Ampthill Clay and Kimmeridge Clay Formations. Those that promote mobility of groundwaters or where groundwater levels can fluctuate as to promote oxidation, would be anticipated to have a greater potential to create aggressive (acidic) groundwater conditions and would potentially have a detrimental impact on concrete foundations and sub-structures. Peat also has the potential to increase acidity in groundwaters.

4.4 Water environment

This section outlines the baseline water environment in the catchment, focusing primarily on surface water bodies considered within the Water Environment Regulations / Water Framework Directive (WER/WFD). Analysis of the groundwater bodies present within the catchment has focused on their overarching status, at this stage. Further information regarding the hydrogeology baseline condition of the catchment, including details of the various aquifers and source protection zones and drinking water safeguard zones present, is provided in the Ground Conditions section of this report. An overview of flood risk and key flood risk management infrastructure within the catchment is provided in the Lower Nene catchment baseline report, and the flood risk technical appendix. Table 12 outlines the key terminology used in this section.

Table 12: Glossary of water environment terminology

Terminology	Summary Definition
Main River	Designated 'Main Rivers' are usually larger rivers and streams with the highest flood risk. The Environment Agency, using its permissive powers, can carry out maintenance, improvement, or construction work on Main Rivers to manage flood risk and protect the environment. As these powers are permissive only, the Environment Agency is not obliged to carry out either maintenance or new works on Main Rivers
Flood Zone	Areas classified by the probability of river or sea flooding, excluding the presence of flood defences.
AIMS	Asset Information and Maintenance programme dataset detailing flood risk management assets. The dataset is owned by the Environment Agency but includes assets also owned or operated by third parties.
River Basin District	The area of land (and sea) comprising one or more neighbouring river basins together with their associated groundwaters and coastal waters. There are 10 river basin districts in England.
Management Catchment	A sub-category of a river basin district, a management catchment comprises a number of water body catchments in one management unit at which actions are applied.
Operational Catchment	A sub-category of a management catchment, an operational catchment groups water body catchments together for economic appraisal.
Water Framework Directive (WFD) or Water Environment Regulations (WER)	Legislation designed to halt the deterioration in status of water bodies in Europe (WFD) and England (WER) and achieve good status for rivers, lakes and groundwaters.
River Basin Management Plan (RBMP)	RBMPs are produced for each river basin district and set the legally binding, locally specific environmental objectives for water regulation and planning activities.

4.4.1 Catchment overview

There is c.86.8km of Main River within the Lower Nene catchment⁶ (see Figure 15).

- The lower River Nene flows through the urban area of Peterborough in the far south-west of the catchment and in a north-easterly direction to Wisbech before flowing north and discharging into The Wash via Lutton Leam Sluice;
- Within Peterborough, the River Nene is joined by the Black Dike Main River upstream of Ferry Meadows Country Park and an unnamed Main River downstream of Frank Perkins Parkway;
- The Morton's Leam Main River flows in an almost straight line parallel to the course of the River Nene between Peterborough and Guyhirn, forming the extent of the Nene Washes. The Stanground Lode Main River flows into Morton's Leam via Back River at Stanground;
- There are also several ordinary watercourses within the catchment, including Thorney River which discharges into Old Wryde Drain and Cat's Water which discharges into New South Eau. These watercourses drain the central portion of the catchment and in turn discharge into the North Level Main Drain in the centre of the catchment and ultimately discharges to the River Nene via Tydd pumping station.
- In the north of the catchment, South Holland Main Drain and Lutton Leam ordinary watercourses also flow in an easterly direction to outfall into the lower reaches of the River Nene. The extent of these Main Rivers and ordinary watercourses are shown in Figure 15. These watercourses generally comprise linear and largely embanked channels to facilitate land drainage and flood risk management, within a complex network of North Level District and South Holland Internal Drainage Board (IDB) drains and pumping stations; and
- The Nene Washes are located between the River Nene and Morton's Leam are an expanse of grassland utilised for flood storage, creating a washland area and is designated as a Ramsar site, SSSI, SPA and SAC. During times of high flow, water is channelled from the River Nene into the Morton's Leam and the washes are inundated and released back into the Nene via a sluice gate at Rings End during low tide. The tidal extent of the River Nene is 45km upstream of The Wash at the Dog-in-a-Doublet Sluice.

⁶ Based on measurements of Main River within the catchment study area boundary undertaken in ArcGIS.

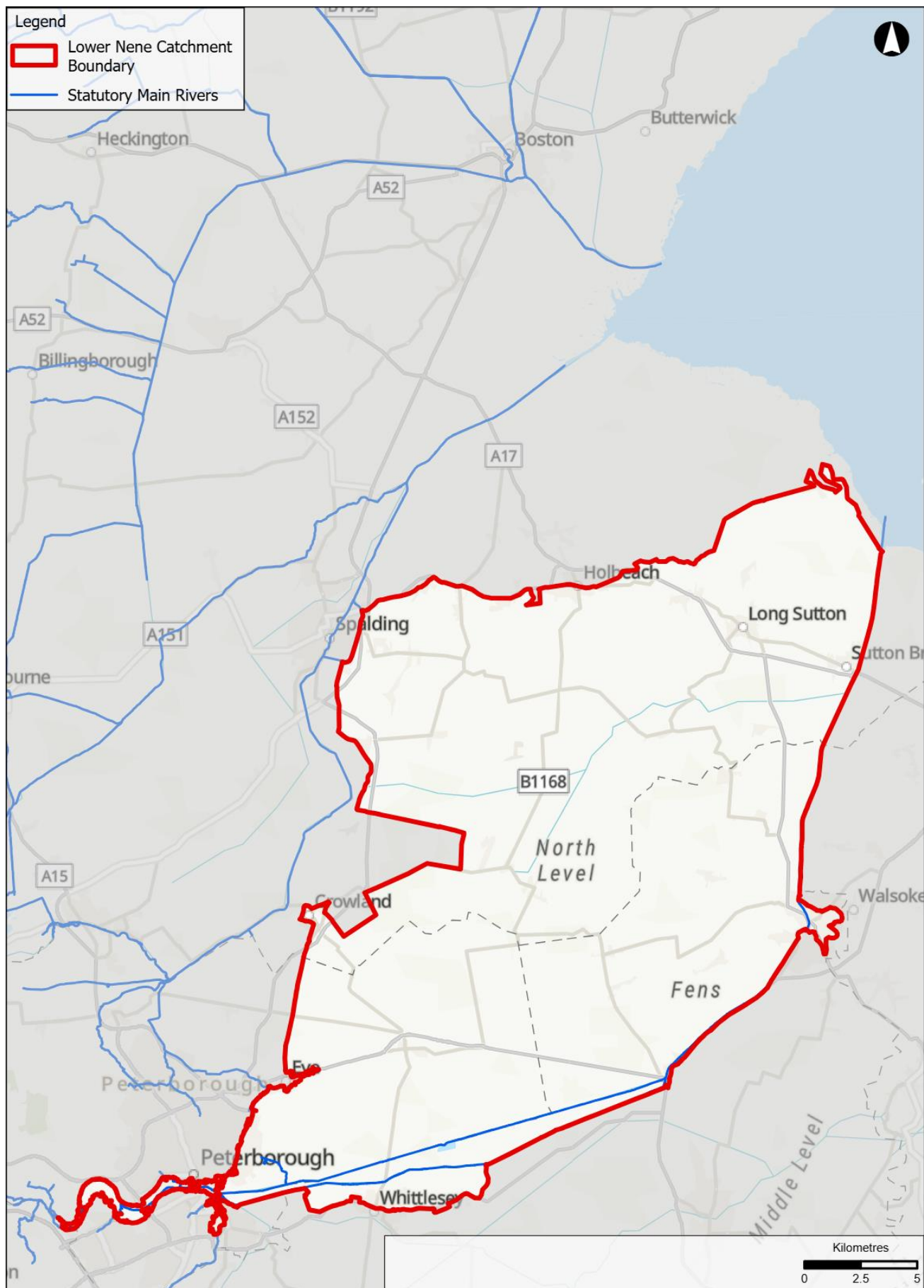


Figure 15: Main Rivers in the catchment

4.4.2 Water Environment Regulations (WER) / Water Framework Directive (WFD)

Surface water bodies

The catchment is located within the Anglian River Basin District (RBD), which extends from Lincolnshire in the north to Essex in the south, and Northamptonshire in the west to the East Anglian coast. The RBD is subdivided into 14 Management Catchments, with the catchment falling within the Nene and Anglian Transitional and Coastal (TRaC) management catchments, and within the Nene Middle and Nene Lower and The Wash TRaC operational catchments, respectively.

The far south-western (upstream) extent of the study area is located within the 'Nene – Islip to tidal' river water body catchment, which extends to North Side just to the north of Whittlesey. Downstream of this point, the remainder of the tidal extent of the River Nene comprises the 'Nene' TRaC water body. The surrounding catchment area is divided into a number of river water body catchments, which each drain into the tidal 'Nene' TRaC water body.

Within the southern portion of the study area, this includes the 'Stanground Lode' and 'Morton's Leam' river water bodies located to the south (right-bank) of the River Nene and the 'North Level Pumped Areas 2 and 3' river water body located to the north (left bank).

The central and northern portions of the study area catchment fall within the 'North Level Main Drain' and 'South Holland Main Drain' river water body catchments, which both drain eastward to the River Nene.

The western boundary of the catchment study area partially ingresses into the 'Welland – conf Greatford Cut to Tidal' and 'Folly River (including Werrington and Marholm Brooks)' WER/WFD river water body catchments, which are part of the Lower Welland operational catchment (and study area catchment). Similarly, the southern boundary of the study area partially ingresses into the 'Middle Level' WER/WFD river water body catchment, which is part of the Middle Level operational catchment (and Great Ouse study area catchment). These water body catchments have therefore been excluded from this baseline.

Parts of the northern and north-eastern extent of the study area comprise areas that are not defined as WER/WFD surface water bodies. These are lowland areas around the tidal reaches of River Nene and near to the coast (which drain into saltmarsh and mudflat habitats that form the margins of the 'Wash Inner' transitional (TRaC) water body).

The location and extent of these surface water body catchments relative to the catchment boundary is shown in Figure 16. All of the surface water bodies in the catchment are considered to be artificial or heavily modified. An overview of these surface water bodies and their current statuses is provided in Table 13.

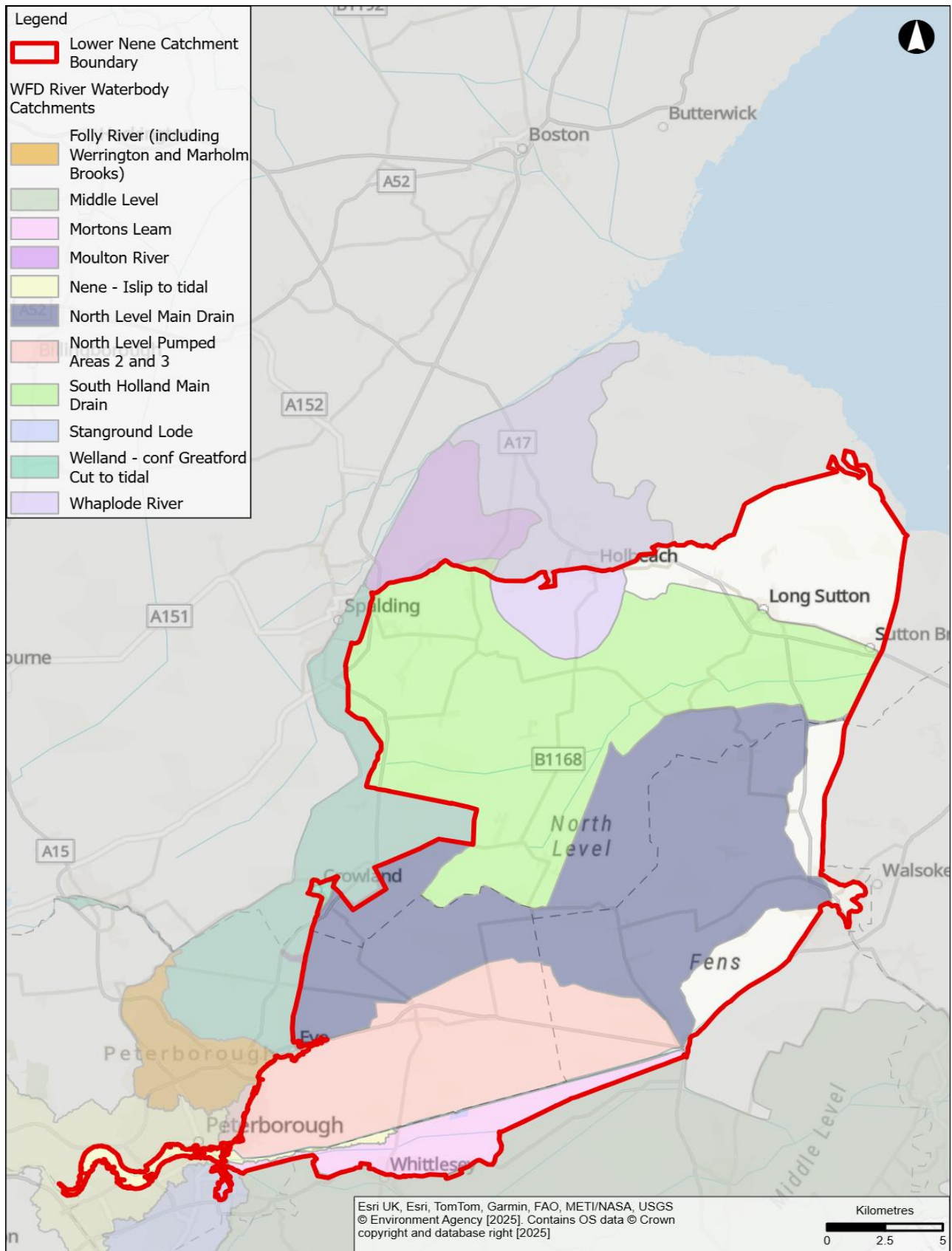


Figure 16: WER/WFD surface waterbodies in the catchment⁷

⁷ Figure 16 does not include the Nene TraC water body which comprises the tidal extent of the River Nene channel; the surrounding catchment area comprises various river water body catchments which are tributaries of the Nene TraC.

Table 13: Summary of WER/WFD surface water bodies and their latest Cycle 3 (2022) status classifications

Waterbody Name	Waterbody ID	Waterbody Type	Hydromorphologic al Designation	Catchment area (km ²)	Overall Status	Ecological Status	Biological quality elements	Physico-chemical quality elements	Hydromorphologic al Supporting Elements	Supporting Elements	Specific Pollutants	Chemical Status
Nene – Islip to tidal	GB105032050381	River	Heavily Modified	149.2	Moderate	Moderate	Good	Moderate	Supports Good	Moderate	High	Fail*
Stanground Lode	GB105032050340	River	Heavily Modified	30.3	Moderate	Moderate	Good	High	Supports Good	Moderate	High	Fail*
Morton's Leam	GB105032050382	River	Artificial	23.3	Poor	Poor	Poor	Moderate	Supports Good	Moderate	-	Fail*
North level Pumped Areas 2 and 3	GB205032050385	River	Artificial	90.9	Moderate	Moderate	-	Moderate	Supports Good	Good	-	Fail*
North Level Main Drain	GB205032050395	River	Artificial	164.7	Moderate	Moderate	Good	Moderate	Supports Good	Good	-	Fail*
South Holland Main Drain	GB205032050405	River	Artificial	169.4	Moderate	Moderate	Poor	Moderate	Supports Good	Good	-	Fail*
Nene	GB530503200200	Transitional water	Heavily Modified	1.9	Moderate	Moderate	High	Moderate	Supports Good	Moderate	High	Fail*

Note: Chemical Status is assessed once per RBMP Cycle (every 6 years) and so was last assessed in 2019 (and is recorded as 'does not require assessment' within the latest interim Cycle 3 2022 status classification.

Existing pressures on status

The Environment Agency's 'Reasons for Not Achieving Good' (RNAG) dataset identifies the key pressures and activities that are currently considered to be limiting the status of each of the different status elements that are not currently achieving their 'Good' status objective. Each RNAG is linked to a 'Surface Water Management Issue' (SWMI), which have been identified via the catchment management planning process. These comprise the main issues that are deemed to limit the uses and potential benefits of managing the water environment in the river basin district in a sustainable way.

The latest RNAG identified for the river water bodies present within the catchment are summarised in Table 14. The current RNAGs identified for the river water bodies in the catchment are primarily related to diffuse and point source pollution from agricultural land and water industry sewage discharge, respectively, and physical modification and flow pressures associated with land drainage for agriculture and rural land management affecting the fish status.

Table 14: Summary of RNAG for waterbodies within the catchment

Water body	Number of RNAGs per Surface Water Management Issue (SWMI)						
	Physical modifications	Pollution from wastewater	Pollution from towns, cities and transport	Changes to the natural flow and level of water	Invasive non-native species	Pollution from rural areas	Pollution from abandoned mine
Nene – Islip to tidal	1	1	2	0	0	2	0
Stanground Lode	2	0	0	0	0	0	0
Morton's Leam	4	0	0	0	1	2	0
North level Pumped Areas 2 and 3	0	2	0	0	0	0	0
North Level Main Drain	0	0	0	0	0	0	0
South Holland Main Drain	0	0	0	0	0	0	0
Nene	1	0	0	0	0	1	0
TOTAL	8	3	2	0	1	5	0

Mitigation measures

The artificial or heavily modified water body Mitigation Measures assessments for the relevant surface water bodies within the catchment study area identified various measures derived to mitigate the impacts of flood protection, land drainage, recreation and water regulation 'uses'. These measures are required to be in place for the water bodies to achieve their Good Ecological Potential objectives under the WER/WFD. A variety of measures are already in place or not applicable to some of the water bodies. The measures which are not in place are outlined in Table 15.

Table 15: Mitigation Measures which are currently not in place in the relevant Surface Water Bodies

Mitigation measure not in place	Relevant Surface Water Body
Preserve and/or restore existing in stream and riparian/shoreline habitats	Morton's Leam; Stanground Lode
Restore or increase in-channel morphological diversity e.g. riffle and pool creation and bar creation etc.	Morton's Leam
Installation of structures designed to facilitate and improve the passage of migratory (e.g. salmon and sea trout) and non-migratory fish where structures cannot be removed	Morton's Leam; Stanground Lode
Modification of structure to prevent/reduce fish entrainment e.g. screens	Morton's Leam; Stanground Lode
Retro-fitting existing structures to accommodate niche habitats, as opposed to more substantial structural modifications that would be likely to deliver greater hydromorphological change but may not be possible given the use	Morton's Leam; Stanground Lode
Good practice management of in channel and riparian vegetation works or maintenance practices (e.g. macrophyte cutting), carried out in a manner that considers the impacts of the activity upon ecology and hydromorphology	Morton's Leam; Stanground Lode
Leaving habitat or parts of natural habitat while undertaking operations or maintenance in a water body	Morton's Leam; Stanground Lode
Ensure best practice techniques are applied when undertaking maintenance activities to minimise impacts to the habitat	Morton's Leam
Ensure best practice is applied when undertaking maintenance works e.g. coffer dam placement, working during appropriate flow conditions	Morton's Leam

Removal or re-location of set-back embankments	Stanground Lode
Restoration of lateral connectivity with the water bodies surrounding floodplain e.g. flood plain spillways	Stanground Lode
Removal/softening of hard engineering structures that modify natural bank profile	Stanground Lode
Implement an active sediment management strategy (develop and revise) which could include a) substrate reinstatement, b) sediment traps, c) allow natural recovery minimising maintenance, d) riffle construction, e) reduce all bar necessary management in flood risk areas	Stanground Lode
Implement an active and operational dredging disposal strategy	Nene – Islip to tidal
Modify or use alternative boats to prevent impact of wash, e.g. electric motors or different propeller design	Nene – Islip to tidal
Ensure that boats use the central track of navigation to protect marginal habitat e.g. Signage, buoys etc.	Nene – Islip to tidal

WER/WFD protected areas

Under the WER/WFD, 'Protected Areas' were defined as areas requiring additional protection because of their sensitivity to pollution or due to their particular economic, social or environmental importance. These include designated water bodies (or parts of water bodies) or catchment areas that are abstracted from for human consumption, support economically significant aquatic species, are recreational waters, are sensitive to nutrient enrichment or support habitats or species of international conservation importance.

The specific environmental designations, measures and actions for these Protected Areas have been established under previous European Directives and their associated domestic legislation/regulations, which set out the requirements to ensure the protection of the area's water environment or protection of wildlife that is directly dependent on that water environment. Where a WER/WFD water body falls within or forms all or part of one of these designated Protected Areas, the water body is subject to additional environmental objectives (and associated monitoring regimes, risk assessments, and regulations) in accordance with the relevant legislation. The WER/WFD Protected Areas present within the catchment study area are summarised in Table 16.

Table 16: WER/WFD Protected Areas present within the catchment

Protected Area Type	Protected Area Name (code)	Relevant waterbody
Nitrates Directive	Thrapstone lake Eutrophic lake NVZ (EL148)	Nene – Slip to tidal
	River Nene NVZ (S382)	Nene – Slip to tidal; Stanground Lode; Morton's Leam
	Northampton Sands (G165)	Nene – Slip to tidal
Shellfish Water Directive	South East Wash (UKSW2)	Nene
Special Area of Conservation	The Wash & North Norfolk Coast (UK0017075)	Nene
	Orton Pit (UK0030053)	Stanground Lode
	Nene Washes (UK0030222)	Morton's Leam
Special Protection Area	The Wash (UK9008021)	Nene
	Nene Washes (UK9008031)	Nene; Nene – Slip to tidal; North level Pumped Areas 2 and 3; Stanground Lode; Morton's Leam
	Upper Nene Valley Gravel Pits (UK9020296)	Nene – Slip to tidal
Ramsar Site	The Wash (UK11072)	Nene
	Nene Washes (UK11046)	Nene; Nene – Slip to tidal; North level Pumped Areas 2 and 3; Stanground Lode; Morton's Leam
	Upper Nene Valley Gravel Pits (UK11083)	Nene – Slip to tidal
Urban Waste Water Treatment Directive	River Nene (UKENRI29)	Nene – Slip to tidal
Safeguard Zone	River Nene (SWSGZ1006)	Nene – Slip to tidal
Drinking Water Protected Area	Nene – Slip to tidal (UKGB105032050381)	Nene – Slip to tidal

Groundwater bodies

Groundwater bodies are the principal units of groundwater as defined in the WER/WFD, and are hydraulically connected, distinct entities of groundwater.

The majority of the catchment is not located within a WER/WFD groundwater body. However, the

south-western extent of the catchment upstream of, and within, Peterborough is partially located over two WER/WFD groundwater bodies within the Anglian Groundwater management catchment. The status of the groundwater body is summarised in Table 17.

Table 17: WER/WFD groundwater body within the catchment and their latest Cycle 3 (2019) status classifications

Waterbody Name	Waterbody ID	Surface Area (km ²)	Overall Status	Quantitative Status	Chemical (GW) Status
Nene Mid Lower Jurassic Unit	GB40502G402400	995.9	Good	Good	Good
Northampton Sands	GB40501G445500	166.9	Good	Good	Good

4.5 Biodiversity

This section outlines the baseline biodiversity in the catchment. Table 18 outlines the key terminology used in this section.

Table 18: Glossary of biodiversity terminology

Terminology	Summary Definition
Priority Habitat and Species	Priority habitats and Species are those identified as being of principal importance for the conservation of biodiversity. These habitats are listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006.
Critically Endangered	Critically Endangered species are defined by the IUCN as species that face an extremely high risk of extinction in wild habitats.
Endangered	Endangered species are species which have been defined by IUCN as very likely to become extinct in their known native ranges in the near future.
Biodiversity Net Gain (BNG)	Biodiversity net gain (BNG) is a world-leading government strategy to create and improve natural habitats by making sure development has a measurably positive impact.
International Union for Conservation of Nature (IUCN)	International Union for Conservation of Nature is a membership union comprised of government and civil society organisations and is regarded as the global authority on the status of the natural world and the measures needed to safeguard it.
Local Nature Reserves (LNR)	Local Nature Reserve are statutory designated areas under Section 21 of the National Parks and Access to the Countryside act 1949.
National Nature Reserves (NNR)	National Nature Reserves are areas of land declared under the National Parks and Access to the Countryside Act 1949 or Wildlife and Countryside Act (1981).
Special Areas of Conservation (SAC)	Special Areas of Conservation are protected areas in the UK designated under the Conservation of Habitats and Species Regulations 2017 (as amended) in England and Wales (including the adjacent territorial sea).
Special Protection Areas (SPAs)	Special Protection Areas are protected areas for birds in the UK classified under the Conservation of Habitats and Species Regulations 2017 (as amended) in England and Wales (including the adjacent territorial sea).
Sites of Special Scientific Interest (SSSI)	Sites of Special Scientific Interest are protected areas within England. They are designated (legally protected) to maintain and protect a specific aspect of biological or earth heritage interest.

4.5.1 Designated nature conservation sites

There are 16 statutory internationally/nationally designated nature conservation sites within or partially within the catchment, some of which overlap in entirety or partially with other designations. These comprise:

- Nene Washes - SPA, SSSI, SAC, Ramsar
- The Wash - SPA, SSSI, Ramsar, NNR
- The Wash & North Norfolk Coast - SAC
- Adventurers' Land - SSSI
- Bassenhally Pit - SSSI
- Eye Gravel Pit - SSSI

- Eye Green - LNR
- Woodston Ponds - LNR
- The Boardwalks - LNR
- The Shrubberies - LNR

The location of each designated site is shown in Figure 17 and a summary provided in Table 19.

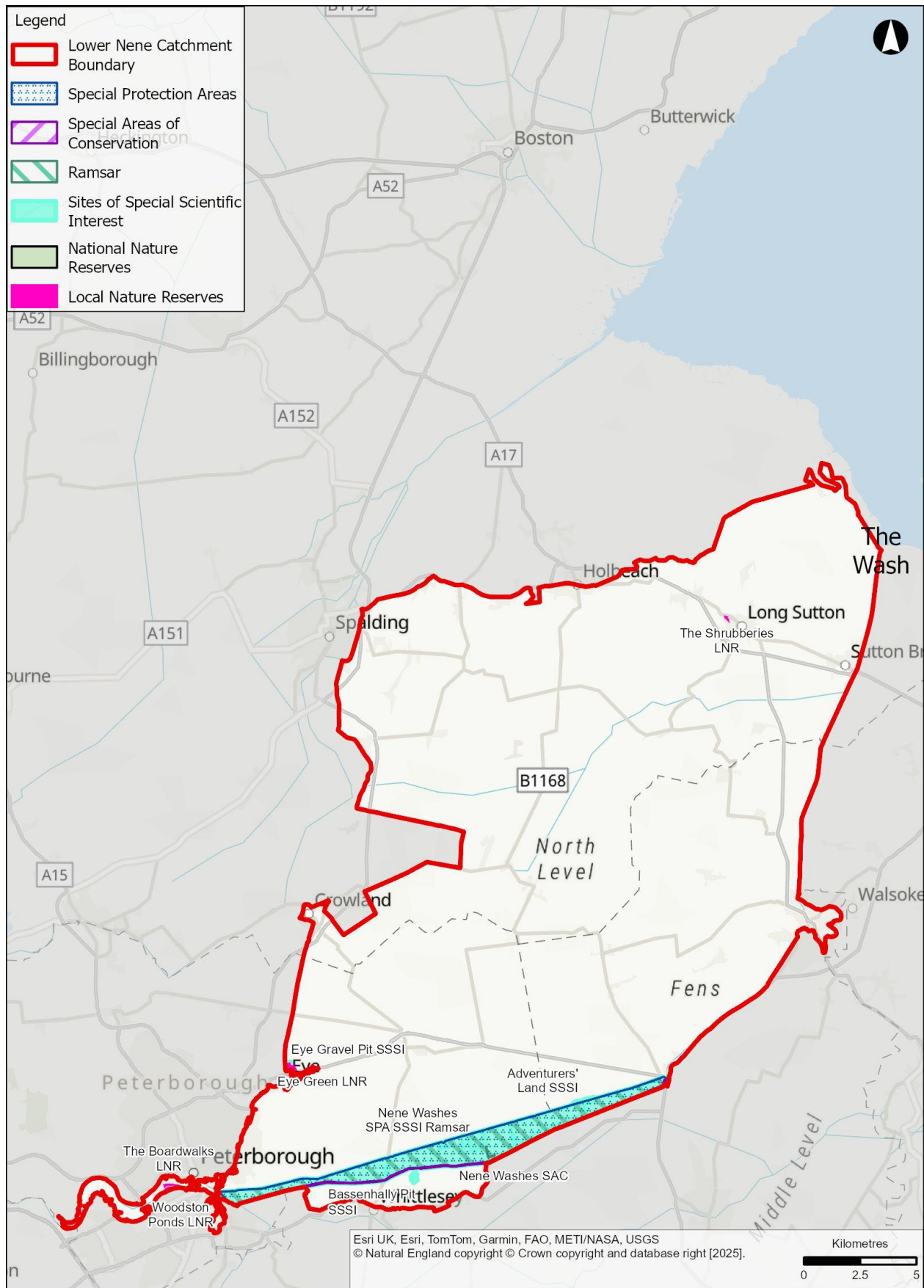


Figure 17: Overview of designated sites for nature conservation within the catchment

Table 19: Designated sites within the catchment

Site Name	Designation	Citation / Overview and key features
Nene Washes	SPA SSSI SAC Ramsar	Nene Washes SAC, SSSI, Ramsar, and SPA overlaps with the catchment for over 95% of the protected areas total as the site is associated coastal intertidal washland habitat and seasonally flooded wet grassland. SPA – The Nene Washes SPA, located in the lower reaches of the River Nene in Cambridgeshire, is an area of seasonally flooding grassland and grazing marsh. It supports an internationally important wintering population of Bewick's swan (<i>Cygnus columbarius bewickii</i>). The site also supports nationally important breeding populations of migratory species such as gadwall (<i>Anas strepera</i>), garganey (<i>Anas querquedula</i>), shoveler (<i>Anas clypeata</i>), and black-tailed godwit (<i>Limosa limosa</i>). Additionally, it supports nationally important wintering populations of wigeon (<i>Anas penelope</i>), teal (<i>Anas crecca</i>), gadwall (<i>Anas strepera</i>), pintail (<i>Anas acuta</i>), and shoveler (<i>Anas clypeata</i>). The site is important for a diverse assemblage of breeding birds of wet grasslands, including redshank (<i>Tringa totanus</i>), snipe (<i>Gallinago gallinago</i>), lapwing (<i>Vanellus vanellus</i>), mute swan (<i>Cygnus olor</i>), sedge warbler (<i>Acrocephalus schoenobaenus</i>), and yellow wagtail (<i>Motacilla flava</i>). It also hosts a notable assemblage of wintering waterfowl and a wide range of raptors throughout the year. SSSI - The Nene Washes Site of Special Scientific Interest (SSSI) represents one of the country's few remaining areas of washland habitat which is essential to the survival nationally and internationally of populations of wildfowl and waders. Covering an area of 1,522 hectares, this site is notable for its diverse plant and animal life within its network of dykes and supports large numbers of wintering wildfowl, including species such as wigeon (<i>Anas penelope</i>), teal (<i>Anas crecca</i>), pintail (<i>Anas acuta</i>), and Bewick's swan (<i>Cygnus bewickii</i>). Additionally, it provides important breeding grounds for wetland birds like snipe (<i>Gallinago gallinago</i>) and redshank (<i>Tringa totanus</i>). SAC - Nene Washes Special Area of Conservation (SAC), covering 82.57 hectares, is designated for the Annex II species spined loach (<i>Cobitis taenia</i>), which is a primary reason for the site's selection. Moreton's Leam, a large drainage channel along the eastern flank of the Nene Washes, contains the highest recorded density of spined loach in the UK. There may also be thriving populations in the smaller ditches of the Washes. This site is one of only four known outstanding localities for spined loach in the United Kingdom. Ramsar - Nene Washes Ramsar Site, covering 1,517 hectares, is an extensive area of seasonally flooded wet grassland along the canalised lower River Nene, known as "washland." The site also contains a substantial network of drainage ditches that remain wet throughout the year. Nationally scarce plants include fringed water-lily (<i>Nymphoides peltata</i>), hairlike pondweed (<i>Potamogeton trichoides</i>), and marsh dock (<i>Rumex palustris</i>). The site supports a relict invertebrate fauna representative of the region's formerly extensive fenland, including the aquatic snail (<i>Valvata macrostoma</i>), the water beetle (<i>Agabus undulatus</i>), the dragonfly (<i>Libellula fulva</i>), and the hoverfly (<i>Anasimyia interpuncta</i>). It also holds a notable assemblage of breeding water birds, such as gadwall (<i>Anas strepera</i>), garganey (<i>Anas querquedula</i>), shoveler (<i>Anas clypeata</i>), snipe (<i>Gallinago gallinago</i>), redshank (<i>Tringa totanus</i>), and black-tailed godwit (<i>Limosa limosa</i>). The site supports internationally important numbers of wintering water birds, including Bewick's swan (<i>Cygnus columbianus bewickii</i>).

The Wash	SPA SSSI Ramsar NNR	The Wash NNR, SSSI, Ramsar, and SPA overlaps with catchment for less than 0.1% of the protected areas total as the site is associated coastal intertidal mudflats and saltmarshes. SPA – The Wash Special Protection Area (SPA) covers 622 km² and forms part of the larger Wash and North Norfolk Coast Special Area of Conservation which encompasses the largest embayment in the UK, as well as extensive intertidal sand and mudflats, subtidal sandbanks, biogenic and geogenic reef, saltmarsh and a barrier beach system unique in the UK. The Wash SPA supports non-breeding including a large number of species such as: bar-tailed godwit; bewick's swan (<i>Cygnus columbianus bewickii</i>) and black-tailed godwit (<i>Limosa limosa islandica</i>). SSSI – Covers the same area as the SPA and Ramsar, and is of international biological interest. The intertidal mudflats and saltmarshes are crucial winter-feeding areas for waders and wildfowl, supporting large numbers of migrant birds. The saltmarsh and shingle communities are botanically significant, and the mature saltmarsh is a valuable bird breeding zone. The Wash is also an important breeding ground for common seals (<i>Phoca vitulina</i>). Ramsar – The Wash is Britain's largest estuarine system, fed by four rivers. It has extensive saltmarshes, intertidal banks, and deep channels. It is crucial for migrant wildfowl and wading birds, supports a shellfish fishery, and hosts large populations of common and grey seals. The sublittoral area includes diverse marine communities. NNR - The Wash National Nature Reserve, covering over 8,880 hectares, is one of England's last great wildernesses and its largest reserve. This crucial wetland, with extensive mudflats and saltmarshes, supports thousands of birds year-round. In winter, it attracts wildfowl like pink-footed geese (<i>Anser brachyrhynchus</i>) and shelduck (<i>Tadorna tadorna</i>), while summer sees waders and seabirds breeding. The Wash is also a prime breeding area for common seals (<i>Phoca vitulina</i>), hosting one of England's largest populations. Seal Sands, a major basking site, offers summer boat trips from Hunstanton to view these seals up close.
The Wash & North Norfolk Coast	SAC	The Wash & North Norfolk Coast overlaps with the catchment for less than 0.1% of the protected areas total as the site is associated coastal subtidal sandbanks mudflats and shallow bays. SAC - The Wash & North Norfolk Coast Special Area of Conservation (SAC) is one of the UK's premier marine areas, featuring extensive subtidal sandbanks, diverse mudflats, and large shallow inlets and bays. It supports significant biogenic reefs formed by Ross worm (<i>Sabellaria spinulosa</i>) and is home to diverse benthic communities, including brittlestars and commercially important fish species. The site also includes the largest single area of glasswort (<i>Salicornia</i>) vegetation in the UK and extensive Atlantic salt meadows. Additionally, it is a crucial habitat for common seals (<i>Phoca vitulina</i>) and otters (<i>Lutra lutra</i>), contributing to its high ecological value. The unique Mediterranean and thermo-Atlantic halophilous scrubs further enhance the site's biodiversity.
Adventurers' Land	SSSI	Adventurers' Land completely overlaps with the catchment.

		SSSI – Adventurers’ Land SSSI, covering 10.1 hectares, has a geological designation and is significant for studying Flandrian sea-level fluctuations. Radiocarbon and micropaleontological analyses of peats and silty clays have established the chronology of sea-level movements in the Fenland, with peat layers dating from approximately 6400 BP to 1850 BP.
Bassenhally Pit	SSSI	The Bassenhally Pit completely overlaps with the catchment. SSSI – Bassenhally Pit SSSI, covering 8.6028 hectares, features a variety of habitats developed over shallow gravel workings. Of primary interest are the grassland and aquatic habitats, particularly a small marsh that hosts many locally uncommon vascular plants. This marsh, rare in Cambridgeshire and nationally scarce, is dominated by grasses, sedges, and rushes, including creeping bent (<i>Agrostis stolonifera</i>), jointed rush (<i>Juncus articulatus</i>), common spike-rush (<i>Eleocharis palustris</i>), and local spike-rush (<i>Eleocharis uniglumis</i>). It also supports a variety of herbs such as lesser water-plantain (<i>Baldellia ranunculoides</i>), early marsh-orchid (<i>Dactylorhiza incarnata</i>), and water violet (<i>Hottonia palustris</i>), with stands of sea club-rush (<i>Scirpus maritimus</i>) being of particular interest. The site’s diverse habitats, including grassland, aquatic areas, scrub, and woodland, make it valuable for wildlife and an important educational resource for local schools.
Eye Gravel Pit	SSSI	Eye Gravel Pit completely overlaps with the catchment. SSSI – The Eye Gravel Pit SSSI, covering less a half a hectare, has a geological designation. It features exposures of Fen Gravel (March Gravel) with marine and occasional non-marine shells, significant for its position at the interface between the Pleistocene fluvial and glacial sequences of the East Midlands and the marine succession of Fenland.
Eye Green	LNR	Eye Gravel Pit overlaps with over 99% of the catchment. LNR - Eye Green LNR, a 12-hectare site, features a picturesque 15-acre lake, areas of woodland, finger lakes, and reed beds. The lake, formed by natural springs filling the disused pit, is now a vital habitat for a wide range of wildlife. It is home to resident swans, geese, and other waterfowl, and also serves as a stopover for migratory geese. The grassland areas burst into colour in spring and summer, supporting wildflowers like violets and pyramidal orchids. The reserve also includes a small part of the Eye Gravel Pit geological Site of Special Scientific Interest. Reeds and scrub around the lake provide cover for water birds such as coots (<i>Fulica atra</i>) and moorhens (<i>Gallinula chloropus</i>), while dense scrub hosts nesting dunnocks (<i>Prunella modularis</i>) and great tits (<i>Parus major</i>). The diverse habitat supports a variety of invertebrate species.
Woodston Ponds	LNR	Woodston Ponds overlaps with over 93% of the catchment. LNR - Woodston Ponds LNR, an 8.9-hectare site, features diverse habitats including reedbeds with pools and channels, grassland, scrub, and Bob’s Pond to the west, and a small lake with a viewing platform to the east. The reedbeds and pools are home to various animals, including water stick insects and uncommon water beetles. Dragonflies and damselflies, such as banded demoiselle (<i>Calopteryx splendens</i>), emerge in spring and summer to feed and breed along the water’s edge. Great crested newts (<i>Triturus cristatus</i>) hibernate in the long vegetation and return to the pools to breed in early spring. Birds like reed buntings (<i>Emberiza schoeniclus</i>) and sedge warblers (<i>Acrocephalus schoenobaenus</i>) nest among the reed stems. Along the river and lake’s edge, grey herons (<i>Ardea cinerea</i>) can be seen fishing, and the lake hosts many duck species, including shoveler (<i>Anas clypeata</i>). The site,

		formerly settling ponds for sugar beet washings, also supports tufted ducks (<i>Aythya fuligula</i>) and pochards (<i>Aythya ferina</i>). The trees and shrubs provide shelter for songbirds such as whitethroats (<i>Sylvia communis</i>) and willow warblers (<i>Phylloscopus trochilus</i>), as well as woodpeckers and several bat species. Kingfishers (<i>Alcedo atthis</i>) can occasionally be spotted darting along the water's surface or perched on branches over the river.
The Boardwalks	LNR	The Boardwalks completely overlaps with the catchment. LNR - The Boardwalks Local Nature Reserve (LNR), a 7.8-hectare site, features a path system winding through diverse habitats including ponds, meadow, marsh, trees, scrub, and the river. The ponds are among the richest sites in Peterborough for water beetles. Toads, frogs, and common newts are well established, and grass snakes can be seen basking or swimming in the ponds. At the western end, a large pool with bays and islands attracts wildfowl and waders. Other birds include herons and woodpeckers. Many dragonflies and damselflies, including the banded demoiselle (<i>Calopteryx splendens</i>), are present. Bats make their homes in the large willows in the wet areas.
The Shrubberies	LNR	The Shrubberies completely overlaps with the catchment. LNR - The Shrubberies LNR features old parkland and pasture, a rare habitat in the Fens, with fine oak and other large trees. The site supports 49 species of birds and 12 species of butterflies. It includes a pond with a wooded island and adjoining marshy areas with fringing alders. The grassland is grazed by cattle and sometimes cut for hay. An acre of land was planted with native trees in 1989.

4.5.2 Priority habitats and other habitats

A habitat map for the catchment was created using Arup's suite of earth observation tools. Initially, habitats within the catchment that are listed on the Priority Habitat Inventory (PHI) were mapped. The PHI describes the spatial extent of 25 priority habitats in England. They were extracted from the existing Lower Nene map tiles to highlight areas specifically designated by Natural England.

In cases where a single area has multiple priority habitat designations (indicative of coexisting habitats in the PHI) both habitats were kept as a separate category. For example, "Coastal floodplain and grazing marsh" and "Coastal floodplain and grazing marsh; Coastal saltmarsh" were kept as two discrete classes in accordance with the PHI.

Following mapping of the PHI areas, OS open map data was used to identify features such as roads, buildings, trees and intertidal zones. Remaining habitats were then identified using a combination of earth observation imagery and publicly available datasets. The imagery was segmented into polygons and each polygon was assigned to a habitat type based on classification rules using Living England, Corine Land Cover, European Space Agency (ESA) World Cover datasets.

The habitats (including priority habitats) that have been identified within the boundary of the catchment are shown in Figure 18 and presented in Table 20.

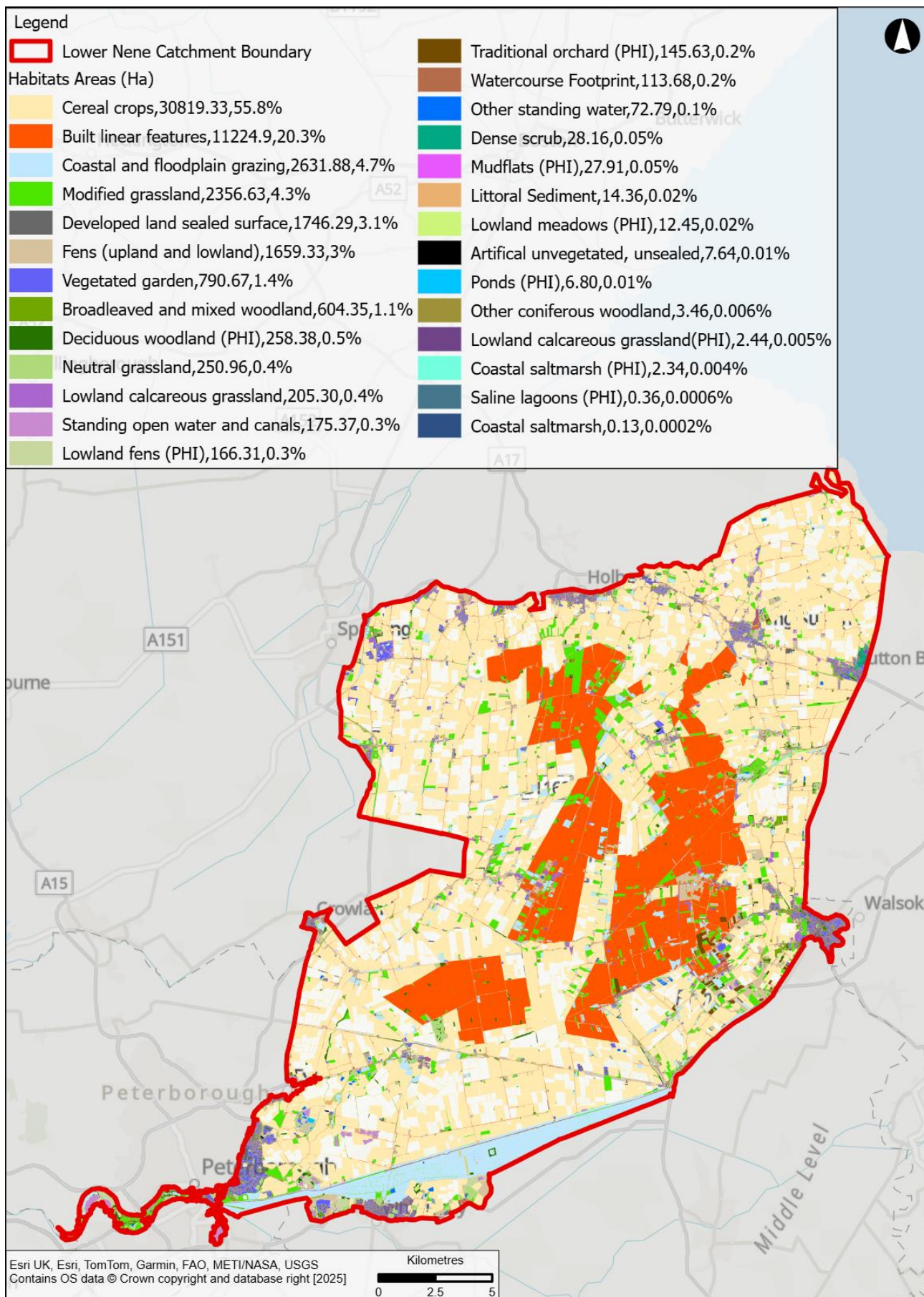


Figure 18: Habitat map for the catchment developed using earth observation

Table 20: Habitat types identified within the catchment

	Habitat Type	Study Area Hectares (ha)	Habitat Description [86]	Context within the catchment
Coastal	Mudflats (PHI)	27.91 ha	Mudflats are intertidal habitats formed by sediment deposition in low-energy coastal environments like estuaries. Their sediment is mainly silts and clays with high organic content, and sand content increases near estuary mouths. Mudflats are linked to other coastal habitats such as soft cliffs and saltmarshes, often appearing between subtidal channels and vegetated saltmarshes. They can be several kilometres wide in large estuaries but have been reduced by land reclamation. Mudflats dissipate wave energy, reducing erosion and flooding risks, and play a crucial role in nutrient chemistry and contaminant sequestration. They are highly productive but have low species diversity.	This habitat is limited to northern portion of the catchment along the coast and River Nene.
	Littoral Sediment	14.37 ha	This is an area of littoral sediment identified from publicly available sources.	This habitat is primarily located within the southwest region of the catchment, north of King's Dyke.
	Coastal Saltmarsh (PHI)	2.34 ha	Coastal saltmarshes in the UK, are the vegetated upper portions of intertidal mudflats. They lie between mean high water neap tides and mean high water spring tides, with the lower limit defined by pioneer saltmarsh vegetation and the upper limit one metre above the highest astronomical tides. Saltmarshes are found in sheltered locations such as estuaries, saline lagoons, behind barrier islands, at sea loch heads, and on beach plains. Their vegetation consists of halophytic species adapted to regular tidal immersion, showing clear zonation based on inundation frequency. Pioneer species like glassworts can withstand up to 600 tides per year, while upper marsh species endure occasional inundation.	This habitat is limited to northern portion of the catchment along the coast.

	Saline Lagoons (PHI)	0.36 ha	Saline lagoons are partially separated from the sea, retaining seawater at low tide and varying in salinity from brackish to hyper-saline. They support diverse flora and fauna, including rare invertebrates and important bird habitats. These lagoons can be separated by natural barriers like sand or shingle, rocky sills, or artificial constructions, with water exchange influenced by channels, percolation, or overtopping.	This habitat is limited to northern portion of the catchment, as it associated with a field drain adjacent to the River Nene.
	Coastal saltmarsh	0.14 ha	This is an area of coastal saltmarsh identified from publicly available sources but not identified on the PHI.	This habitat is limited to the coastal areas of the catchment.
Aquatic / semi-aquatic	Coastal and Floodplain Grazing Marsh (PHI)	2646.69 ha	Grazing marsh is defined as periodically inundated pasture, or meadow with ditches which maintain the water levels, containing standing brackish or fresh water. The ditches are especially rich in plants and invertebrates. Almost all areas are grazed, and some are cut for hay or silage. Sites may contain seasonal water-filled hollows and permanent ponds with emergent swamp communities, but not extensive areas of tall fen species like reeds; although they may abut with fen and reed swamp communities. Grazing marshes are particularly important for the number of breeding waders such as snipe (<i>Gallinago gallinago</i>), lapwing (<i>Vanellus vanellus</i>) and curlew (<i>Numenius Arquata</i>) they support. Internationally important populations of wintering wildfowl also occur including Bewick swans (<i>Cygnus bewickii</i>) and whooper swans (<i>Cygnus cygnus</i>).	This habitat found throughout the catchment. This habitat is associated with the Nene Washes SPA, SSSI, and Ramsar. There are further isolated patches located across the catchment
	Fens (upland and lowland)	1752.06 ha	This is an area of lowland fens habitat identified from publicly available sources.	This habitat found throughout the catchment, with the highest concentration found west of Wisbech.

	Standing open water and canals	175.37 ha	This is an area of standing open water and canals identified from publicly available sources.	This habitat is primarily located within the southwest region of the catchment, in Peterborough.
	Lowland Fens (PHI)	166.32 ha	Lowland Fens are peatlands that receive water and nutrients from the soil, rock, and groundwater, as well as from rainfall, making them minerotrophic. These Fens can be categorised into topogenous Fens, where water movement is vertical, and soligenous Fens, where water movement is lateral. Rich in biodiversity, lowland Fens support a variety of plant and animal communities, including up to 550 species of higher plants and numerous insect species, making them crucial habitats despite their decline in the past century.	This habitat is primarily located within the southern region of the catchment. This habitat is associated with the Eye Green LNR, Woodston Ponds LNR, and the Boardwalks LNR. There are further isolated patches located across the catchment.
	Watercourse	113.68 ha	This is an area of watercourse identified from publicly available sources.	This habitat is primarily associated with River Nene across the eastern boarder of the catchment.
	Ponds	72.80 ha	This is an area of ponds identified from publicly available sources.	This habitat is primarily located within the southern region of the catchment.
	Ponds (PHI)	6.81 ha	Ponds are defined as permanent and seasonal standing water bodies up to 2 hectares in size that meet specific ecological criteria. These criteria include supporting species of high conservation importance, exceptional assemblages of key biotic groups, and high ecological quality. High-quality ponds are now extremely localised in the UK.	Ponds are located across the catchment with a particular focus within the southwest region of the catchment, south of Eye Green.
Grassland	Modified grassland	2397.14 ha	This is an area of modified grassland identified from publicly available sources.	This habitat found throughout the catchment, with the highest concentration found northern portion of the catchment.

	Neutral grassland	251.80 ha	This is an area of neutral grassland identified from publicly available sources.	This habitat found throughout the catchment, with the highest concentration found southern portion of the catchment.
	Lowland calcareous grassland	220.59 ha	This is an area of lowland calcareous grassland identified from publicly available sources.	This habitat found throughout the catchment.
	Lowland Meadow (PHI)	12.45 ha	Lowland grasslands, treated as lowland meadows, includes most forms of unimproved neutral grassland in the UK. It covers various plant communities and considers both hay-cut and livestock-grazed pastures. These grasslands, though less common in non-agricultural settings, can be found in recreational sites, churchyards, and roadside verges. Excluded are maritime grasslands, upland hay meadows, and Molinia-Juncus pastures. Unimproved neutral grassland has declined significantly due to changing agricultural practices, with a 97% reduction in lowland England and Wales by 1984. Losses continued in the 1980s and 1990s, at rates of 2-10% per annum in some areas.	This habitat is limited to small, isolated patches along North Level Main Drain and north of Whittlesey.
	Lowland Calcareous grassland (PHI)	2.45 ha	Lowland calcareous grassland is a unique habitat found on shallow, lime-rich soils over limestone rocks, primarily in southern and eastern UK. These grasslands support a rich variety of flora and fauna, including rare species. Ecologically, they are vital for maintaining biodiversity, providing essential habitats for specialised plants and invertebrates, and supporting the life cycles of species.	This habitat is limited to small, isolated patches along the North Level Main Drain and the River Nene.
Scrub and heathland	Dense Scrub	28.17 ha	This is an area of dense scrub identified from publicly available sources.	This habitat is primarily located in northeast region of the catchment, north of Sutton Bridge.

Woodland	Broadleaved and mixed woodland	615.58 ha	This is an area of broadleaved and mixed woodland identified from publicly available sources.	This habitat is found throughout the catchment.
	Deciduous woodland (PHI)	258.85 ha	Lowland mixed deciduous woodland grows on a range of soil conditions, from very acidic to base-rich, and includes most semi-natural woodland in southern and eastern England, and parts of lowland Wales and Scotland. These woodlands, often ancient and small (less than 20ha), complement upland oak and ash types. They often show great variety in canopy and ground flora species, with <i>Quercus robur</i> being the common oak. Locally, they may form mosaics with other types, including beech woodland and wet areas. Canopy variations include field maple, lime, elm, hornbeam, wych elm, ash, and oak, with occasional birch and alder stands.	This habitat is primarily limited to small, isolated patches.
	Other coniferous woodland	3.46 ha	This is an area of other coniferous woodland identified from publicly available sources.	This habitat is primarily located in the central portion of the catchment.
Agricultural	Arable and Horticulture	43383.59 ha	This is an area of arable land / horticultural land identified from publicly available sources. Further analysis of agricultural land use is available in the East and West Fens Catchment Agricultural Baseline. It is noted that there are likely to be some variation between landcover datasets used. The agricultural baseline has identified that the agricultural land use in the study area is dominated by arable crops.	This habitat is dominant and widely dispersed across the entirety of the catchment.
	Vegetated Garden	807.26 ha	This is an area of vegetated garden identified from publicly available sources.	This habitat is scattered throughout the entire catchment. Generally, the areas are adjacent to residential areas.

	Traditional Orchard (PHI)	145.85 ha	Habitat structure, rather than vegetation type, topography, or soils, defines traditional orchards. These orchards are similar to wood-pasture and parkland but differ in tree species (mainly Rosaceae), denser tree arrangement, smaller habitat patches, and wider dispersion. They include nut plantings like hazel and walnuts. Management focuses on fruit and nut production through grafting and pruning, unlike wood-pastures where timber is the main product. Grazing or cutting herbaceous vegetation is integral, and scrub, often in hedgerows, plays a similar ecological role. Ponds and wetlands are common for livestock watering.	This habitat is limited to small, isolated patches across the catchment. The largest concentration of patches is located in the area surrounding Wisbech.
Developed land	Developed land sealed surface	1759.09 ha	This is an area of developed land sealed surface identified from publicly available sources.	This habitat is located across the catchment and is associated residential communities such as the surrounding area of Peterborough.
	Built linear features	1438.59 ha	This is an area of built linear features identified from publicly available sources.	This habitat is primarily associated with agricultural areas adjacent to watercourses.
	Artificial unvegetated, unsealed	7.65 ha	This is an area of artificial unvegetated, unsealed land identified from publicly available sources.	This habitat is limited to small, isolated patches.

4.5.3 Key species

The key species identified as qualifying species for the protected areas and designated sites within the catchment are presented in Table 21. Only species that are relevant to protected areas are included in the following table. Therefore, this table is intended to highlight some of the key species and not as an exhaustive list.

Table 21: Key species noted as citations for protected areas within the catchment

Species Common Name	Scientific Name	Relevant Protected Area or Key Habitats
Redshank	<i>Tringa totanus</i>	Nene Washes SSSI, Nene Washes Ramsar, The Wash Ramsar, Nene Washes SPA, The Wash SPA
Bewick's swan	<i>Cygnus bewickii</i>	Nene Washes SSSI, Nene Washes Ramsar, Nene Washes SPA, Coastal and Floodplain Grazing Marsh (PHI)
Snipe	<i>Gallinago gallinago</i>	Nene Washes SSSI, Nene Washes Ramsar, Nene Washes SPA, Coastal and Floodplain Grazing Marsh (PHI)
Water violet	<i>Hottonia palustris</i>	Nene Washes SSSI, Bassenhally Pit SSSI
Gadwall	<i>Anas strepera</i>	Nene Washes Ramsar, Nene Washes SPA, The Wash SPA
Shoveler	<i>Anas clypeata</i>	Nene Washes Ramsar, Nene Washes SPA, Woodston Ponds LNR
Black-tailed godwit	<i>Limosa limosa</i>	Nene Washes Ramsar, Nene Washes SPA, The Wash SPA
Wigeon	<i>Anas penelope</i>	Nene Washes SSSI, Nene Washes SPA, The Wash SPA
Teal	<i>Anas crecca</i>	Nene Washes SSSI, Nene Washes SPA
Pintail	<i>Anas acuta</i>	Nene Washes SSSI, Nene Washes SPA, The Wash SPA
Common seal	<i>Phoca vitulina</i>	The Wash Ramsar, The Wash & North Norfolk Coast SAC, The Wash SSSI

4.5.4 Critical habitat screening

A critical habitat screening exercise has been conducted based on the criteria outlined in International Finance Corporation Performance Standard 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources (2012) [87].

Critical habitats are defined as areas with high biodiversity value based on criterion 1 to 5 as outlined in the IFC guidance note. This screening has specifically focused only on Criterion 1 in Performance Standard 6 as defined below (Figure 19). It should be noted that a full critical habitat screening would require screening against all five criterion (see Figure 19).

International Finance Corporation Performance Standard 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources.

Criterion 1: Critically Endangered and Endangered Species.

Species threatened with global extinction and listed as CR and EN on the IUCN Red List of Threatened Species shall be considered as part of Criterion 1. Critically Endangered species face an extremely high risk of extinction in the wild. Endangered species face a very high risk of extinction in the wild.

As described in footnote 11 of Performance Standard 6, the inclusion in Criterion 1 of species that are listed nationally/regionally as CR or EN in countries that adhere to IUCN guidance shall be determined on a project-by-project basis in consultation with competent professionals.

Thresholds for Criterion 1 are the following:

- a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species ($\geq 0.5\%$ of the global population AND ≥ 5 reproductive units GN16 of a CR or EN species).
- b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in GN72(a).
- c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.

Figure 19: Critical habitat Criterion 1

The results of the critical habitat screening are presented in Table 22.

Table 22: Overview of IUCN Global Red List species identified within the catchment

Common Name and Status (IUCN Global Red List)	Scientific Name	Habitat and ecology	Population Trend	Relevance to the catchment
Interrupted Brome (Extinct in the Wild)	<i>Bromus interruptus</i>	Artificial/Terrestrial	Unspecified	Extinction of species in the wild occurred in 1972, with the last known population in Cambridgeshire. This plant, once found in southern Lincolnshire and Cambridgeshire, was reintroduced to Whittlesford, Cambridgeshire, in 2003. The reintroduction marked a significant conservation milestone as the first known reintroduction of an extinct plant in Britain [88].
Allis Shad (Critically Endangered)	<i>Alosa alosa</i>	Wetlands (inland), Marine Neritic, Marine Oceanic	Decreasing	The species is native to the northeastern Atlantic ocean and considered rare within most of its range. The species is considered possibly extinct within the catchment.
Balearic Shearwater (Critically Endangered)	<i>Puffinus mauretanicus</i>	Marine Neritic, Marine Oceanic, Marine Coastal/Supratidal	Decreasing	The fully migratory species congregates off the Atlantic coasts of southwest Europe during the summer and autumn, after breeding in the Mediterranean [89]. Since the 1990s, an apparent increase in Balearic Shearwaters in north-west European waters, including north-west France and south-west Britain, was noted [90].
European Eel (Critically Endangered)	<i>Anguilla anguilla</i>	Wetlands (inland), Marine Neritic, Marine Oceanic, Marine Intertidal, Artificial/Aquatic & Marine	Decreasing	This species likely present in a number of watercourses across the catchment and has been specifically recorded in the River Nene [91].
Depressed River Mussel (Endangered)	<i>Pseudanodonta complanata</i>	Wetlands (inland)	Decreasing	The species has been lost from at least 50% of its previously known sites over the past 20 years. Threats are likely related to habitat degradation and loss, including poor river management, water pollution (organic and inorganic), siltation, channeling, water abstraction, drought, and poaching for private collections and aquaria [92].
White-clawed Crayfish	<i>Austropotamobius pallipes</i>	Wetlands (inland), Artificial/Aquatic & Marine	Decreasing	This species has declined by 50-80% in England, France, and Italy, primarily due to invasive crayfish species and crayfish plague. Despite international and national

(Endangered)				protections, these measures have limited success in halting the spread of non-native species [93].
Freshwater Pearl Mussel (Endangered)	<i>Margaritifera margaritifera</i>	Wetlands (inland)	Decreasing	It is possible that some scattered individuals are present within the catchment study area however the only viable populations are in Scotland.
Glistening waxcap (Endangered)	<i>Gloioxanthomyces vitellinus</i>	Grassland	Decreasing	The IUCN red list distribution indicates that this species range falls within the catchment study area however the presence of this species is unconfirmed at present.

4.6 Cultural heritage

This section outlines the cultural heritage baseline in the catchment. Table 23 outlines the key terminology used in this section.

Table 23: Glossary of cultural heritage terminology

Terminology	Summary Definition
Designated heritage asset	A World Heritage Site, Scheduled Monument, Listed Building, Protected Wreck Site, Registered Park and Garden, Registered Battlefield or Conservation Area designated under the relevant legislation.
Non-designated heritage asset	A building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions, because of its heritage interest. It includes designated heritage assets and assets identified by the local planning authority (including local listing).
Historic environment	All aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora.
Historic Landscape Character	The Historic Landscape Character of Lincolnshire is interpreted on two scales: Character Area and Character Zone. There are 10 Character Area's across the county. Character Areas are large, regional parts of the county's landscape and are known as, for example, 'The Fens', 'The Wash', and 'The Southern Cliff'. Each Character Area comprises between two and five Character Zones, for example, 'The East Fen' and 'The West Fen' are the two Character Zones of 'The Fens' Character Area. Character Zones can still cover large parts of the landscape and are assessed in greater detail than Character Areas which communicate the broad trends of the component Character Zones. The major urban centres of exclude the major urban centres of Lincoln, Scunthorpe, and Grimsby are excluded and have their own urban assessments.
Setting of a heritage asset	The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral.
Significance (for heritage policy)	The value of a heritage asset to this and future generations because of its heritage interest. The interest may be archaeological, architectural, artistic or historic. Significance derives not only from a heritage asset's physical presence, but also from its setting. For World Heritage Sites, the cultural value described within each site's Statement of Outstanding Universal Value forms part of its significance.

4.6.1 Archaeological and historical background

The catchment historic environment is best understood through the evidence of the long interaction of people, the land and the sea which can be read in the settlements, fields, place names and the layers of soil in this area.

The coastal zone of Lincolnshire and north Cambridgeshire changed dramatically throughout the Prehistoric (1,000,000BCE-43CE) period. During the Palaeolithic (1,000,000BCE-10,000BCE), the fenlands and intertidal zones of the catchment had not yet formed [94] and did not emerge until after the last Ice Age approximately 10,000 years ago at the start of the Mesolithic (10,000BCE-4,000BCE) period. As the ice sheets retreated and sea levels rose, the vast plains of Doggerland (which once linked Britain with north-western Europe) were submerged and a coastline more akin to that of today emerged [95].

For most of the Later Prehistoric (4,000BCE-43CE) period the catchment would have been an expanse of marshes and creeks influenced by seasonal inundation by the sea, the flooding of the

Rivers Nene, Thorney and Welland and their tributaries. These characteristics are reflected in dominance of Tidal Flat (Clays and Silts) Deposits throughout all but the western edge of the catchment – which comprises areas of Peat deposit to the north-east, east, and south-east of Peterborough, areas of River Terrace Deposits (Sand and Gravel) within and to the east of the modern Peterborough city limits, and Alluvium (Clay, Silt, Sand and Gravel) Deposits along the course of the River Nene and other watercourses as they pass through the city.

The Fen and coastal marshland landscape of the catchment would have been an excellent resource for Prehistoric people for fishing, fowling, and foraging, and for the provision of materials such as rushes and reeds. The western edge of this landscape appears to have formed an important place for Prehistoric people in the Bronze Age. At this time the landscape was becoming successively wetter, becoming an area of marsh and fen with smaller islands of drier ground within it. The people living there used logboat canoes to travel, built timber causeways to cross between drier areas and built piled houses on stilt above the water. The wetland conditions created the conditions for organic materials to survive, meaning that archaeological investigations have been able to record extensive evidence of this lost landscape. At Flag Fen, excavations in the 1980s recorded a timber post alignment representing the surviving remains of a causeway and a timber platform. Associated with these were a large amount of artefacts, including weapons and personal ornaments, which had been deliberately deposited into the water – a practice we believe to have been ceremonial [96]. Only a couple of kilometres south of Flag Fen, at the northern edge of the Great Ouse catchment area, recent excavations at Must Farm found pile-driven stilted roundhouses and numerous logboat canoes, associated with what has been described as possibly the largest Late Bronze Age assemblage of domestic material, including wooden artefacts, fibres and textiles [97]. In addition to Flag Fen and Must Farm, there are a large number of Bronze Age burial mounds (barrows) in a swathe of land between the Wellan and Nene.

During the Roman period, the peatland and fenland parts of the catchment were extensively, and often densely, occupied and farmed [98]. Rural settlements were typically small and, while some individual farmsteads are known to have existed, it was more common for groups of farmsteads to be organised into small villages with their associated field systems aligned along droves (trackways or other routeways, used to move cattle from one area to another, often on a seasonal basis) which would link these clusters of farming communities together over several kilometres [99]. The communities were largely self-sufficient, with arable plots supplemented by the use of pasture on areas of higher, dryer ground and summer grazing and winter fodder provided by the fenland and freshwater marsh.

The catchment includes multiple Roman (43CE-410CE) and Romano-British structures and occupation sites. Some of the known occupation sites, such as the settlement at Bar Pastures [99], provide evidence of the gradual Romanisation of an earlier Iron Age settlement over time. There is a noticeable evolution of Roman rural settlements during the 1st Century and 2nd Century CE when settlements were typically very small and almost indistinguishable in form and from Iron Age settlements and then becoming larger and more complex as small and large-scale engineering projects – which included the construction of roads and canals – respectively, were carried out [99]. Many of these settlements were, however, abandoned during the 3rd Century CE [99].

One of the most substantial of these new structures of the 2nd Century CE is Carr Dyke. Stretching over approximately 92km from east of Peterborough to Lincoln (beyond the catchment in the north) Carr Dyke is an artificial channel constructed around 125CE [100]. Today, the remains of the dyke remain visible either as a landscape features, typically in the form of a wide ditch, or as is the case in the catchment, incorporated into the later Post Medieval drainage system of the fenland.

Following withdrawal of direct control from Rome in 410CE, a wave of settlers from mainland Europe arrived. During the 6th Century CE the Anglian tribe the *Spaldingas*, who are thought to

have given their name to the town of Spalding (located just north of the catchment in the Lower Welland catchment), arrived. It is likely that the catchment was part of the tribal lands of the *Spaldingas* which remained an administratively independent entity as a part of the larger Early Medieval (410CE-1066CE) Kingdom of Mercia until the late 9th Century.

While archaeological evidence for Early Medieval settlements is uncommon within the catchment, having typically been destroyed by later Medieval (1066CE-1542CE) or Post Medieval (1542CE-1901CE) settlement and occupation activity, placename evidence suggests that many of the villages and market towns of the catchment were established in the early centuries of the period. For example, the placename Whaplode derives from the Old English *cwappa-lad* meaning 'Eelpout watercourse' [101], while Peterborough, named *Medeshamstede* contemporary historic documentary sources, existed before 655CE. Several other villages and towns (named in Section 4.2) are recorded in the Domesday survey of 1086 [102] and are also likely to have been founded as small farmsteads before growing into the villages and important market towns during the Medieval period.

Although a natural reduction in the water table of the Fens and neighbouring marshlands had begun around the end of the Roman period, the effects of this change were largely unnoticeable to local communities until the Post Medieval period, during late 16th Century to early 17th Century when sea levels fell. With more of the fen and marshland drying and becoming more easily accessible, multiple coordinated schemes for the draining and coastal land reclamation [103] of the catchment (and those of the Lower Welland and others to the north) began. Their purpose was to allow the rich and fertile soils of the catchment to be used year-round for intensive agriculture.

During the 18th Century numerous new drainage channels were cut and pumping stations constructed to overcome the challenge of draining land that, because of historic natural drying and shrinkage (which started as early as the end of the Roman period), was now below sea level [104]. While initially wind powered, the pumping engines of the catchment were replaced by steam engines during the 19th Century. It is likely that the greater efficiency and capacity of these engines actually contributed to the ever-increasing need for pumping [103] as the drained agricultural land continued to dry and shrink, settling lower, and lower beneath sea level, defences, and the canalised River Nene (the River Nene Navigation). Shrinkage associated with 19th Century, and ongoing 20th Century and early 21st Century drainage and water management, is a particular issue for the surviving areas of peatland at the western edge of the catchment near Peterborough.

Along the coastline in particular there are a large number of Second World War defences, including pillboxes, tank cubes and gun emplacements which were created as a first line of defence against an invasion from the sea. There are also further defences inland along key infrastructure corridors and at settlements [105].

4.6.2 Historic Landscape Character

As discussed in the Landscape baseline, the majority of the catchment is situated within The Fens NCA [47] and the south-western part of the catchment is located within the Bedfordshire and Cambridgeshire Claylands NCA [48]. Figure 20 shows the Historic Landscape Character (HLC) areas within the catchment. Three of Lincolnshire's HLC areas are present in the landscape of the catchment including: Peterborough, The Fens, and The Wash:

- **Peterborough HLC**

The south-western portion of the catchment is part of The Peterborough HLC which comprises interspersed areas of Pre-18th Century Enclosure, Post-18th Century Enclosure, Park and Leisure Landscapes, Built-up Areas, Major Transportation and Communication Routes, and areas of the 'Other Types' [106] of the Peterborough HLC typology. This regularly enclosed landscape, which is bounded along its southern edge by the canalised route of the River Nene (the River Nene Navigation) as it exits Peterborough, gives way to The Eastern Fens character zone of The Fens HLC to its north and north-east.

- **The Fens HLC**

The centre of the catchment comprises The Eastern Fens character zones of The Fens HLC. The Eastern Fens character zone of the catchment comprises small, scattered nucleated settlements which are typically located on ridges of slightly higher, drier ground and isolated farmsteads. The farmsteads are often associated with the reclamation of the Fens and planned enclosure of the 18th and 19th Century. The landscape is typically divided into a pattern of rectilinear fields separated by drains rather than hedges that are used for intensive arable farming. Within the catchment, The Eastern Fens character zone, and neighbouring Townlands character zone (part of The Wash HLC) reach roughly to the route of New South Eau and North Level Main Drain – which runs on a west/east alignment through the catchment and joins the River Nene near the village of Tydd Gote. The landscape of the catchment to the south of the North Level Main Drain, in the vicinity of the settlement of Wisbech, comprises similarly dense, regular enclosed fields turned over to arable farming. Some of the fields are bounded by hedgerows although most are separated by ditches and minor drains. The settlements in this part of the catchment are typically larger linear villages which most likely grew up as satellites of the larger market town is Wisbech. There are scattered farmsteads and several, larger industrial farm complexes.

- **The Wash HLC**

The north-eastern portion of the catchment is part of The Wash HLC, comprising the Townlands, Reclaimed Wash Farmlands, and Reclaimed Coastal Fringe character zones. The Townlands character zone comprises a string of nucleated market towns and villages located around the western circumference of The Wash and running northward through the catchment, the neighbouring Lower Welland catchment, and beyond (see Figure 1). The principal settlements of the Townlands character zone are Weston, Moulton, Whaplode, Holbeach, Fleet Hargate, and Long Sutton. The route of the A17 passes Long Sutton, Fleet Harrogate and Holbeach, linking these settlements with King Lynn in the south-east and Sleaford in the north-west (both beyond the catchment). Apart from Long Sutton, all these settlements are located along the very northern/north-eastern edge of the catchment and are also part of the neighbouring Lower Welland catchment. Much of the landscape in this character zone is turned over to a combination of arable cash-crop and food farming and, along with the other principal towns of the catchment (Peterborough, Wisbech, Crowland, and Whittlesey) are recorded in the Domesday survey [102]. These settlements have likely Early Medieval, and in some cases Roman or earlier, origins. The landscape of the catchment between the Townlands and Reclaimed Coastal Fringe character zones comprises the Reclaimed Wash Farmlands, a part of the landscape that was reclaimed from semi-natural and natural saltmarsh between 1660 and 1811 [107] and is now used for intensive agriculture. Relict sea-banks, associated with the various stages of historic land reclamation in the catchment, are present along the edges of the character area. Settlements along the route of the Medieval ‘Roman Bank’ sea bank tend to be satellites of larger more inland market towns, with settlements to the north being more linear in form and typically tracing road alignments. There are multiple large, industrial scale farmsteads throughout the Reclaimed Wash Farmlands character zone and there are a small number of orchards to the south-west. The agricultural landscape comprises semi-regular fields, the boundaries of which typically comprise narrow and shallow wet Dykes. The settlement density in the Reclaimed Coastal Fringe is very low and typically comprises individual 19th and 20th Century farmsteads and isolated barns and other agricultural buildings. Although predominantly agricultural in land use, which includes the grazing of outlying saltmarsh areas, it is most keenly characterised by the network of active and relict earth sea-banks and its confined and small straight minor roads and trackways.

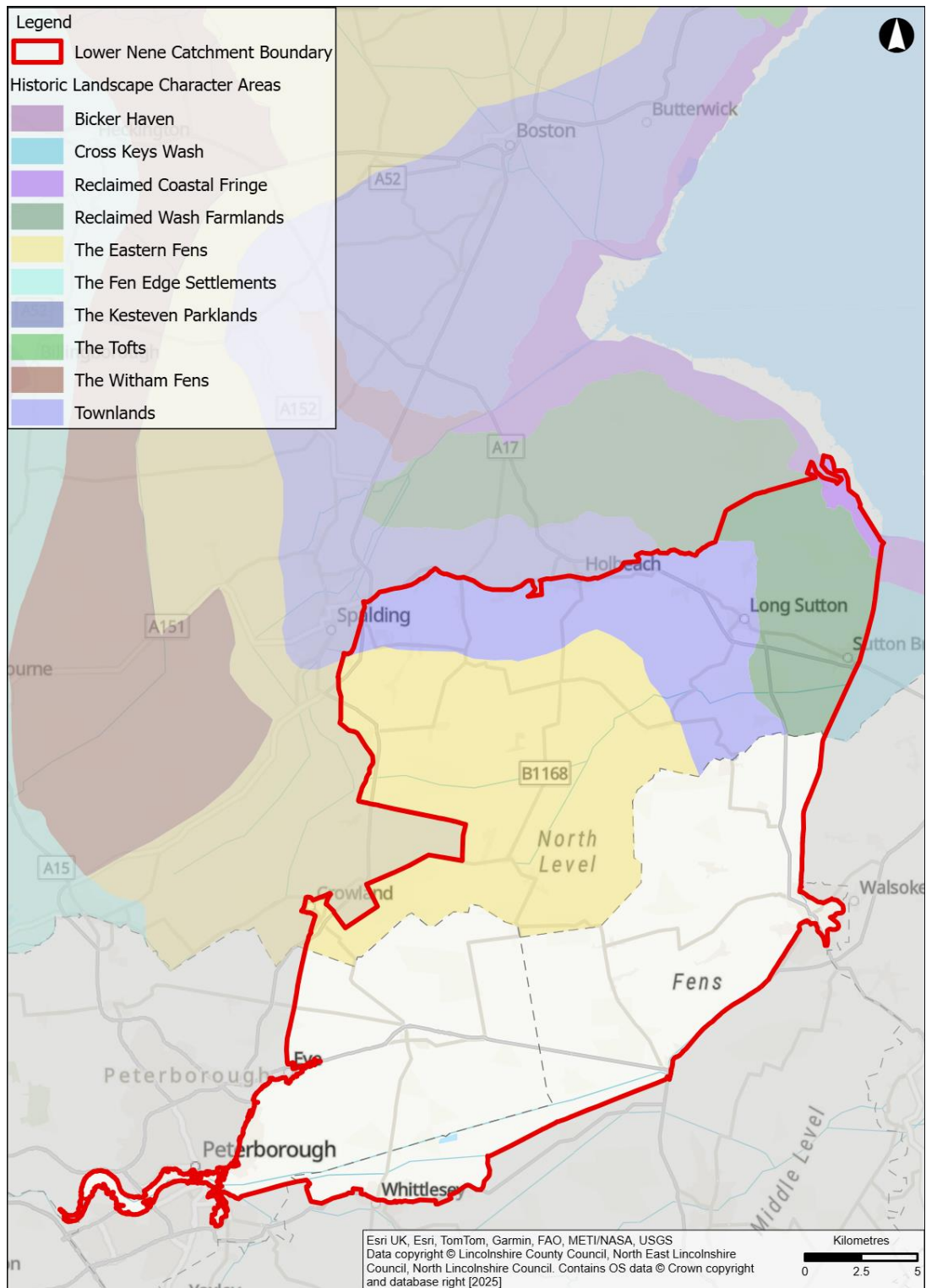


Figure 20: Historic Landscape Character areas within the catchment

4.6.3 Designated heritage assets

In total, 703 designated heritage assets are located throughout the catchment including:

- 42 scheduled monuments - The scheduled monuments include several areas of later prehistoric and Romano-British settlement evidence and field systems, Bronze Age ceremonial structures, including barrows and the timber structures at Flag Fen, and medieval moated and ecclesiastical sites.

- 22 Grade I listed buildings and 44 Grade II* listed buildings. The Grade I and II* listed buildings are mostly medieval churches, but also include bridges, windmills, a hydraulic engine house and several high-status houses.

There are 557 Grade II listed buildings, one Grade II registered park and gardens (Peckover House) and the following 17 conservation areas are also present:

- Moulton Conservation Area
- Holbeach Conservation Area
- Fleet Conservation Area
- Fleet Hargate Conservation Area
 - Long Sutton Conservation Area
 - Tydd St Mary Conservation Area
- Tydd Gote Conservation Area
 - Leverington Conservation Area
 - Wisbech Conservation Area
 - Bowthorpe Conservation Area
 - Parson Drove Conservation Area
- Crowland Conservation Area
 - Thorney Conservation Area
 - Coates Conservation Area
 - Whittlesey Conservation Area
 - Stanground Conservation Area
 - Peterborough City Centre Conservation Area

There are no World Heritage Sites, Grade I or Grade II* registered park and gardens, registered battlefields, or protected wreck sites within the catchment. Figure 21 sets out the designated heritage assets within the catchment.

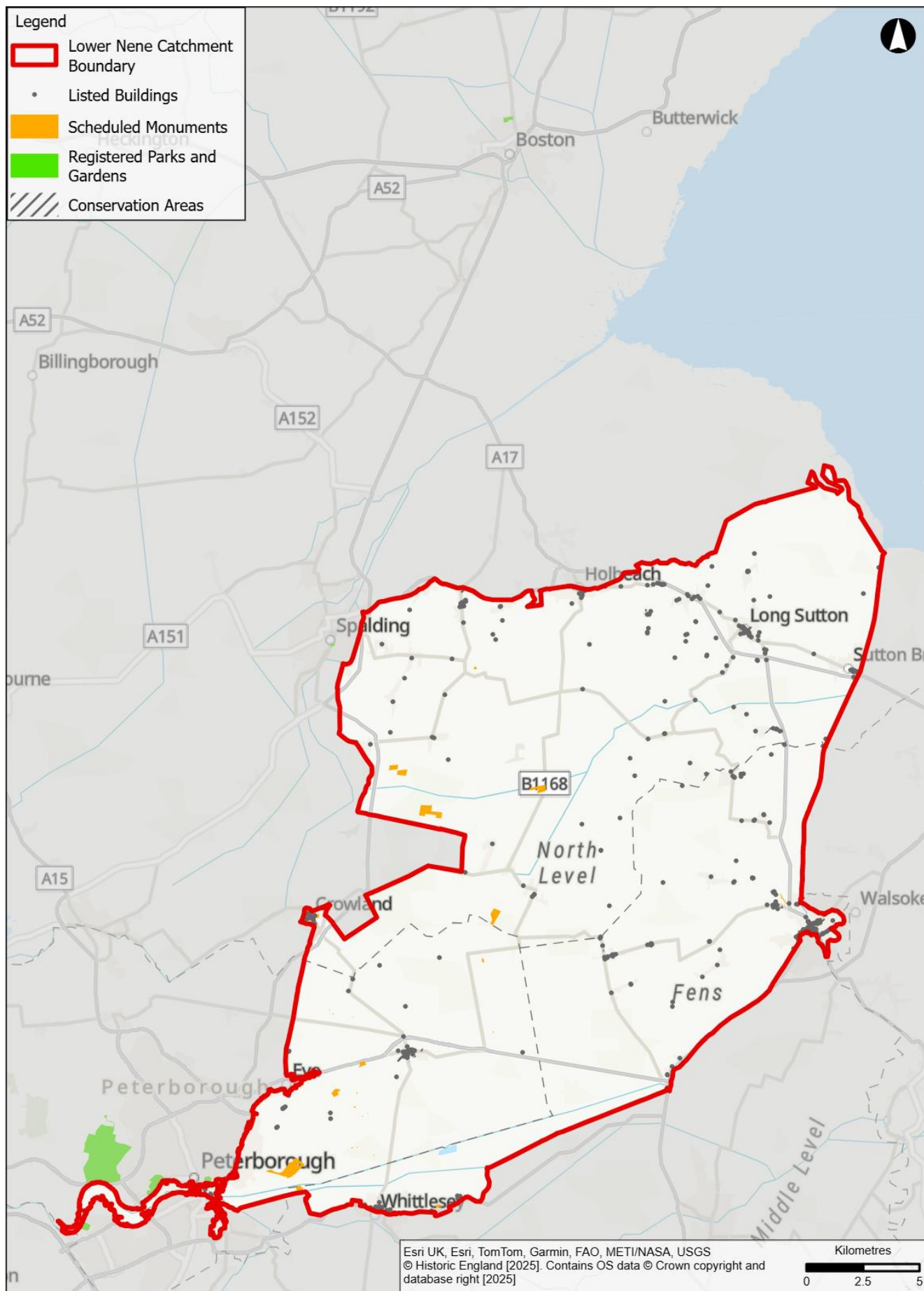


Figure 21: Designated sites for heritage within the catchment

4.6.4 Non-designated heritage assets

While specific non-designated heritage assets have not been identified as part of this study, the following are known or likely to be present:

- Unrecorded archaeological features and remains and palaeoenvironmental deposits are likely to be present throughout the catchment. Because of the waterlogged and anaerobic environments of the catchment, it is likely that ecofacts and composite, organic, and inorganic artefacts will survive.
- There are several areas of known Peat deposit along the western edge of the catchment in the vicinity of Peterborough. There is also the potential for areas of Peat to survive in sealed environments beneath the fertile topsoil and Tidal Flat (Clays and Silts) Deposits of the rest of the catchment. Peat has a high potential for paleoenvironmental deposits and organic and composite archaeological remains in the form of artefacts, structures, and large objects.
- Unrecorded early Prehistoric, Bronze Age, Iron Age, and Roman archaeology is likely to be present throughout the catchment. There is a high likelihood of Bronze Age archaeology surviving along the western edge of the catchment at the hinterland of The Bedfordshire and Cambridgeshire Claylands and The Fens NCAs, with unrecorded Roman archaeology likely to be present in proximity to known sites throughout the catchment. It is likely that unrecorded Prehistoric archaeology will also survive beneath the fertile and rich topsoil and Tidal Flat Deposits of the former fenlands of the catchment.
- Many of the catchment's settlements are likely to have Early Medieval (and in some cases Roman) origins and may represent a continuation of occupation within a localised area since that time. Recorded and unrecorded archaeology associated with potentially Roman, but more likely Early Medieval and Medieval occupation, are likely to survive within and in proximity to the towns and villages of the catchment and, potentially, around their edges – although later Post Medieval and 20th Century expansion may have resulted in the truncation or loss of some remains and landscape features.
- Some of the isolated farms, farmsteads, and farm buildings of the catchment, if not listed buildings, may be recorded as non-designated built heritage assets. Such assets are typically Post Medieval in date.

Prehistoric remains are likely to date from the Mesolithic period onward. These are likely to comprise scatters of stone tools or the detritus from tool manufacture and are most commonly recovered from higher drier parts of the landscape, beyond the fen-edge. Overall, Mesolithic remains are rare across the county and there is little known evidence of seasonal occupation sites; although these would have existed.

It is possible that the known Neolithic settlement sites of the county have Mesolithic origin or connections. Remains likely to be encountered from the Neolithic period include examples of tools (including weapons), and pottery - although fewer examples of this have been recovered north of the River Welland. Burial monuments for inhumed remains are also built during this period. Often, evidence for the Bronze Age transition is found near these monuments and at the same settlement sites.

The Bronze Age is notable not only the wider adoption of metal (resulting in the presence of metalworking sites and metal artefacts), but also changes in burial practice with community burial monuments falling out of use in favour of individual burial mounds. There are also observable changes in pottery typologies. These trends continue into and throughout the Iron Age, although burial in monuments disappears from practice.

The Iron Age also brings with it evidence for possible landscape division through the marking of territorial boundaries and salt production. Important archaeological remains, such as trackways or walkways, boats, and metal and wooden objects such as swords and shields and jewellery, survive well in waterlogged environments and, when found, are often of national importance.

Roman influence in rural Lincolnshire is most observable through the presence of large-scale engineering works such as Carr Dyke, and other navigable canals and waterways, and the roads network. There are shifts in religious and burial practice during the Roman period with inhumation and cremation cemeteries replacing the Iron Age preference for excarnation. It is likely that the 'Romanisation' of the Iron Age settlements occurred steadily during the period with existing settlements and societal structures being absorbed into the more structured rural Roman economy and practices of land and people management. Industry expands during this period with remains of metal working sites, evidence of large-scale quarrying, and the production of pottery and presence of kilns becoming common. Salt production also continues.

4.7 Population and health

This section outlines the population and health baseline for the catchment. Table 24 outlines the key terminology used in this section.

Table 24: Glossary of population and health terminology

Terminology	Summary Definition
Indices of Multiple Deprivation (IMD) [108]	These datasets are small area measures of relative deprivation across each of the constituent nations of the United Kingdom and is part of a suite of outputs that form the Indices of Deprivation (IoD). The IoD2019 is based on 39 separate indicators, organised across seven distinct domains of deprivation which are combined and weighted to calculate the Index of Multiple Deprivation 2019. Areas are ranked from the most deprived area (rank 1) to the least deprived area. Some of these separate indicators include Employment Deprivation, Income Deprivation, Health Deprivation and Disability, Education Skills and Training Deprivation, Crime, Living Environment Deprivation and Barriers to Housing and Services.
Lower Layer Super Output Area (LSOAs) [109]	These are defined geographical areas which comprise between 400 and 1,200 households and have a usually resident population of between 1,000 and 3,000 persons. These LSOAs are a neat aggregation or split of wards, or may be exactly the same as wards in some areas. Unlike wards whose population sizes vary widely, the LSOAs provide a consistently sized statistical unit. There are 32,844 LSOAs in England.
Middle Layer Super Output Areas (MSOAs)	Middle layer Super Output Areas (MSOAs) are made up of groups of LSOAs, usually four or five. They comprise between 2,000 and 6,000 households and have a usually resident population between 5,000 and 15,000 persons. MSOAs fit within local authorities. There are 6,856 MSOAs in England.

Different classes of administrative unit each have their own datasets and are ordered from smallest to largest in terms of the geographical scale at which they operate. Data for the population and health baseline is collected at the level of Wards, Lower Layer Super Output Area (LSOAs), and Middle Layer Super Output Areas (MSOAs). All of these administrative areas which intersect with the catchment have been included in the analysis and are listed in Table 25.

In most of England, including the Fens, there is a two-tier system of local government sitting at larger scales than the MSOAs: county and district. In two-tier areas, each county council area is subdivided into districts, for which there is an independent district council. The catchment is subdivided into three local authority areas (see Figure 5) which each have a different 'upper-tier' authority:

- The north of the catchment is within the South Holland District Council area, which is governed by Lincolnshire County Council;
- The east and south-east of the catchment is within the Fenland District Council area which is governed by Cambridgeshire County Council; and
- The south-west of the catchment is within the Peterborough City Council area. Peterborough city council was formed as a unitary authority in 1998, having previously been part of Cambridgeshire County Council. As a unitary authority, the council has both the powers of a county and district council combined. Both Peterborough City Council and Fenland District Council are part of the Cambridgeshire and Peterborough Combined Authority.

4.7.1 Overview

The catchment is located in the county of Lincolnshire and Cambridgeshire.

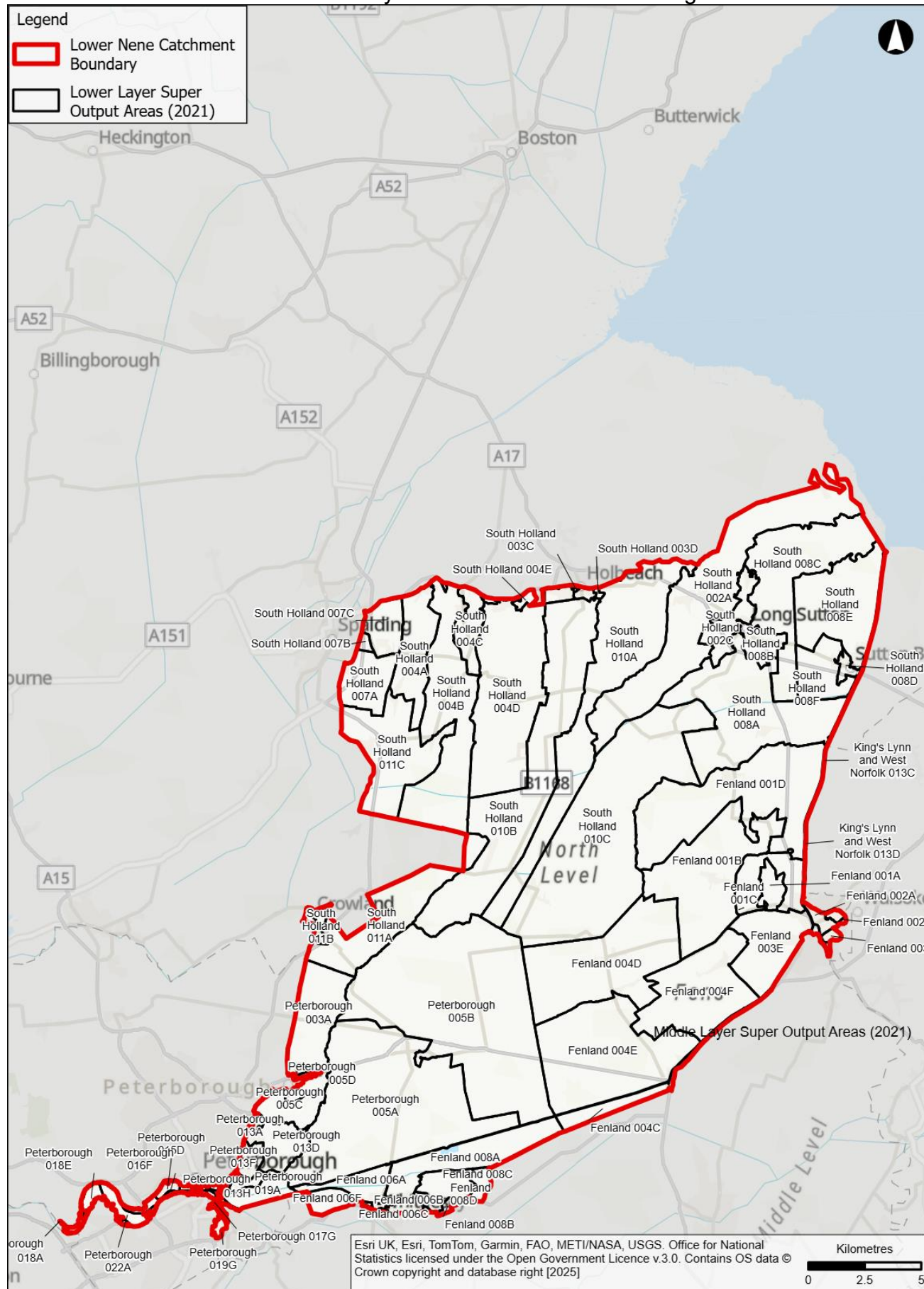


Figure 22 and Figure 23 show a map of the MSOA and LSOA areas within the catchment. Table 25 shows the MSOA and LSOA areas that intersect the catchment and will henceforth be used to analyse and report the demographic and health profile. Where summary values were not available at the LSOA or MSOA level, data for the relevant district and county council areas have also been provided.

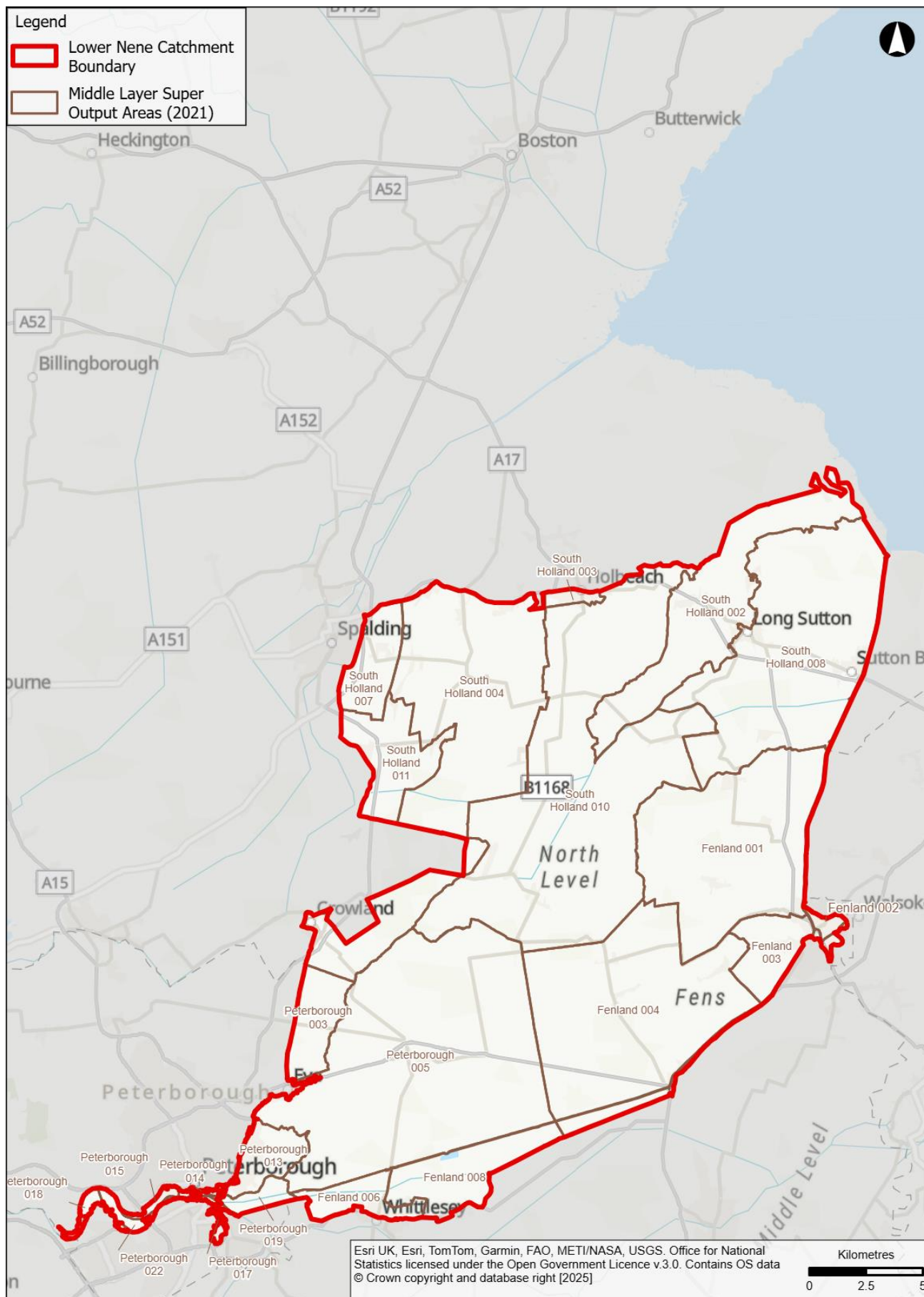


Figure 22: MSOAs which intersect with the catchment boundary

Table 25: LSOAs and MSOAs which intersect with the catchment boundary

LSOAs		MSOAs	
Peterborough 014A	E01015599	Peterborough 003	E02003239
Peterborough 013A	E01015606	Peterborough 005	E02003241
Peterborough 013C	E01015613	Peterborough 013	E02003249
Peterborough 013D	E01015614	Peterborough 014	E02003250
Peterborough 013E	E01015615	Peterborough 015	E02003251
Peterborough 013F	E01015616	Peterborough 016	E02003252
Peterborough 005A	E01015617	Peterborough 017	E02003253
Peterborough 005B	E01015618	Peterborough 018	E02003254
Peterborough 005C	E01015619	Peterborough 019	E02003255
Peterborough 005D	E01015620	Fenland 001	E02003742
Peterborough 016A	E01015622	Fenland 002	E02003743
Peterborough 018A	E01015627	Fenland 003	E02003744
Peterborough 003A	E01015630	Fenland 004	E02003745
Peterborough 022A	E01015638	Fenland 006	E02003747
Peterborough 018D	E01015646	Fenland 008	E02003749
Peterborough 018E	E01015648	Huntingdonshire 002	E02003754
Peterborough 022B	E01015650	South Holland 002	E02005466
Peterborough 017D	E01015666	South Holland 003	E02005467
Peterborough 019A	E01015667	South Holland 004	E02005468
Peterborough 017E	E01015668	South Holland 007	E02005471
Peterborough 019B	E01015669	South Holland 008	E02005472
Peterborough 016D	E01015688	South Holland 010	E02005474
Peterborough 015C	E01015689	South Holland 011	E02005475
Peterborough 015D	E01015690	King's Lynn and West Norfolk 013	E02005563
Fenland 008A	E01018058	Peterborough 022	E02006877
Fenland 008B	E01018059		
Fenland 008C	E01018060		
Fenland 008D	E01018061		
Fenland 002A	E01018063		
Fenland 006A	E01018064		
Fenland 004C	E01018068		
Fenland 003A	E01018069		
Fenland 003B	E01018070		
Fenland 003C	E01018071		
Fenland 006B	E01018072		

LSOAs		MSOAs
Fenland 002B	E01018073	
Fenland 006C	E01018074	
Fenland 004D	E01018090	
Fenland 004E	E01018091	
Fenland 004F	E01018092	
Fenland 003E	E01018093	
Fenland 001A	E01018094	
Fenland 001B	E01018095	
Fenland 001C	E01018096	
Fenland 001D	E01018097	
Fenland 006E	E01018098	
Fenland 006F	E01018099	
Fenland 006G	E01018100	
Fenland 006H	E01018101	
Fenland 003F	E01018103	
Fenland 003G	E01018104	
Fenland 002C	E01018107	
Fenland 002D	E01018108	
Fenland 002E	E01018109	
Huntingdonshire 002A	E01018127	
South Holland 011A	E01026239	
South Holland 011B	E01026240	
South Holland 010A	E01026245	
South Holland 002A	E01026246	
South Holland 002B	E01026248	
South Holland 010B	E01026249	
South Holland 003A	E01026250	
South Holland 003B	E01026251	
South Holland 003C	E01026252	
South Holland 003D	E01026253	
South Holland 008A	E01026254	
South Holland 008B	E01026255	
South Holland 008C	E01026256	
South Holland 002C	E01026257	
South Holland 007A	E01026268	
South Holland 007B	E01026269	
South Holland 007C	E01026270	

LSOAs		MSOAs
South Holland 008D	E01026277	
South Holland 008E	E01026278	
South Holland 008F	E01026279	
South Holland 010C	E01026280	
South Holland 004A	E01026281	
South Holland 004B	E01026282	
South Holland 004C	E01026283	
South Holland 011C	E01026284	
South Holland 004D	E01026285	
South Holland 004E	E01026286	
King's Lynn and West Norfolk 013C	E01026719	
King's Lynn and West Norfolk 013D	E01026720	
Fenland 003H	E01033111	
Fenland 003I	E01033112	
Peterborough 016F	E01033173	
Peterborough 022D	E01033179	
Peterborough 013G	E01035540	
Peterborough 013H	E01035541	
Peterborough 017F	E01035544	
Peterborough 017G	E01035545	
Peterborough 019G	E01035546	
Peterborough 019J	E01035549	

4.7.2 Demographic Profile

Population

In 2022, the population of the catchment was 87,599⁸ [110]. Between 2011 and 2021, all three of the local authority districts which intersect with the catchment have seen rates of population growth above the overall rate for England (6.6%).

- Peterborough City Council saw the largest percentage growth of any of the three districts overlapping with the catchment, increasing by 17.5% from around 183,600 in 2011 to 215,700 in 2021 [111];
- In the South Holland District, the population size increased by 7.7% from around 88,300 in 2011 to 95,100 in 2021 [111]; and
- The Fenland District saw the lowest growth of the three local authority areas at 7.6% over

⁸ This population figure has been calculated using the total population of every LSOA that fully or partially overlaps with Lower Nene catchment area. It considers the proportion of the LSOA which intersects with the study area, such that the same percentage of the population of an LSOA will be counted as the percentage area which overlaps with the catchment study area. It is assumed that the population density across each LSOA is uniform.

the same period [111]

The population within all three districts (Peterborough, South Holland and Fenland) are anticipated to continue to grow, above the population growth rate (6%) between 2025 and 2043, at 9%, 10.2% and 10.1% respectively [112].

Population density

The population density within LSOAs intersecting with the catchment are displayed in Table 26. The highest density areas in the catchment are the urban areas of Peterborough and Wisbech, with Fenland 002C covering the northern part of Wisbech recording the highest density of 5,462 residents per km². However, large portions of the catchment are very sparsely populated, with twenty-five of the ninety-one LSOAs which intersect with the Nene catchment having a population density of less than 100 residents per km². The least densely populated LSOA which fully intersects with the catchment is Peterborough 005B (the area north and east of Thorney) where there are just 27 residents per km² [113].

Table 26: Population Density by LSOA Area (2021)

LSOA	Area (km ²)	Mid-2022 population	Population Density (residents per km ²)
Peterborough 014A	0.90	2,813	3,126
Peterborough 013A	0.50	1,850	3,719
Peterborough 013C	0.31	1,580	5,112
Peterborough 013D	4.12	2,222	539
Peterborough 013E	0.45	1,950	4,381
Peterborough 013F	1.90	2,227	1,174
Peterborough 005A	39.34	1,569	40
Peterborough 005B	48.81	1,333	27
Peterborough 005C	0.91	2,192	2,420
Peterborough 005D	6.30	2,203	350
Peterborough 016A	0.58	2,669	4,604
Peterborough 018A	34.40	1,867	54
Peterborough 003A	39.23	2,027	52
Peterborough 022A	2.43	1,569	645
Peterborough 018D	0.82	1,877	2,292
Peterborough 018E	2.14	1,350	632
Peterborough 022B	0.92	1,984	2,154
Peterborough 017D	0.34	1,496	4,337
Peterborough 019A	4.84	1,454	300
Peterborough 017E	1.07	2,159	2,019

Peterborough 019B	0.36	1,502	4,224
Peterborough 016D	0.71	2,697	3,811
Peterborough 015C	2.57	1,487	579
Peterborough 015D	1.05	1,255	1,196
Fenland 008A	9.20	1,496	163
Fenland 008B	34.91	1,512	43
Fenland 008C	44.96	1,889	42
Fenland 008D	3.55	1,270	357
Fenland 002A	0.81	2,809	3,477
Fenland 006A	3.41	2,543	747
Fenland 004C	73.39	1,532	21
Fenland 003A	0.56	1,764	3,142
Fenland 003B	0.85	2,006	2,357
Fenland 003C	0.38	1,942	5,057
Fenland 006B	1.09	2,511	2,299
Fenland 002B	0.62	2,649	4,295
Fenland 006C	1.08	1,215	1,127
Fenland 004D	22.43	2,066	92
Fenland 004E	23.23	1,546	67
Fenland 004F	14.91	1,905	128
Fenland 003E	8.58	2,519	294
Fenland 001A	1.83	1,844	1,009
Fenland 001B	19.01	1,728	91
Fenland 001C	5.46	1,678	307
Fenland 001D	24.74	1,560	63
Fenland 006E	0.59	1,286	2,171
Fenland 006F	3.28	1,237	377
Fenland 006G	0.30	1,496	5,064
Fenland 006H	0.78	1,439	1,851
Fenland 003F	0.22	1,213	5,430
Fenland 003G	0.71	1,151	1,626

Fenland 002C	0.32	1,762	5,462
Fenland 002D	0.45	2,027	4,475
Fenland 002E	0.39	1,874	4,861
Huntingdonshire 002A	28.58	1,514	53
South Holland 011A	52.89	2,140	40
South Holland 011B	1.50	3,029	2,023
South Holland 010A	27.75	2,469	89
South Holland 002A	51.58	2,329	45
South Holland 002B	75.25	2,346	31
South Holland 010B	30.82	2,083	68
South Holland 003A	0.50	2,164	4,341
South Holland 003B	1.27	1,840	1,444
South Holland 003C	1.39	1,780	1,284
South Holland 003D	0.88	2,040	2,322
South Holland 008A	23.19	1,807	78
South Holland 008B	2.37	2,037	861
South Holland 008C	18.46	1,646	89
South Holland 002C	3.91	2,261	578
South Holland 007A	8.50	2,025	238
South Holland 007B	1.32	2,207	1,669
South Holland 007C	6.52	1,964	301
South Holland 008D	1.02	1,676	1,646
South Holland 008E	42.06	1,500	36
South Holland 008F	5.21	1,348	259
South Holland 010C	42.72	2,767	65
South Holland 004A	22.10	1,438	65
South Holland 004B	20.44	1,929	94
South Holland 004C	26.30	1,790	68
South Holland 011C	18.10	2,393	132
South Holland 004D	23.06	1,418	61
South Holland 004E	11.87	1,227	103

King's Lynn and West Norfolk 013C	23.26	2,593	111
King's Lynn and West Norfolk 013D	15.45	1,436	93
Fenland 003H	4.44	1,682	379
Fenland 003I	0.36	1,452	4,065
Peterborough 016F	0.43	2,264	5,298
Peterborough 022D	1.75	3,043	1,744
Peterborough 013G	1.01	1,496	1,487
Peterborough 013H	0.45	1,554	3,466
Peterborough 017F	0.32	1,694	5,351
Peterborough 017G	0.37	1,595	4,363
Peterborough 019G	0.50	1,471	2,969
Peterborough 019J	1.85	1,833	993

4.7.3 Demographic Profile

Population

In 2022, the population of the catchment was 87,599*⁸.

Between 2011 and 2021, all three of the local authority districts which intersect with the Lower Nene catchment have seen rates of population growth above the overall rate for England (6.6%). Peterborough saw by far the highest growth in population between 2011 and 2021, increasing by 17.5% from around 183,600 in 2011 to 215,700 in 2021. This was by far the largest growth percentage of any local authority in the wider Fens study area. In the South Holland District, the population size increased by 7.7% from around 88,300 in 2011 to 95,100 in 2021.

Based on 2018 population projections, all three districts will continue to grow at a much faster rate than the overall figure for England (6%). Between 2025 and 2043, the South Holland district will see its population grow by the highest percentage of the four districts, increasing by 10.2% from 100,043 to 110,272. In the same period, Fenland district will see its population grow by 10.1% in the same period, from 108,029 to 118,939. Peterborough City Council is predicted to see a growth of 9.0% from 214,847 in 2025 to 234,197 in 2043.

Population density

The mean population density across all LSOAs intersecting with the catchment was 1,624 residents per km², which is above the national average of 434 people per square kilometre. However, large portions of the catchment are very sparsely populated, with twenty-five of the ninety-one LSOAs which intersect with the Nene catchment having a population density of less than 100 residents per km².

Age distribution

Across all MSOAs which intersect with the catchment, the mean percentage of residents aged 65 or older is 21.9%. This is lower than the average for Lincolnshire but higher than the average for the Peterborough and Cambridgeshire Combined Authority, and England as a whole. Figure 24

shows that the age distribution varied widely across the catchment, largely divided between a more youthful population in urban and peri-urban areas around Peterborough, and a much older population across more rural areas to the north and east. Fenland 001 MSOA which covers Tydd St Giles and the rural area north-west of Wisbech has the highest proportion of elderly residents of any in the catchment, at 30.1%. Conversely, Peterborough 016 MSOA covering central Peterborough has the lowest proportion of over-65s at just 9%, and it also has the highest proportion of children aged 0-15, at 26.1%.

Although currently high, the proportion of elderly residents in the catchment is expected to rise significantly by 2043 [114]. The projected increases for the three local authorities indicate a notable aging trend across all districts and are summarised as follows:

- South Holland: From 24.2% to 29.0%;
- Fenland: From 22.7% to 28.2%;
- Peterborough City Council: From 14.7% to 19.9%.

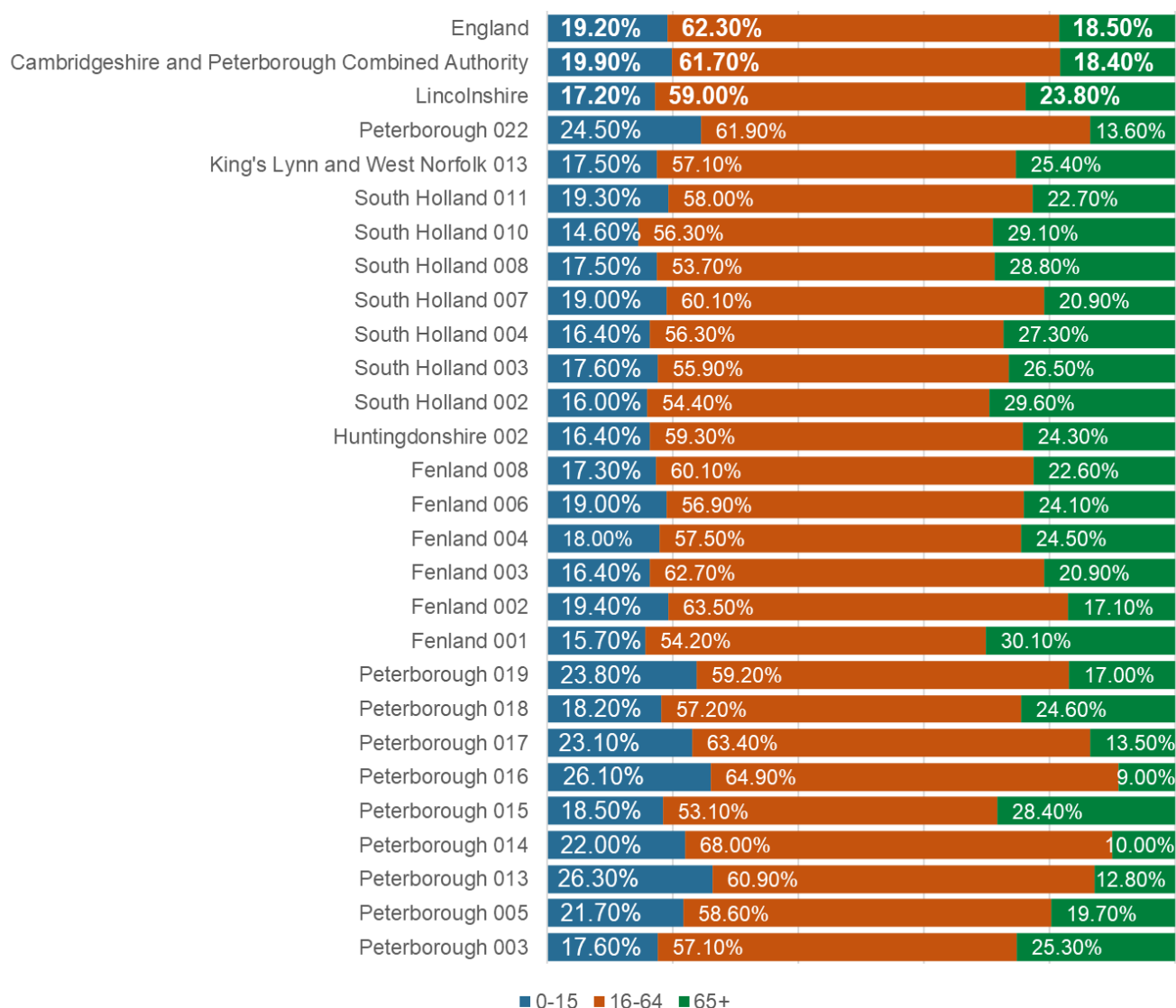


Figure 24: Age Structure by MSOA area, compared to county and England averages [115]

Ethnicity

The catchment has a much higher proportion of ethnically white residents than England. Across the 94 LSOA areas which wholly or partially overlap with the catchment, an average of 90.4% of

the residents are white, compared to a national average of approximately 82% [116]. Of those white residents, the vast majority (87.1%) identified as English, Welsh, Scottish, Northern Irish or British, with 11.7% identified as 'other white' and less than 0.7% as Gypsy, Irish Traveller or Roma. The second largest ethnic group in the catchment is 'Asian' (including Bangladeshi, Chinese, Indian, Pakistani, or other), making up approximately 4.7% of the population.

4.7.4 Employment Status

Employment

The largest employment sector in the catchment is 'Wholesale and retail trade; repair of motor vehicles and motorcycles', which constitutes an average of 18.8% across the 25 MSOAs which intersect with the catchment [117]. This is slightly higher than the England average of 15.0% for this sector.

Another large sector is 'human health and social work activities', employing 12.3% of working adults in the catchment, again higher than the England average of 14.6%. 'Agriculture, forestry and fishing' employs an average of 2.9% of adults in the catchment, but the percentage is much higher than the catchment average in South Holland 002 and South Holland 010 covering the central and northern catchment, where 7.7% of working adults are employed in the sector. Across England as a whole, only 0.8% of employees work in the sector, showing the local importance of agricultural, forestry and fishing for employment in much of the catchment. For information on employment within the agricultural sector, please see Section 4.2.

Travel

Across the catchment, there is a high reliance on private vehicles for getting to and from places of work. The most common commute mode is in a car or van (either as a driver or passenger) with an average of approximately 62.4% travelling to work in this way across the 25 MSOAs. This is significantly higher than the England figure of 44.5%, although it is lower than the Boston local authority average of 73.3%, which is the highest of any of the four local authorities covering the catchment. This is significantly higher than the England figure of 44.5%. The more remote rural areas of the northern catchment have even higher reliance on private vehicles for commuting: in South Holland 003 (Holbeach), the percentage of those commuting in a car or van is the highest of any in the catchment, at 75.4%, and in South Holland 002 and 008 around Long Sutton and Sutton Bridge, the rates are 73.5% and 74.0% respectively.

In terms of active travel modes, an average of 2.7% of commuters in the catchment travel to work by bicycle (which is higher than the England average of 2.1%). Rates of cycling to work are highest in South Holland 007 (eastern Spalding) where 6.4% of workers cycling to work, but in the neighbouring MSOA of South Holland, the rate drops to just 1.1%. Across the catchment, 6.5% of workers commute on foot, but again there are pockets where walking is a much more popular mode. The highest rates of commuting on foot is 15.3% recorded in Fenland 003 (western Wisbech). The popularity of active travel modes in South Holland 007 (eastern Spalding) is emphasised by the fact that not only are rates of cycling high, but also walking, with 14.1% of workers commuting on foot.

Unemployment

There is significant variation in unemployment (measured as a percentage of the working age population claiming out of work benefits) across the catchment [118]. Peterborough has the highest unemployment rate for 2021-2022, measured as a percentage of the working age population claiming out of work benefit, at 6.8%. This is the highest of any local authority within the wider Fens study area, and is in the top quintile of local authorities nationally. The MSOA within the catchment with the highest unemployment rate is Peterborough 014, covering the city centre, where 10.4% of residents were claiming out of work benefit in 2021-2022. This is more than

double the England average of 5.0%.

Rates of long-term unemployment do not seem to correlate with unemployment. For example, Peterborough has the highest rates of unemployment, but also has by far the lowest rate of long-term unemployment (at a rate of only 7 people per 10,000) indicating that those who are out of work quickly find other employment. Long-term unemployment rates are lower than the England average in all three of the local authority areas.

4.7.5 Health profiles

Life expectancy

Average life expectancy at birth for both males and females within the catchment are highly variable. Life expectancy for males and females within Peterborough and Fenland is lower than the England average, with the lowest life expectancy being 78 years for Peterborough, versus the England average of 79.5 [119]. In South Holland, life expectancy is higher, at 80 years for males, and 83.2 for females.

However, these local authority level figures conceal some significant variation in life expectancy at the local level. For example, the MSOA in the catchment with the lowest life expectancy for males is Fenland 003 (southern Wisbech) where males are only expected to live to the age of 74.1 – this is 4.3 years lower than the Fenland average, and 5.4 years lower than the England average. Strikingly it is 8.5 years lower than in Huntingdonshire 002 which overlaps with the far west of the catchment. Wisbech also has the lowest life expectancy for females. In Fenland 002 covering northern Wisbech, female life expectancy is 79.5 – this is the lowest of any MSOA in the catchment, and is 3.7 years lower than the England average. This contrasts starkly with Huntingdonshire 002, where females are expected to live 7.7 years longer than their counterparts in northern Wisbech, at 87.2 years.

Mortality and cause of death

Health indicators relating to mortality are assessed using the Standardised Mortality Ratio (SMR). This ratio illustrates whether a study population is more or less likely to die than a reference population (in this case the reference population is England, which has a SMR of 100). Wherever the SMR is greater than 100, there are a higher number of deaths than expected.

Wisbech displays much poorer mortality statistics than elsewhere in the catchment, with an SMR of preventable deaths of 160.2, showing that preventable deaths are far more likely here than would be expected [120]. South Holland 010 in the rural centre of the catchment has the lowest SMR of preventable deaths, at 61.3 showing that it performs significantly better than the national average.

Long-term illness or disability

As an average across the 25 MSOAs which overlap with the catchment, 5.5% of the population are classed as being in either bad or very bad health [121]. This compares to an average of 5.2% across England as a whole. In terms of the percentage of residents living with a limiting long-term illness or disability, the percentage generally increases from west to east, with the highest figures recorded in the eastern half of the catchment towards the coast. The nine most westerly MSOAs in the catchment all record rates of 20% or above. Of all MSOAs intersecting with the catchment, South Holland 008 (covering the most westerly area of the catchment at the mouth of the River Nene) has the highest percentage of residents with a limiting long-term illness or disability, at 25.3%.

Obesity

Obesity is prevalent across the wider Fens study area, and the catchment is no exception. The majority of the MSOAs intersecting the catchment have a prevalence of obesity (including overweight) in adults which is within the highest 20% nationally [122]. The prevalence of obesity (including severe obesity) among year six students in the catchment is also high, particularly in Peterborough and in the areas of the catchment nearest the coast in the north and east (e.g. 33.3% of year six students in South Holland 002 (the coastal area north and east of Holbeach) are obese or severely obese. This is far higher than the average for England of 21.6% [122].

Mental wellbeing

The estimated prevalence of common mental disorders (aged 16 and over) is 15.8% for Lincolnshire, and 14.2% for Cambridgeshire, which are both lower than the prevalence of 16.9% reported for England [123]. However, in Peterborough the highest estimated prevalence was much higher, at 18.8%.

Self-reported wellbeing

Self-reported wellbeing status of people within the UK is now measured by the Office for National Statistics. This data is only available at county and unitary authority level. Reports for Lincolnshire reflected fewer people with a low satisfaction score than the England average, at 4.5% compared to 6.1%. Comparatively, the percentage of people with a low happiness score was significantly lower in Lincolnshire than the England average. The percentage of people with a high anxiety score was only marginally higher than the England average of 24.2%, with the Lincolnshire score being 25.5% [124].

4.7.6 Deprivation

Overall deprivation

According to the English Indices of Deprivation (2019) there are only four LSOAs in the catchment which fall within the 10% most deprived in the country. One of these is Peterborough 013F in the east of the city (see Figure 25) and the other three critically deprived LSOAs are clustered in Wisbech [108]. Parts of Wisbech, Sutton Bridge Tydd St Giles and Peterborough fall within the 20% most deprived neighbourhoods in the country, but otherwise deprivation levels are broadly in line with the England average. The least deprived parts of the catchment are located west of Peterborough, and also south of the River Nene close to Whittlesey. These areas are in the 20% or 30% least deprived neighbourhoods in England, based on the most recent 2019 data.

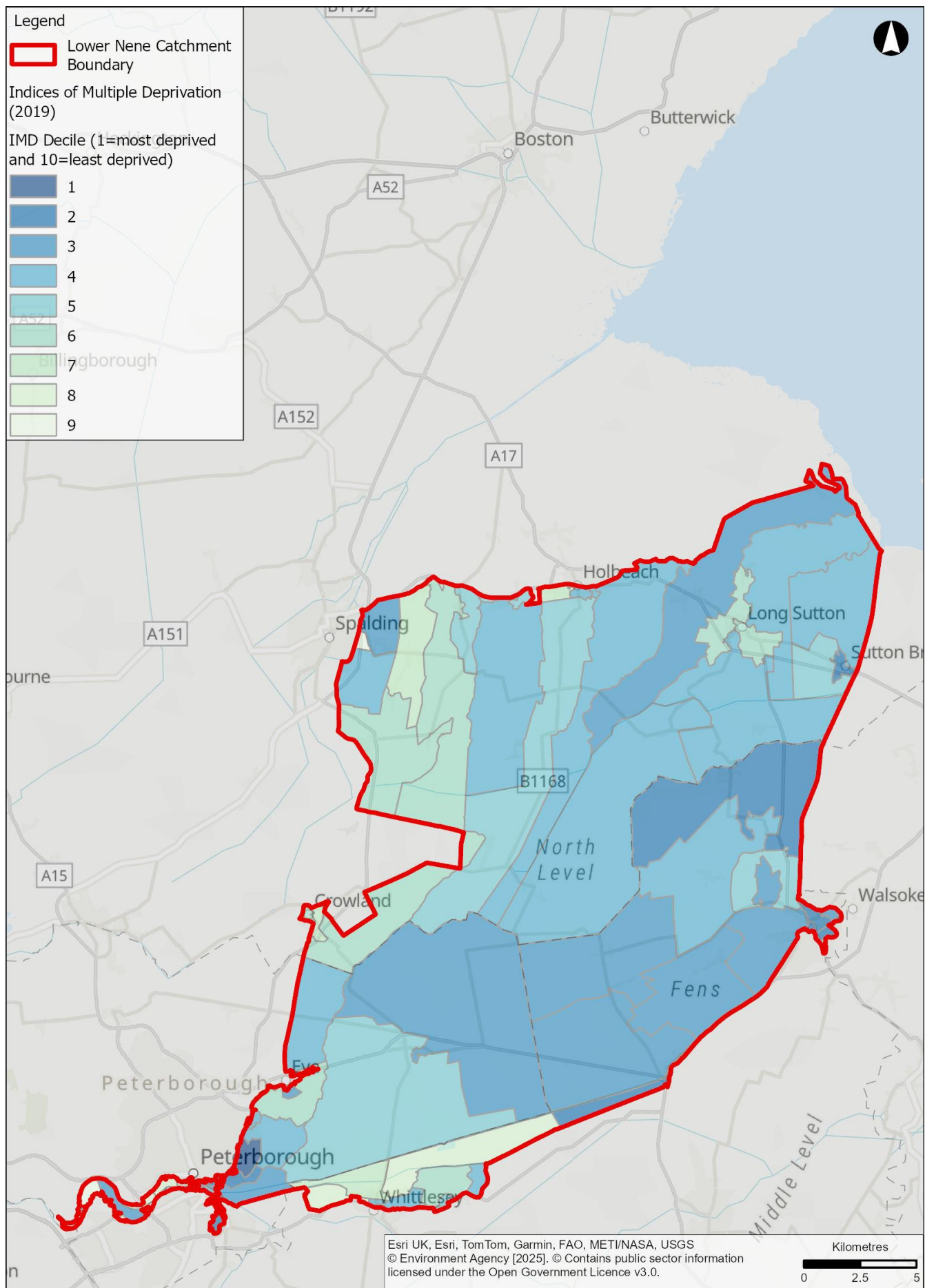


Figure 25: Map of deprivation across the catchment

Education, skills and training deprivation

In terms of education, skills and training, the majority of LSOAs intersecting with the catchment are within the top 50% most deprived. Ten of the LSOAs which partially overlap with the catchment are within the top 10% most deprived nationally, with five of these worst-performing LSOAs clustered in Wisbech. The worst ranked LSOAs are Fenland 002D and 002C in the northern part of the town which were ranked just 72 and 220 respectively out of 32,844 LSOAs in England, with 1 being the most deprived.

Taken as an average across all MSOAs in the catchment, 23.2% of residents have no qualifications [121]. Fenland 002 in Wisbech is again the area of the catchment with the highest percentage of residents with no qualifications, at 33.4%. This further demonstrates the extreme educational deprivation experienced by residents in this part of the catchment. Other MSOAs with high percentages on unqualified residents are Fenland 003 (31.4%) and Peterborough 014 (31.6%). These areas contrast starkly with Huntingdonshire 002 in the far west of the catchment, where only 13.3% of residents have no qualifications.

Income deprivation

The income deprivation domain measures the proportion of the population experiencing deprivation relating to low income. This included those people who are out of work as well as those who are in work but who have low earnings. The IMD 2019 identified that the least income deprived LSOA in the catchment was South Holland 004A, covering part of the village of Weston and the rural fringe east of Spalding, which is in the 20% least deprived in the country for this measure [108]. Fenland 002C covering northern Wisbech is the most income-deprived neighbourhood in the catchment, and is ranked in the in the top 10% nationally. More broadly, Holbeach, Wisbech, Sutton Bridge and suburbs in eastern Peterborough were found to experience higher levels of income deprivation than other parts of the catchment.

4.7.7 Housing and private property

Housing allocations for future residential development in the South Holland District, for settlements within, or partially located within the catchment are outlined in the South East Lincolnshire Local Plan as follows [41]:

- Holbeach has a housing allocation of 2202;
- Long Sutton has a housing allocation of 608;
- Sutton Bridge has a housing allocation of 273;
- Cowbit has a housing allocation of 120;
- Moulton Chapel has a housing allocation of 130;
- Fleet Hargate has a housing allocation of 70;
- Gedney hill has a housing allocation of 120;
- Moulton has a housing allocation of 190;
- Sutton St James has a housing allocation of 70;
- Tydd St Mary has a housing allocation of 40;
- Weston has a housing allocation of 310; and
- Whaplode has a housing allocation of 130;

The Local Plan for Peterborough City Council has outlined several sites allocated for Residential Development within the catchment boundary [42]. Four of these are within Peterborough's eastern suburbs, four are in the village of Thorney, and the largest (LP39.7) is located in Eye.

The emerging Fenland Local Plan Policies Map [125] has designated several large sites for residential or residential-led development in Whittlesey and The Lipneas, as well as numerous but smaller sites east of Wisbech in villages such as Leverington, Wisbech St Mary, Parson Drove and Gorefield. Whittlesey and Wisbech have also been identified as sites for employment/ non-residential development.

4.7.8 Social infrastructure

There are a range of community resources located within the catchment:

- Most of the larger villages in the catchment have a primary school and/or a pre-school [126]. University Academy Long Sutton is the only secondary school within the catchment boundary. There are several secondary schools in Peterborough, including the City of Peterborough Academy, which serves the western part of the catchment. There are further secondary schools in Stanground, Spalding and Wisbech.
- There are two special schools within the catchment providing support to primary and secondary aged pupils with a range of additional learning needs. These are located in Thorney and Millgate (south of Whaplode), but there are further special schools in Wisbech, Peterborough and Spalding [126].
- There are four designated youth centres within the catchment, located in Eye, Moulton Chapel, Holbeach and Wisbech [126].
- The only hospital within the catchment is the North Cambridgeshire Hospital in Wisbech, which has a Minor Treatment Centre, and provides a range of diagnostic services. The nearest hospitals providing all major specialties and 24-hour major accident and emergency services are Peterborough City Hospital to the south-west, and The Queen Elizabeth Hospital, King's Lynn [126].
- There are several residential care/nursing homes distributed across the catchment, including Peterborough, Eye, Crowland, Whittlesey, Wisbech, Moulton, Holbeach, Sutton Bridge, Fleet Hargate and Gedney [126].
- Playing fields and other sports facilities are spread fairly evenly across settlements in the area, with most large villages having access to at least one sports and active recreation facility [127] (see Figure 26). There are five golf courses in the catchment, located in Peterborough, Thorney, Gedney Hill, Tydd St Giles, and Sutton Bridge.

The key challenges identified in the local plans which have prevented better provision of leisure facilities are the ageing population, low population density and small settlement sizes, heavy reliance on private transport, and significant levels of deprivation and poor health.

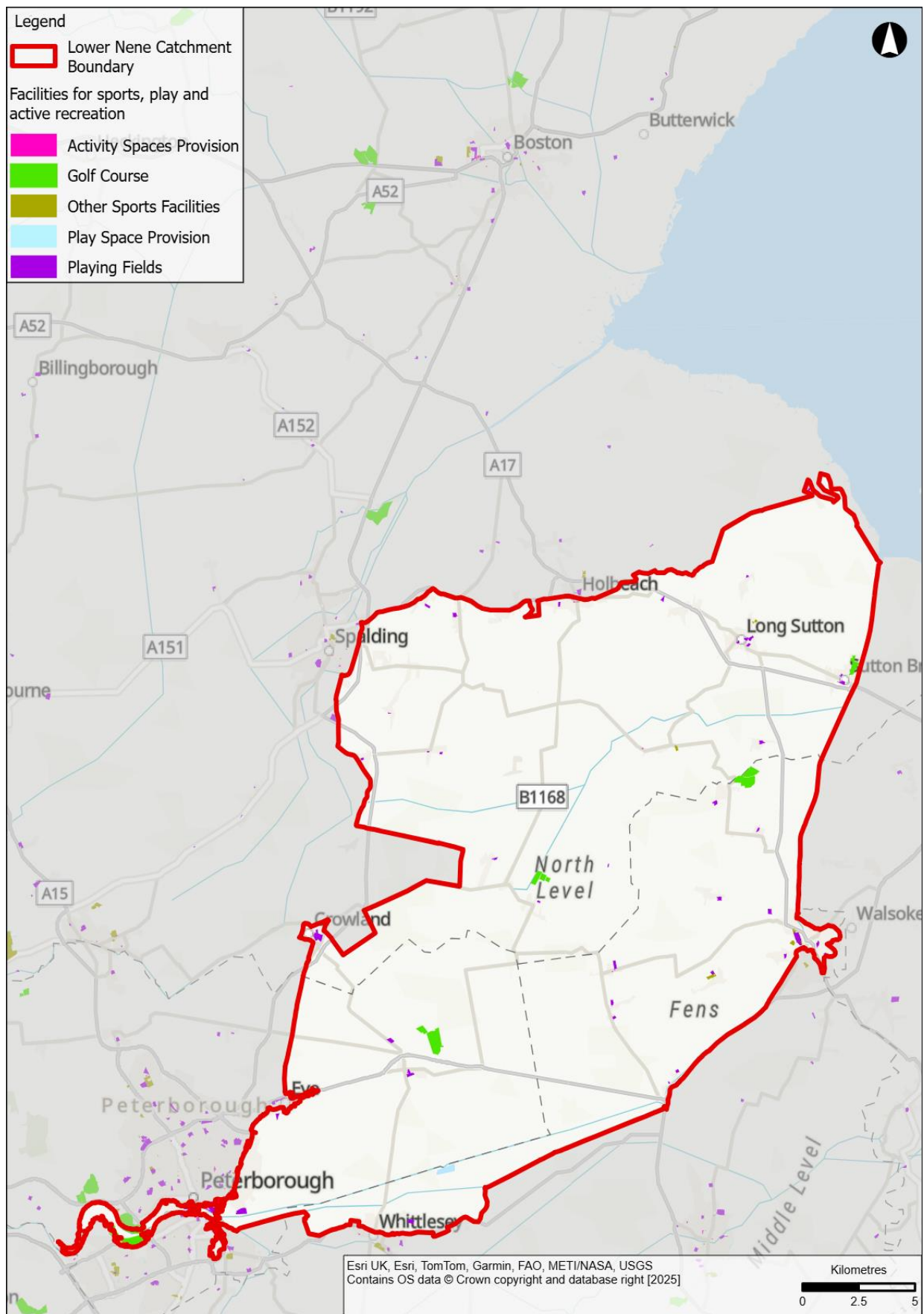


Figure 26: Facilities for sports, play and active recreation within the catchment

4.7.9 Transport Infrastructure

The catchment is poorly served for active travel routes (refer to

Figure 4):

- There are approximately 216.8 km of Public Rights of Way within the catchment boundary, comprising 147.4 km of footpaths, 47.0 km of bridleways and 22.3 km of byways open to all traffic. Generally, routes are well provided along the banks of the River Nene itself, as well as in the northern and eastern portions of the catchment near Wisbech and Tydd St Giles. Nevertheless, many of the rural communities within the catchment have no access to any meaningfully joined-up network of routes for walking, wheeling or horse-riding [128].
- There are approximately 84.9 km of National Cycle Network routes within the catchment boundary [129]. Route 1 of the National Cycle Network passes through the north of the catchment, connecting Holbeach with Whittlesey via minor roads. Route 12 passes through the south-west of the catchment and connects Peterborough with Spalding. Route 63 runs roughly parallel with the River Nene, and connects Wisbech with Whittlesey and Peterborough, although most of this route lies outside the catchment boundary. The cycle network in Peterborough and its suburbs is more extensive and provides a good network of traffic free routes.
- The King Charles III England Coast Path National Trail follows the entire coastline of the catchment, including the tidal banks of the River Nene from the mouth of the river to Sutton Bridge which forms the first available crossing point of the route over the river [130].

4.8 Air quality

This section outlines the air quality baseline in the catchment. Table 27 outlines the key terminology used in this section.

Table 27: Glossary of air quality terminology

Terminology	Summary Definition
Air quality management area (AQMA)	A geographically defined area designated by a local authority where national air quality objectives are not likely to be met. This may cover an area from one street or much larger where the Local Authority is required to develop an Air Quality Action Plan to improve air quality in the that area.
Air Quality Action Plan	The action plan developed by a local authority setting out measures to address achieving air quality objectives in a designated AQMA.
Background concentrations	The levels of air pollutants for a reference year including nitrogen, nitrogen dioxide and particulate matter, published by Defra for support the review and assessment of local air quality under the Environment Act (2021) [3]
Sensitive receptors	A receptor that is potentially sensitive to changes in air quality such as residential property, schools, hospitals, and statutory designated ecological sites.
NO _x , NO ₂	Nitrogen oxides (NO _x) refers to nitric oxide (NO) and nitrogen dioxide (NO ₂), both of which are mainly formed during the combustion of fossil fuels.
PM ₁₀ and PM _{2.5}	Particulate matter (PM) is everything in the air that is not a gas. It consists of a huge variety of chemical compounds and materials, some of which can be toxic. Particulates are classified according to size. The UK is currently focused on measuring the fractions of PM where particles are less than 10 micrometres in diameter (PM ₁₀) and less than 2.5 micrometres in diameter (PM _{2.5}).
Units - µg/m ³	The units are in microgrammes of pollutant per cubic metre of air.

4.8.1 AQMAs

There are three AQMAs within the Catchment: Fenland AQMAs; Whittlesey AQMA No.1 (SO₂) (declared in 2007), Wisbech AQMA No.1 (SO₂) (declared in 2001), and Peterborough AQMA No.1 (declared in 2006), all designated due to exceedances of the 15-minute mean SO₂ objective. The designations cover Whittlesey brickworks and a canning factory. Further details are below:

- Peterborough AQMA No.1 covers two rural areas near Flag Fen, east of Peterborough, impacted by emissions from Whittlesey brickworks.
- Whittlesey AQMA No.1 (SO₂) includes roads, cycle routes, dwellings, schools, and public spaces around Whittlesey brickworks.
- Wisbech AQMA No.1 (SO₂) an area in central Wisbech surrounding the canning factory.

Fenland is reviewing all AQMAs, considering pollution changes and new developments. The council is working with local industries to remodel Whittlesey's AQMA and assess a proposed Wisbech development, with potential variations based on modelling results.

4.8.2 Air quality monitoring

A review of the existing air quality conditions in the catchment area has been undertaken using the South Holland District Council 2024 Air Quality Status Report [131], Peterborough City Council 2024 Air Quality Status Report [132] and Fenland District Council 2024 Air Quality Status Report [133]. Within the catchment area there are several monitoring sites, including diffusion tubes and

automatic monitors. South Holland District Council, Peterborough City Council, and Fenland District Council operate five, two, and 14 monitoring sites, respectively.

All monitoring sites within the catchment area recorded concentrations below than the NO₂ annual mean objective (40µg/m³) from 2019 to 2023. Fenland District Council's monitoring site, roadside diffusion tubes S21, recorded the highest NO₂ concentrations within the catchment. The recorded NO₂ concentrations in 2023, at S21 is 33.8 µg/m³ which is well below the annual mean objective (40µg/m³). As the area is largely rural, these roadside monitoring locations are not considered representative of the overall catchment area.

4.8.3 Background concentrations

Background concentrations refer to the existing levels of pollution in the atmosphere, produced by a variety of stationary and non-stationary sources, such as roads and industrial processes. Defra publishes background pollutant mapping [134] for every 1km x 1km OS grid square across the UK for NO_x, NO₂ and PM₁₀ and PM_{2.5}, as well as national air quality objectives for each pollutant.

Within the catchment area there are two urban background automatic monitors; the CM2, located at Westmere School (South Holland District Council), and S12, located on the edge of the Catchment at Lynn Road AWSTW, Wisbech (Fenland District Council). CM2 measures NO₂ and PM₁₀ concentrations, which are below the annual mean objective (40µg/m³) from 2019 to 2023. S12 measures only NO₂, which is also below the annual mean objective.

The 2023 annual mean NO₂ concentration from Defra's background concentrations were compared with the actual measured values for the OS grid square for the automatic urban background monitoring sites. At CM2, Defra's prediction was 5.9 µg/m³ which is lower than the actual measured concentrations 6.8 µg/m³. At site S12, Defra predicted 9.2 µg/m³ which is also lower than the actual measured concentrations, 11.7 µg/m³. However, due to the area being largely rural Defra's predicted concentrations are used for this assessment.

The catchment spans across 467 of these grid squares. The background pollutant mapping has been reviewed for those grid squares and an average of the 2024 Defra background concentration has been used as representative for the area. The average Defra background concentration for NO₂ is 5.6 µg/m³, for NO_x (relevant to ecological receptors) it is 7.1 µg/m³, for PM₁₀ it is 12.9 µg/m³ and for PM_{2.5} it is 5.9 µg/m³. All concentrations are well below the annual air quality standards for NO₂, NO_x, PM₁₀ and PM_{2.5}. The PM_{2.5} Defra background concentration is also below the Environmental Improvement Plan target (12µg/m³) and the Environmental Target (10µg/m³) for PM_{2.5}.

4.8.4 Sources of Air Pollution

Industrial air pollution sources are regulated through a system of operating permits or authorisations, requiring stringent emission limits to be met, and ensuring that any releases to the environment are minimised or rendered harmless. Regulated (or prescribed) industrial processes are classified as Part A(1), A(2), Part B of Medium Combustion Plant processes and are regulated through the Pollution Prevention and Control (PPC) system [135] [136]. The larger more polluting processes are regulated by the Environment Agency and the smaller, less polluting ones by the local authorities. Local authorities focus on regulation for emissions to air, whereas the Environment Agency regulates emissions to air, water, and land.

There are several Part A(1) and MCP processes within the catchment listed on the EA website [137], however only four have releases to air and relevant combustion activities. These sites are Volmary Limited, River Nene Power Limited, Bridge Farm Bioscience Limited, and National Gas Transmission plc. It is assumed that these processes are included in the Defra background concentrations. The impact of other smaller industrial processes further from the catchment are also assumed to be represented in the background concentrations used in this assessment.

Traffic is a significant contributor to air pollution. Pollution from traffic includes vehicle exhaust emissions, secondary pollutants formed in the atmosphere, evaporative emissions from vehicles and non-combustion emissions such as tyre wear and road dust. There are very few A-roads and minor roads within the catchment: the A16, A47, B1357, B1168, B1040 spanning approximately 8km, 15.4km, 7.7km, 8.5m and 12.6km, respectively.

4.8.5 Sensitive Receptors

Sensitive human receptors are defined as those residential properties, schools and hospitals that are likely to experience a change in pollutant concentrations with potential exposure relevant to the averaging periods set out in the air quality standards.

Below is a list with the most sensitive receptors within the catchment, although this is not an exhaustive list:

- Individual properties and residential areas within the catchment e.g. Long Sutton; Sutton Bridge; Wisbech; and Gedney Hill;
- Weston Hills C Of E Primary School;
- Sutton St James Community Primary School;
- Tydd St Mary C of E Primary School;
- Kinderley Community Primary School;
- Long Sutton CP School & Nursery ;
- University Academy Long Sutton ;
- Lutton St Nicholas Primary School;
- Gedney Church End Primary School; and
- North Cambridgeshire Hospital.

There are sensitive nationally and internationally designated ecological receptors within the catchment, such as The Nene Washes SSSI, SPA, SAC and Ramsar located on the south side of the catchment. Adventurers' Land, Bassenhally Pit, and Eye Gravel Pit SSSI sites are also located on the south side of the catchment. The Wash SSSI, SPA, SAC and NNR is located on the edge of the north-east side of the catchment. Please see Section 4.5 for further information.

5. References

- [Open Infrastructure Map, “Open Infrastructure Map,” 2024. [Online]. Available:
1 <https://openinframap.org/#11.78/52.80012/-0.30981>. [Accessed 13 November 2024].
]
- [Biogas Map, “Biogas Map,” 2023. [Online]. Available: [https://www.biogas-](https://www.biogas-info.co.uk/resources/biogas-map/)
2 [info.co.uk/resources/biogas-map/](https://www.biogas-info.co.uk/resources/biogas-map/). [Accessed 12 November 2024].
]
- [HM Government, “Environment Act,” 2021. [Online]. Available:
3 <https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted>. [Accessed 4 November
] 2024].
- [H. Government, “Environment Act 1995,” n.d.. [Online]. Available:
4 <https://www.legislation.gov.uk/ukpga/1995/25/contents>. [Accessed 5 February 2025].
]
- [UK Parliament, “Agriculture Act 2020,” 2020. [Online]. Available:
5 <https://www.legislation.gov.uk/ukpga/2020/21/contents/enacted>. [Accessed 22
] November 2024].
- [HM Government, “Flood and Water Management Act 2010,” 2010. [Online]. Available:
6 <https://www.legislation.gov.uk/ukpga/2010/29>. [Accessed 5 October 2024].
]
- [Ministry of Housing, Communities and Local Government (MHCLG), “National Planning
7 Policy Framework (NPPF),” 12 December 2024. [Online]. Available:
] <https://www.gov.uk/government/publications/national-planning-policy-framework--2>.
[Accessed 20 February 2025].
- [DEFRA, “Environmental Improvement Plan (EIP),” 2023. [Online]. Available:
8 <https://www.gov.uk/government/publications/environmental-improvement-plan>.
] [Accessed 14 August 2024].
- [Landscape Institute and Institute of Environmental Management & Assessment ,
9 “Guidelines for Landscape and Visual Impact Assessment. Third Edition.,” Routledge,
] London, 2013.
- [Council of Europe, “Landscape Convention (2006) (ETS No. 176),” [Online]. Available:
1 <https://www.coe.int/en/web/conventions/full-list?module=treaty-detail&treatynum=176>.
0 [Accessed 05 December 2024].
]
- [UK Government, “Autumn Budget 2024,” 12 November 2024. [Online]. Available:
1 <https://www.gov.uk/government/publications/autumn-budget-2024>. [Accessed 30
1 October 2024].
]

[DEFRA, “Safeguarding our Soils – A strategy for England,” 2009. [Online]. Available:
1 [https://assets.publishing.service.gov.uk/media/5a795b71ed915d0422067beb/pb13297-](https://assets.publishing.service.gov.uk/media/5a795b71ed915d0422067beb/pb13297-soil-strategy-090910.pdf)
2 [soil-strategy-090910.pdf](https://assets.publishing.service.gov.uk/media/5a795b71ed915d0422067beb/pb13297-soil-strategy-090910.pdf). [Accessed 06 December 2024].
]

[DEFRA, “England Peat Action Plan,” 2021. [Online]. Available:
1 [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachmen](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_t_data/file/1010786/england-peat-action-plan.pdf)
3 [t_data/file/1010786/england-peat-action-plan.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_t_data/file/1010786/england-peat-action-plan.pdf). [Accessed 14 August 2024].
]

[HM Government, “The Environment (Amendment etc.) (EU Exit) (Amendment)
1 (England and Wales) Regulations 2020,” 2020. [Online]. Available:
4 <https://www.legislation.gov.uk/ukxi/2020/603/introduction/made>. [Accessed 08 July
] 2024].

[HM Government, “Environmental Protection Act 1990,” n.d.. [Online]. Available:
1 <https://www.legislation.gov.uk/ukpga/1990/43/contents>. [Accessed 10 July 2024].
5
]

[HM Government, “Water Resources Act 1991,” n.d.. [Online]. Available:
1 <https://www.legislation.gov.uk/ukpga/1991/57/contents>. [Accessed 08 July 2024].
6
]

[HM Government, “The Water Environment (Water Framework Directive) (England and
1 Wales) Regulations 2017 (WFD),” n.d.. [Online]. Available:
7 <https://www.legislation.gov.uk/ukxi/2017/407/contents/made>. [Accessed 10 July 2024].
]

[HM Government, “Land Drainage Act 1991 [Online].,” [Online]. Available:
1 <https://www.legislation.gov.uk/ukpga/1991/59/contents> . [Accessed 10 July 2024].
8
]

[HM Governemnt, “Water Act 2014,” n.d.. [Online]. Available:
1 <https://www.legislation.gov.uk/ukpga/2014/21/contents/enacted>. [Accessed 10 July
9 2024].
]

[HM Government, “Water Resources (Abstraction and Impounding) Regulations 2006,”
2 n.d.. [Online]. Available: <https://www.legislation.gov.uk/ukxi/2006/641/contents/made>.
0
]

[HM Government, “Flood Risk Regulations 2009,” n.d.. [Online]. Available:
2 <https://www.legislation.gov.uk/ukxi/2009/3042/contents/made>. [Accessed 10 July 2024].
1
]

[HM Government, “Nitrate Pollution Prevention Regulations 2015,” n.d.. [Online].
2 Available: <https://www.legislation.gov.uk/ukxi/2015/668/contents>. [Accessed 10 July
2 2024].
]

[HM Government, "The Conservation of Habitats and Species Regulations 2017," n.d..
2 [Online]. Available: <https://www.legislation.gov.uk/uksi/2017/1012/contents/made>.
3 [Accessed 12 August 2024].
]

[HM Government, "Wildlife and Countryside Act 1981 (as amended)," n.d.. [Online].
2 Available: <https://www.legislation.gov.uk/ukpga/1981/69>.. [Accessed 12 August 2024].
4
]

[HM Government, "Natural Environment and Rural Communities Act 2006 Chapter 16,"
2 2006. [Online]. Available:
5 https://www.legislation.gov.uk/ukpga/2006/16/pdfs/ukpga_20060016_en.pdf. [Accessed
] 12 August 2024].

[H. Government, "Countryside and Rights of Way Act 2000," n.d.. [Online]. Available:
2 <https://www.legislation.gov.uk/ukpga/2000/37/contents>.. [Accessed 12 August 2024].
6
]

[H. Government, "The Hedgerow Regulations 1997," n.d.. [Online]. Available:
2 <https://www.legislation.gov.uk/uksi/1997/1160/contents/made>. [Accessed 12 August
7 2024].
]

[HM Government, "Protection of Badgers Act 1992," n.d.. [Online]. Available:
2 <https://www.legislation.gov.uk/ukpga/1992/51/contents>. [Accessed 12 August 2024].
8
]

[HM Government, "Salmon and Freshwater Fisheries Act 1975," n.d.. [Online]. Available:
2 <https://www.legislation.gov.uk/ukpga/1975/51>. [Accessed 12 August 2024].
9
]

[HM Government, "The Eels (England and Wales) Regulations 2009," n.d.. [Online].
3 Available: <https://www.legislation.gov.uk/uksi/2009/3344/contents/made>.. [Accessed 12
0 August 2024].
]

[HM Government, "The Invasive Alien Species (Enforcement and Permitting) Order
3 2019," n.d.. [Online]. Available:
1 <https://www.legislation.gov.uk/uksi/2019/527/contents/made>.. [Accessed 12 August
] 2024].

[HM Government, "Ancient Monuments and Archaeological Areas Act 1979," n.d..
3 [Online]. Available: <https://www.legislation.gov.uk/ukpga/1979/46>.. [Accessed 12 August
2 2024].
]

[HM Government, "Planning (Listed Buildings and Conservation Areas) Act 1990," n.d..
3 [Online]. Available: <https://www.legislation.gov.uk/ukpga/1990/9/contents>.. [Accessed
3 12 August 2024].
]

[HM Government, "Protection of Military Remains Act 1986," n.d.. [Online]. Available:
3 <https://www.legislation.gov.uk/ukpga/1986/35/contents..> [Accessed 12 August 2024].
4
]

[HM Government, "The Hedgerows Regulations 1997," n.d.. [Online]. Available:
3 <https://www.legislation.gov.uk/uksi/1997/1160/contents/made..> [Accessed 12 August
5 2024].
]

[HM Government, "Treasure Act 1996," n.d.. [Online]. Available:
3 <https://www.legislation.gov.uk/ukpga/1996/24/contents.> [Accessed 12 August 2024].
6
]

[Department of Health and Social Care, "Health and Social Care Act," 2012. [Online].
3 Available: <https://www.legislation.gov.uk/ukpga/2012/7/contents.> [Accessed 18 August
7 2024].
]

[HM Government, "The Air Quality Standards (Amendment) Regulations 2016, SI
3 2016/1184," n.d.. [Online]. Available:
8 <https://www.legislation.gov.uk/uksi/2016/1184/contents/made.> [Accessed 16 November
] 2024].

[Department for Communities and Local Government, "Planning Practice Guidance: Air
3 Quality," 2014. [Online]. Available: <https://www.gov.uk/guidance/air-quality--3.>
9 [Accessed 14 November 2024].
]

[DEFRA, "Clean Air Strategy 2019," 2019. [Online]. Available:
4 <https://www.gov.uk/government/publications/clean-air-strategy-2019.> [Accessed 14
0 November 2024].
]

[South East Lincolnshire Joint Strategic Planning Committee, "South East Lincolnshire
4 Local Plan 2011-2036," March 2019. [Online]. Available:
1 [https://southeastlincslocalplan.org/media/21941/South-East-Lincolnshire-Local-Plan-
\] 2011-2036/pdf/Local-Plan-text-March-2019.pdf?m=1720710748483.](https://southeastlincslocalplan.org/media/21941/South-East-Lincolnshire-Local-Plan-2011-2036/pdf/Local-Plan-text-March-2019.pdf?m=1720710748483.) [Accessed 20
February 2025].

[Peterborough City Council, "Peterborough Local Plan 2016-2036," 2019. [Online].
4 Available:
2 [https://cccandpcc.sharepoint.com/sites/PCCPlanningPolicyPublicData/Shared%20Docu
\] ments/Forms/AllItems.aspx?id=%2Fsites%2FPCCPlanningPolicyPublicData%2FShare
d%20Documents%2FPlanning%20Policy%2FAdopted%20Local%20Plan%2FPeterboro
ugh%20Local%20Plan%2F1%2EPeter.](https://cccandpcc.sharepoint.com/sites/PCCPlanningPolicyPublicData/Shared%20Documents/Forms/AllItems.aspx?id=%2Fsites%2FPCCPlanningPolicyPublicData%2FShared%20Documents%2FPlanning%20Policy%2FAdopted%20Local%20Plan%2FPeterborough%20Local%20Plan%2F1%2EPeter.) [Accessed 20 February 2025].

[Fenland District Council, "Fenland Local Plan. Adopted May 2014," 2014. [Online].
4 Available: [https://www.fenland.gov.uk/media/12064/Fenland-Local-Plan-Adopted-
3 2014/pdf/Fenland_Local_Plan-Adopted_2014.pdf?m=1591111057500.](https://www.fenland.gov.uk/media/12064/Fenland-Local-Plan-Adopted-2014/pdf/Fenland_Local_Plan-Adopted_2014.pdf?m=1591111057500.) [Accessed 20
] February 2025].

- [P. C. Council, "Local Plan Review," 2025. [Online]. Available:
4 <https://www.peterborough.gov.uk/council/planning-and-development/planning->
4 [policies/local-plan-review](https://www.peterborough.gov.uk/council/planning-and-development/planning-policies/local-plan-review). [Accessed 12 August 2025].
]
- [Natural England, "National Character Area Profiles," 2014. [Online]. Available:
4 <https://nationalcharacterareas.co.uk/>. [Accessed 14 December 2024].
5
]
- [Landscape Institute, "Landscape Character Assessment," 10 December 2024. [Online].
4 Available: <https://www.landscapeinstitute.org/wp-content/uploads/2016/01/Landscape->
6 [Character-Assessment-TIN-08_15-20160216.pdf](https://www.landscapeinstitute.org/wp-content/uploads/2016/01/Landscape-Character-Assessment-TIN-08_15-20160216.pdf). [Accessed February 2016].
]
- [Natural England, "National Character Area 46: The Fens," 2024. [Online]. Available:
4 <https://nationalcharacterareas.co.uk/The-Fens/>. [Accessed 18 October 2024].
7
]
- [Natural England, "National Character Area 88: Bedfordshire and Cambridgeshire
4 Claylands," 2025. [Online]. Available: <https://nationalcharacterareas.co.uk/Bedfordshire->
8 [and-Cambridgeshire-Claylands/](https://nationalcharacterareas.co.uk/Bedfordshire-and-Cambridgeshire-Claylands/). [Accessed 4 March 2025].
]
- [John Campion Associates Ltd, "Strategic Landscape Capacity Study for South Holland
4 District Council," 2003. [Online]. Available:
9 [Strategic_Landscape_Capacity_Study_for_South_Holland_District_Council.pdf](https://www.southholland.gov.uk/media/10000/Strategic_Landscape_Capacity_Study_for_South_Holland_District_Council.pdf) .
] [Accessed 7 February 2025].
- [Peterborough City Council, "Landscape Character Assessment for Peterborough City
5 Council," May 2007. [Online]. Available:
0 <https://www.peterborough.gov.uk/council/planning-and-development/planning->
] [policies/local-supporting-information#primary-evidence-1-0](https://www.peterborough.gov.uk/council/planning-and-development/planning-policies/local-supporting-information#primary-evidence-1-0). [Accessed 10 March 2025].
- [Fenland District Council, "Local Plan," May 2014. [Online]. Available:
5 <https://www.fenland.gov.uk/developmentplan>. [Accessed 12 March 2025].
1
]
- [The Wash Estuary Project, "The Wash and Fens Green Infrastructure Plan," 2011.
5 [Online]. Available: <https://safe.rbi->
2 [umbrella.com/doc/docview/viewer/docN6C474CC9F406949a074e68b7ce3e7d6a04d75](https://safe.rbi-umbrella.com/doc/docview/viewer/docN6C474CC9F406949a074e68b7ce3e7d6a04d75)
] [68b7b5f335fb946b7ffaa27578795d6f60120ce](https://safe.rbi-umbrella.com/doc/docview/viewer/docN6C474CC9F406949a074e68b7ce3e7d6a04d7568b7b5f335fb946b7ffaa27578795d6f60120ce). [Accessed 15 October 2024].
- [Peterborough City Council, "Green Infrastructure and Biodiversity Supplementary
5 Planning Document," 2019. [Online]. Available:
3 <https://www.peterborough.gov.uk/council/planning-and-development/conservation->
] [trees-and-hedges/biodiversity-and-ecology/biodiversity-strategy-and-supplementary-](https://www.peterborough.gov.uk/council/planning-and-development/conservation-trees-and-hedges/biodiversity-and-ecology/biodiversity-strategy-and-supplementary-planning-document)
planning-document. [Accessed 10 March 2025].
- [Natural England, "Green Infrastructure," 2025. [Online]. Available:
5 <https://designatedsites.naturalengland.org.uk/GreenInfrastructure/Map.aspx>. [Accessed
21 January 2025].

[Greater Lincolnshire Local Nature Recovery Strategy, "Greater Lincolnshire Local Nature Recovery Strategy," 2025. [Online]. Available: <https://www.glincsnrs.org.uk>. [Accessed 22 January 2025].

[Cambridgeshire and Peterborough Local Nature Recovery Strategy, "Cambridgeshire and Peterborough Local Nature Recovery Strategy," 2024. [Online]. Available: <https://naturalcambridgeshire.org.uk/lnrs/>. [Accessed 11 February 2025].

[Land Information Service, "Land Information Service, Soils, Cranfield Environment Centre, Cranfield University," 2024. [Online]. Available: <https://www.landis.org.uk/soils/>. [Accessed 05 October 2024].

[Natural England, "Peaty Soils Location (England), Authoritative, Natural England Open Data Publication," 2008. [Online]. Available: <https://naturalengland-defra.opendata.arcgis.com/datasets/Defra::peaty-soils-location-england/about>. [Accessed 15 November 2024].

[I. Holman and C. Kechavarzi, "A revised estimate of peat reserves and loss in the East Anglian Fens, Commissioned by the RSPB," January 2011. [Online]. Available: <https://www.fensforthefuture.org.uk/admin/resources/banners/cranfieldfenland-phase-2-peat-assessment-19-01-11-final.pdf>. [Accessed 9 April 2025].

[Environment Agency, "Nene Catchment Abstraction Licensing Strategy, A strategy to manage water resources sustainably, March 2021," 2021. [Online]. Available: <https://assets.publishing.service.gov.uk/media/606d91e28fa8f57359cf4346/CAMS-Nene-Catchment-Abstraction-Management-Strategy.pdf>. [Accessed 20 November 2024].

[DEFRA, "Structure June Local Authority," June 2022. [Online]. Available: <https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fassets.publishing.service.gov.uk%2Fmedia%2F62c40b06e90e077485f509d5%2Fstructure-june-eng-localauthority-05jul22.ods&wdOrigin=BROWSELINK>. [Accessed 5 October 2024].

[Planning Data, "Dataset, Local authority district, Office for National Statistics," 2024. [Online]. Available: <https://www.planning.data.gov.uk/dataset/local-authority-district>. [Accessed 28 October 2024].

[DEFRA, "Accredited official statistics. Agriculture in the United Kingdom 2023," 2024. [Online]. Available: <https://www.gov.uk/government/statistics/agriculture-in-the-united-kingdom-2023>. [Accessed 18 November 2024].

[Office for National Statistics, "Business Register and Employment Survey: open access," 2024. [Online]. Available: <https://www.nomisweb.co.uk/query/construct/summary.asp?mode=construct&version=0&dataset=189>. [Accessed 7 October 2024].

- [DEFRA, “Research and analysis, UK Food Security Index 2024,” 2024. [Online].
6 Available: <https://www.gov.uk/government/publications/uk-food-security-index-2024/uk-5-food-security-index-2024>. [Accessed 5 October 2024].
]
- [Environment Agency, “Groundwater source protection zones,” 2019. [Online]. Available:
6 <https://www.gov.uk/guidance/groundwater-source-protection-zones-spzs>. [Accessed 16
6 August 2024].
]
- [F. & R. A. a. E. A. Department for Environment,
6 “<https://www.gov.uk/government/collections/nitrate-vulnerable-zones>,” HM Government,
7 12 February 2025. [Online]. Available:
] <https://www.gov.uk/government/collections/nitrate-vulnerable-zones>.
- [UKHSA, “UK maps of radon,” 2025. [Online]. Available:
6 <https://www.ukradon.org/information/ukmaps>. [Accessed 4 February 2025].
8
]
- [BGS, 1:50,000 Spalding Sheet 144 Solid and Drift Geology, 1992.
6
9
]
- [BGS, 1:50,000 King's Lynn and The Wash 145 Solid and Drift Geology, 1978.
7
0
]
- [BGS, 1:50,000 Peterborough Sheet 158 Solid and Drift Geology, 1984.
7
1
]
- [BGS, 1:50,000 Wisbech Sheet 159 Solid and Drift Geology, 1995.
7
2
]
- [J. Doody, “‘Coastal squeeze’ – an historical perspective,” *Journal of Coastal*
7 *Conservation*, vol. 10, no. 1, pp. 129-138, 2004.
3
]
- [Arup, “Fluvial River Nene Bank Crest Improvement (SP11-14C) Ground Investigation
7 Report,” 2022.
4
]
- [A. Powell, A. McMillan and JH, Classification of artificial (man-made) ground and
7 natural superficial deposits applications to geological maps and datasets in the UK,
5 BGS, 1999.
]

[D. Z. J. W. M. W. I. R. M. & B. C. Smith, "Holocene drainage systems of the English
7 Fenland: roddons and their environmental significance," *Proceedings of the Geologists'*
6 *Association*, vol. 121, no. 3, pp. 256-269, 2010.
]

[P. Migon, *The Fens - An example of large-scale anthropic transformation of a lowland*
7 *landscape*, 2020.
7
]

[BGS, "GeoIndex Onshore," 09 2024. [Online]. Available:
7 <https://mapapps2.bgs.ac.uk/geoindex/home.html>. [Accessed 2 November 2024].
8
]

[P. Kent, *Eastern England from the Tees to The Wash*, British Regional Geology,
7 Second Edition, Institute of Geological Sciences, Natural Environment Research
9 Council, 1980.
]

[Woods, M A, "National geological screening: East Anglia region. Minerals and Waste
8 Programme Commissioned Report, CR/17/100," British Geological Survey, 2018.
0
]

[S. Price, *The glacial and periglacial history of a Middle Pleistocene ice-margin of the*
8 *British Ice Sheet (BIS) in north Buckinghamshire, England and its influence on*
1 *geotechnical variability*. PhD Thesis, Clare Hall College, University of Cambridge, 2018.
]

[A. Horton, *Geology of the Peterborough district. Memoir for 1:50 000 geological sheet*
8 *158 (England and Wales)*, 1989.
2
]

[R. Gallois, *Geology of the country around King's Lynn and The Wash : memoir for*
8 *1:50000 geological sheet 145 and part of 129 (England & Wales).*, 1994.
3
]

[DEFRA, "Magic Map," 2025. [Online]. Available:
8 <https://magic.defra.gov.uk/MagicMap.aspx>. [Accessed 2 February 2025].
4
]

[*Hydrogeological Map of England, and Wales*, 1:625,000 scale, Institute of Geological
8 *Sciences*, 1977.
5
]

[J. N. C. C. (JNCC), "UK Terrestrial & Freshwater Habitat Descriptions," 2015. [Online].
8 Available: <https://jncc.gov.uk/resources/b0b5e833-7300-4234-8ae5-bdbf326e854c>.
6 [Accessed August 2025].
]

- [International Finance Corporation (IFC), "International Finance Corporation's Guidance
8 Note 6: Biodiversity Conservation and Sustainable Management of Living Natural
7 Resources.," 2019. [Online]. Available:
] <https://www.ifc.org/content/dam/ifc/doc/2010/20190627-ifc-ps-guidance-note-6-en.pdf>.
[Accessed 27 October 2024].
- [R. Moyse, "Brome, Interrupted," 1 August 2019. [Online]. Available:
8 <https://naturebftb.co.uk/2019/08/01/brome-interrupted/>. [Accessed 28 March 2025].
8
]
- [BirdLife International, "Puffinus mauretanicus (Europe assessment). The ICUN Red List
8 of Threatened Species," 2021. [Online]. Available:
9 <https://www.iucnredlist.org/species/22728432/166437191>. [Accessed 28 March 2025].
]
- [BirdGuides, "Importance of UK waters to Balearic Shearwater revealed," 29 January
9 2021. [Online]. Available: [https://www.birdguides.com/articles/ornithology/importance-](https://www.birdguides.com/articles/ornithology/importance-of-uk-waters-to-balearic-shearwater-revealed/)
0 [of-uk-waters-to-balearic-shearwater-revealed/](https://www.birdguides.com/articles/ornithology/importance-of-uk-waters-to-balearic-shearwater-revealed/). [Accessed 28 March 2025].
]
- [Britains Rivers, "River Nene," n.d.. [Online]. Available:
9 <https://www.britainsrivers.com/river-nene>. [Accessed 28 March 2025].
1
]
- [M. Lopes-Lima, V. Prié, D. Aldridge and M. Urbańska, "Pseudanodonta complanata.
9 The IUCN Red List of Threatened Species," 2024. [Online]. Available:
2 <https://www.iucnredlist.org/species/211999791/212006932>. [Accessed 28 March 2025].
]
- [L. Füreder, F. Gherardi, D. Holdich, J. Reynolds, P. Sibley and C. Souty-Grosset,
9 "Austropotamobius pallipes. The IUCN Red List of Threatened Species," 2010. [Online].
3 Available: <https://www.iucnredlist.org/species/2430/9438817>. [Accessed 28 March
] 2025].
- [C. R. Green, Land on the Edge: The landscape evolution of the Lincolnshire Coastline,
9 Historic England project number: 8398, 2023.
4
]
- [C. Green, "The prehistoric evolution of the coastline of the north-eastern Lincolnshire,"
9 2015. [Online]. Available: [https://www.caitlingreen.org/2015/06/prehistoric-evolution-](https://www.caitlingreen.org/2015/06/prehistoric-evolution-lincolnshire-coastline.html)
5 [lincolnshire-coastline.html](https://www.caitlingreen.org/2015/06/prehistoric-evolution-lincolnshire-coastline.html). [Accessed 29 November 2024].
]
- [Historic England, "A Bronze Age post alignment and timber platform at Flag Fen and
9 associated Bronze Age and later field systems and settlement to either side of the
6 Northey Road," 2012. [Online]. Available: [https://historicengland.org.uk/listing/the-](https://historicengland.org.uk/listing/the-list/list-entry/1406460?section=official-list-entry)
] [list/list-entry/1406460?section=official-list-entry](https://historicengland.org.uk/listing/the-list/list-entry/1406460?section=official-list-entry). [Accessed 27 February 2025].
- [M. Knight, "Must Farm Must Road," June 2012. [Online]. Available:
9 <https://www.mustfarm.com/wp/wp-content/uploads/MustRead-June2012.pdf>. [Accessed
27 February 2025].

[Historic England, "Roman field system and trackway with later field ditches and drove on Whittlesey Washes, 60m south of Bedford House," 1994. [Online]. Available: <https://historicengland.org.uk/listing/the-list/list-entry/1009992?section=official-list-entry>. [Accessed 27 February 2025].

[Historic England, "Iron Age and Roman Settlement at Bar Pastures," 1995. [Online]. Available: <https://historicengland.org.uk/listing/the-list/list-entry/1009991?section=official-list-entry>. [Accessed 10 January 2025].

[Lincolnshire County Council, "'Monument record MLI60706 - Car Dyke in Lincolnshire'," Lincolnshire Heritage Explorer, 2024. [Online]. Available: <https://heritage-explorer.lincolnshire.gov.uk/Monument/MLI60706>. [Accessed 2 December 2024].

[University of Nottingham, "Key to England Place-Names," n.d.. [Online]. Available: <http://kepn.nottingham.ac.uk/map/place/Lincolnshire/Whaplode>. [Accessed 27 February 2025].

[A. Powell-Smith, "Open Domesday," n.d.. [Online]. Available: <https://opendomesday.org/map/>. [Accessed 29 November 2024].

[E. A. Labrum, Civil Engineering Heritage, Eastern & Central England, London: ICE, 1994.

[Lincolnshire County Council, North East Lincolnshire Council, and North Lincolnshire Council, "'Character Zone FEN2, The Eastern Fen within The Fens Character Area', Lincolnshire Historic Landscape Characterisation (HLC)," 2017. [Online]. Available: https://archaeologydataservice.ac.uk/archives/view/lincolnshire_hlc_2017/downloads.cfm. [Accessed 29 November 2024].

[Council for British Archaeology, Defence of Britain Archive, York: Archaeology Data Service [distributor], 2006.

[D. Lock, "The Historic Landscape of Peterborough Unitary Authority," 2003. [Online]. Available: https://archaeologydataservice.ac.uk/archives/view/peterborough_hlc_2014/downloads.cfm. [Accessed 4 December 2024].

[Lincolnshire County Council, North East Lincolnshire Council, and North Lincolnshire Council, "Character Zone WSH4, Reclaimed Wash Farmlands within The Wash Character Area', Lincolnshire Historic Landscape Characterisation (HLC)," 2017.

7 [Online]. Available:

1 https://archaeologydataservice.ac.uk/archives/view/lincolnshire_hlc_2017/downloads.cfm. [Accessed 29 November 2024].

[Ministry of Housing, Communities, Local Government, "The English indices of Deprivation (2019)," 2019. [Online]. Available:

0 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/835115/loD2019_Statistical_Release.pdf. [Accessed 21 August 2024].

]

[Office for National Statistics (ONS), "Census 2021 Geographies," 2021. [Online]. Available:

0 <https://www.ons.gov.uk/methodology/geography/ukgeographies/censusgeographies/census2021geographies#lower-layer-super-output-areas-isoas->. [Accessed 08 September 2024].

[Office for National Statistics (ONS), "Lower Layer Super Output Area Population Estimates," 2021. [Online]. Available:

1 <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/lowersuperoutputareamidyearpopulationestimatesnationalstatistics>. [Accessed 09 September 2024].

[Office for National Statistics (ONS), "How the population changed where you live: Census 2021," 2021. [Online]. Available:

1 <https://www.ons.gov.uk/visualisations/censuspopulationchange/>. [Accessed 20 February 2025].

]

[Office for National Statistics (ONS), "Population projections for local authorities: Table 2," 2018. [Online]. Available:

1 <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/localauthoritiesinenglandtable2>. [Accessed 20 February 2025].

]

[Office for National Statistics (ONS), "Population density, people per square kilometre," 2020. [Online]. Available: [https://fingertips.phe.org.uk/local-](https://fingertips.phe.org.uk/local-health#page/3/gid/1938133180/pat/30000/par/al-Sr1JPIAp8k/ati/8/are/E05010784/iid/93747/age/1/sex/4/cat/-1/ctp/-1/yr/1/cid/4/tbm/1)

1 [health#page/3/gid/1938133180/pat/30000/par/al-Sr1JPIAp8k/ati/8/are/E05010784/iid/93747/age/1/sex/4/cat/-1/ctp/-1/yr/1/cid/4/tbm/1](https://fingertips.phe.org.uk/local-health#page/3/gid/1938133180/pat/30000/par/al-Sr1JPIAp8k/ati/8/are/E05010784/iid/93747/age/1/sex/4/cat/-1/ctp/-1/yr/1/cid/4/tbm/1). [Accessed 20 February 2025].

[O. f. N. Statistics, "Subnational population projections for England: 2018-based.," 2020. [Online]. Available:

1 <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/subnationalpopulationprojectionsforengland/2018based>.

4 [Accessed 14 September 2024].

[Office for Health Improvement and Disparities, "Small area population estimates, England and Wales: mid 2020," 2020. [Online]. Available:

1

- 1 https://www.localhealth.org.uk/#c=report&chapter=c01&report=r01&selgeo1=msoa_20151.E02005440. [Accessed 18 September 2024].
]
- [Office for National Statistics (ONS), "Ethnic Group (Detailed)," 2022. [Online]. Available:
1 [https://www.ons.gov.uk/datasets/TS021/editions/2021/versions/1/filter-](https://www.ons.gov.uk/datasets/TS021/editions/2021/versions/1/filter-outputs/2c157d27-8f89-4567-9598-fe558a180c57)
1 [outputs/2c157d27-8f89-4567-9598-fe558a180c57](https://www.ons.gov.uk/datasets/TS021/editions/2021/versions/1/filter-outputs/2c157d27-8f89-4567-9598-fe558a180c57). [Accessed 19 October 2024].
6
]
- [Office for National Statistics (ONS), "Census Profile for MSOA areas in England and
1 Wales," 2021. [Online]. Available:
1 [https://www.nomisweb.co.uk/reports/localarea?compare=E02005436,E07000137,E920](https://www.nomisweb.co.uk/reports/localarea?compare=E02005436,E07000137,E920700001)
7 [00001](https://www.nomisweb.co.uk/reports/localarea?compare=E02005436,E07000137,E920700001). [Accessed 19 October 2024].
]
- [Office for Health Improvement and Disparities, "Unemployment, percentage of the
1 working age population claiming out of work benefit, 2021 to 2022 (%).," 2022. [Online].
1 Available: [https://fingertips.phe.org.uk/local-](https://fingertips.phe.org.uk/local-health#page/0/gid/1938133180/pat/30000/par/al-PFHqBc7RZ0/ati/3/iid/93747/age/1/sex/4/cat/-1/ctp/-1/yr/1/cid/4/tbm/1/page-options/car-ao-0_car-do-1)
8 [health#page/0/gid/1938133180/pat/30000/par/al-](https://fingertips.phe.org.uk/local-health#page/0/gid/1938133180/pat/30000/par/al-PFHqBc7RZ0/ati/3/iid/93747/age/1/sex/4/cat/-1/ctp/-1/yr/1/cid/4/tbm/1/page-options/car-ao-0_car-do-1)
] [PFHqBc7RZ0/ati/3/iid/93747/age/1/sex/4/cat/-1/ctp/-1/yr/1/cid/4/tbm/1/page-](https://fingertips.phe.org.uk/local-health#page/0/gid/1938133180/pat/30000/par/al-PFHqBc7RZ0/ati/3/iid/93747/age/1/sex/4/cat/-1/ctp/-1/yr/1/cid/4/tbm/1/page-options/car-ao-0_car-do-1)
options/car-ao-0_car-do-1. [Accessed 19 October 2024].
- [Office for Health Improvement and Disparities, "Life expectancy at birth," 2022. [Online].
1 Available: [https://fingertips.phe.org.uk/local-](https://fingertips.phe.org.uk/local-health#page/3/gid/1938133185/pat/30000/par/al-Sr1JPIAp8k/ati/8/iid/93283/age/1/sex/2/cat/-1/ctp/-1/yr/5/cid/4/tbm/1/page-options/car-do-0)
1 [health#page/3/gid/1938133185/pat/30000/par/al-](https://fingertips.phe.org.uk/local-health#page/3/gid/1938133185/pat/30000/par/al-Sr1JPIAp8k/ati/8/iid/93283/age/1/sex/2/cat/-1/ctp/-1/yr/5/cid/4/tbm/1/page-options/car-do-0)
9 [Sr1JPIAp8k/ati/8/iid/93283/age/1/sex/2/cat/-1/ctp/-1/yr/5/cid/4/tbm/1/page-options/car-](https://fingertips.phe.org.uk/local-health#page/3/gid/1938133185/pat/30000/par/al-Sr1JPIAp8k/ati/8/iid/93283/age/1/sex/2/cat/-1/ctp/-1/yr/5/cid/4/tbm/1/page-options/car-do-0)
] [do-0](https://fingertips.phe.org.uk/local-health#page/3/gid/1938133185/pat/30000/par/al-Sr1JPIAp8k/ati/8/iid/93283/age/1/sex/2/cat/-1/ctp/-1/yr/5/cid/4/tbm/1/page-options/car-do-0). [Accessed 8 September 2024].
- [Office for Health Improvement and Disparities, "Causes of death - all ages, 2016 to
1 2020: Standardised Mortality Ratios (SMR)," 2016. [Online]. Available:
2 <https://www.localhealth.org.uk/#c=report&chapter=c17&report=r02>. [Accessed 5
0 September 2024].
]
- [Office for National Statistics (ONS), "2021 Census profile for for areas in England and
1 Wales," 2021. [Online]. Available:
2 [https://www.nomisweb.co.uk/sources/census_2021/report?compare=E07000137#sectio](https://www.nomisweb.co.uk/sources/census_2021/report?compare=E07000137#section_9)
1 [n_9](https://www.nomisweb.co.uk/sources/census_2021/report?compare=E07000137#section_9). [Accessed 05 September 2024].
]
- [Office for Health Improvement and Disparities, "Adults (aged 16 years and over):
1 Estimated prevalence of obesity, including overweight, by national quintile (Q5 is lowest
2 20%), 2014 (Quintile)," 2024. [Online]. Available:
2 [https://www.localhealth.org.uk/#bbox=497728,367008,52746,55232&c=indicator&i=t2.y](https://www.localhealth.org.uk/#bbox=497728,367008,52746,55232&c=indicator&i=t2.y6_ob_v&view=map7)
] [6_ob_v&view=map7](https://www.localhealth.org.uk/#bbox=497728,367008,52746,55232&c=indicator&i=t2.y6_ob_v&view=map7). [Accessed 21 January 2024].
- [Adult Psychiatric Morbidity Survey, "Estimated prevalence of common mental
1 disorders: % of population aged 16 and over," 2017. [Online]. Available:
2 [https://fingertips.phe.org.uk/common-mental-](https://fingertips.phe.org.uk/common-mental-disorders#page/4/gid/8000026/pat/6/ati/202/are/E10000019/iid/93495/age/164/sex/4/ca)
3 [disorders#page/4/gid/8000026/pat/6/ati/202/are/E10000019/iid/93495/age/164/sex/4/ca](https://fingertips.phe.org.uk/common-mental-disorders#page/4/gid/8000026/pat/6/ati/202/are/E10000019/iid/93495/age/164/sex/4/ca)
] [t/-1/ctp/-1/yr/1/cid/4/tbm/1](https://fingertips.phe.org.uk/common-mental-disorders#page/4/gid/8000026/pat/6/ati/202/are/E10000019/iid/93495/age/164/sex/4/ca). [Accessed 08 September 2024].

[Office for Health Improvements and Disparities, “Self-reported wellbeing indicators by
1 area,” 2021. [Online]. Available:
2 <https://fingertips.phe.org.uk/search/self%20reported#page/1/gid/1/pat/6/ati/402/are/E10>
4 000019/iid/22301/age/164/sex/4/cat/-1/ctp/-1/yr/1/cid/4/tbm/1. [Accessed 08
] September 2024].

[Fenland District Council, “Draft Local Plan - Policies Map,” 2022. [Online]. Available:
1 [https://fenlanddc.maps.arcgis.com/apps/instant/basic/index.html?appid=72272581e9d0](https://fenlanddc.maps.arcgis.com/apps/instant/basic/index.html?appid=72272581e9d042efaf961cea4737d41c)
2 42efaf961cea4737d41c. [Accessed 11 March 2025].
5
]

[DEFRA, “National Receptor Dataset,” 2022. [Online]. Available:
1 <https://environment.data.gov.uk/dataset/c715de67-db49-4029-ac59-d6fed5ff08f8>.
2 [Accessed 12 December 2024].
6
]

[Sports England, “Active Places Power,” 2024. [Online]. Available:
1 <https://designatedsites.naturalengland.org.uk/GreenInfrastructure/Map.aspx>. [Accessed
2 09 September 2024].
7
]

[Catchment Based Approach Data Hub, “Public Rights of Way England,” 2024. [Online].
1 Available: [https://data.catchmentbasedapproach.org/datasets/public-rights-of-way-](https://data.catchmentbasedapproach.org/datasets/public-rights-of-way-england/explore?location=53.080558%2C0.027508%2C10.88)
2 [england/explore?location=53.080558%2C0.027508%2C10.88](https://data.catchmentbasedapproach.org/datasets/public-rights-of-way-england/explore?location=53.080558%2C0.027508%2C10.88). [Accessed 20 February
8 2025].
]

[Sustrans, “National Cycle Network 2024,” 2024. [Online]. Available: [https://data-](https://data-sustrans-uk.opendata.arcgis.com/)
1 [sustrans-uk.opendata.arcgis.com/](https://data-sustrans-uk.opendata.arcgis.com/). [Accessed 8 January 2025].
2
9
]

[Natural England, “King Charles III England Coast Path Route,” 2024. [Online].
1 Available: [https://naturalengland-](https://naturalengland-defra.opendata.arcgis.com/datasets/a1488f928832407fbd267feb6802bed6/explore)
3 [defra.opendata.arcgis.com/datasets/a1488f928832407fbd267feb6802bed6/explore](https://naturalengland-defra.opendata.arcgis.com/datasets/a1488f928832407fbd267feb6802bed6/explore).
0 [Accessed 20 February 2025].
]

[Bureau Veritas, “South Holland District Council Annual Status Report 2024,” 2024.
1 [Online]. Available: <http://shollandair.aeat.com/>. [Accessed 19 February 2025].
3
1
]

[Peterborough City Council, “Air Quality Annual Status Report (ASR),” September 2024.
1 [Online]. Available: [https://www.peterborough.gov.uk/asset-library/air-quality-report-](https://www.peterborough.gov.uk/asset-library/air-quality-report-2024.pdf)
3 [2024.pdf](https://www.peterborough.gov.uk/asset-library/air-quality-report-2024.pdf). [Accessed 14 March 2025].
2
]

[Fenland District Council, "Air Quality Annual Status Report (ASR)," July 2024. [Online].
 1 Available: https://www.fenland.gov.uk/media/21463/Air-Quality-Annual-Status-Report-2024/pdf/Fenland_Air_Quality_Annual_Status_Report__2024.pdf?m=1727088605257.
 3 [Accessed 14 March 2025].
 3]

[DEFRA, "Background Mapping data for local authorities - 2021," 2021. [Online].
 1 Available: <https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2021>.
 3 [Accessed 10 December 2024].
 4]

[HM Government, "Directive 2010/75/EU of the European Parliament and of the Council
 1 of 24 November 2010 on industrial emissions (integrated pollution prevention and
 3 control)," n.d.. [Online]. Available: <https://www.legislation.gov.uk/eudr/2010/75/contents>.
 5 [Accessed 10 October 2024].
]

[HM Government, "The Environmental Permitting (England and Wales) Regulations
 1 2016, SI 2016/1154," n.d.. [Online]. Available:
 3 <https://www.legislation.gov.uk/ukxi/2016/1154/contents>. [Accessed 10 October 2024].
 6]

[DEFRA, "Environmental Permitting Regulations - Installations," 2024. [Online].
 1 Available: [https://environment.data.gov.uk/public-register/view/search-industrial-](https://environment.data.gov.uk/public-register/view/search-industrial-installations)
 3 installations. [Accessed 10 October 2024].
 7]

[UK Centre for Ecology and Hydrology, "Lowland peatlands [online]," (n.d.). [Online].
 1 Available: <https://lowlandpeat.ceh.ac.uk/>. [Accessed 28 October 2024].
 3]
 8]

[Greater Lincolnshire Nature Partnership, "Geodiversity Strategy," 2022. [Online].
 1 Available: <https://glnp.org.uk/our-services/geodiversity-strategy>. [Accessed 06
 3 December 2024].
 9]

[Fens For the Future, "Cranfield University, A revised estimate of peat reserves and loss
 1 in the East Anglian Fens, Commissioned by the RSPB, Holman, IP and Kechavarzi, C.,"
 4 January 2011. [Online]. Available:
 0 [https://www.fensforthefuture.org.uk/admin/resources/banners/cranfieldfenland-phase-2-](https://www.fensforthefuture.org.uk/admin/resources/banners/cranfieldfenland-phase-2-peat-assessment-19-01-11-final.pdf)
] [peat-assessment-19-01-11-final.pdf](https://www.fensforthefuture.org.uk/admin/resources/banners/cranfieldfenland-phase-2-peat-assessment-19-01-11-final.pdf). [Accessed 16 November 2024].

[Anglian Water, "Our strategic pipelines, Strategies and Plans, Corporate, Anglian
 1 Water," 2023. [Online]. Available: [https://www.anglianwater.co.uk/corporate/strategies-](https://www.anglianwater.co.uk/corporate/strategies-and-plans/new-water-pipelines/)
 4 [and-plans/new-water-pipelines/](https://www.anglianwater.co.uk/corporate/strategies-and-plans/new-water-pipelines/). [Accessed 27 November 2024].
 1]

[Fens Reservoir, "Proposals, Our latest proposals, Associated water infrastructure, Overview, Fens Reservoir, Anglian Water," 2024. [Online]. Available: <https://fensreservoir.co.uk/proposals/our-latest-proposals/associated-water-infrastructure/overview/>. [Accessed 27 November 2024].]

[Gentle Farming, "Gentle Farming," 2024. [Online]. Available: <https://www.gentle-farming.co.uk/>. [Accessed 27 November 2024].]

[GH Hoyles, "Crops, GH Hoyles Limited," 2024. [Online]. Available: <https://www.ghhoyles.co.uk/crops/>. [Accessed 27 November 2024].]

[Oldershaws Group, "Oldershaws of Moulton, Oldershaws Group," 2024. [Online]. Available: <https://www.oldershawgroup.co.uk/oldershaws-of-moulton>. [Accessed 27 November 2024].]

[The Landscape Partnership, "Fenland District Council - Wind Turbine Development Policy Guidance Incorporating Revisions Following Public Consultations," 2009. [Online]. Available: https://www.fenland.gov.uk/media/2509/Wind-Turbine-Study/pdf/2009-10-12_Wind_Turbine_Development_Policy_Guidance.pdf. [Accessed 4 March 2025].]

[Fendyke Solar Farm, "Fendyke Solar Farm, Integrum Renewable Energy," 2024. [Online]. Available: <https://www.fendykesolarfarm.com/>. [Accessed 12 November 2024].]

[Meridian Solar Farm, "Meridian Solar Farm, Proposals, Downing Renewable Developments," 2024. [Online]. Available: <https://www.meridiansolarfarm.co.uk/proposals/>. [Accessed 12 November 2024].]

[Pathfinder Clean Energy, "Pathfinder Clean Energy UK submits 49MW co-located solar and energy storage project into planning, Pathfinder Clean Energy," 2024. [Online]. Available: <https://pathfinderce.com/2024/02/21/pathfinder-clean-energy-uk-submits-49mw-co-located-solar-and-energy-storage-project-into-planning/>. [Accessed 12 November 2024].]

[Renewable Connections, "Treading Bank Solar Farm, Our Sites, Renewable Connections," 2024. [Online]. Available: <https://renewableconnections.co.uk/our-sites/treading-bank-solar-farm/>. [Accessed 12 November 2024].]

