

A47 North Tuddenham to Easton Dualling

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SCHEME DESIGN REPORT

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Executive Summary

This report provides a summary of the design decisions that informed development of the design for the A47 North Tuddenham to Easton Dualling Scheme. This report also supports the review of compliance with the design requirements of the National Policy Statement for National Networks (2019).

This report demonstrates how the design of the North Tuddenham to Easton dualling scheme meets the ten principles of good design in *The Road to Good Design (2018)* and the Design Manual for Roads and Bridges (DMRB) standard GG103 *Introduction and general requirements for sustainable development and design*. The subsequent sections then explore specific elements of the design in more detail and, where applicable, the factors and alternative options considered in determining the preferred design that has been presented for the Scheme in the DCO application.

1. INTRODUCTION

1.1. Purpose of the Report

- 1.1.1. This Scheme Design Report (this “Report”) is submitted by Highways England (the Applicant) under section 37 of the Planning Act 2008 (“PA 2008”) to the Secretary of State for Transport via the Planning Inspectorate (the Inspectorate) for a Development Consent Order (DCO) for the A47 North Tuddenham to Easton Dualling Scheme (the “Scheme”). A detailed description of the Scheme can be found in Chapter 2 The Proposed Scheme of the Environmental Statement (ES) (**TR010038/APP/6.1**).
- 1.1.2. Highways England’s Licence¹ includes both statutory directions and statutory guidance issued by the Secretary of State, as provided for in section 6 of the Infrastructure Act 2015. Paragraph 5.26 of the Licence states “In exercising its functions, the Licence holder must have due regard to relevant principles and guidance on good design, to ensure that the development of the network takes account of geographical, environmental and socio-economic context”.
- 1.1.3. The principles of good design are also noted in *The road to good design*² and are a requirement of the Design Manual for Roads and Bridges (DMRB) standard *GG103 Introduction and general requirements for sustainable development and design*.
- 1.1.4. The aim of this Report is to provide a guide to the design decisions that informed development of a good design for the Scheme and assist those reviewing the application documentation. This report also supports the review of compliance with the design requirements of the National Policy Statement for National Networks (NPS NN) (2019), such as: paragraphs 4.28 to 4.35 that outline criteria for “good design” for national network Infrastructure; and consideration of alternatives option in light of the paragraphs 3.23 to 3.27. For further details refer to the NPS NN Accordance Tables (**TR010038/APP/7.2**).

1.2. Structure of this Document

- 1.2.1. This Report comprises 11 sections as described below:
- Executive Summary
 - Section 1 – introduces this Report
 - Section 2 – provides a high-level description of the Scheme
 - Section 3 – application of Highways England’s Design Principles
 - Sections 4 to 12 – review of specific design considerations

¹ Department for Transport (2015) Highways England Licence. Secretary of State for Transport statutory directions and guidance to the strategic highways company. [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/431389/strategic-highways-licence.pdf (last accessed August 2020).

² Highways England (2018) The road to good design (2018). [online] available at: <https://www.gov.uk/government/publications/the-road-to-good-design-highways-englands-design-vision-and-principles>

2. THE SCHEME

2.1. Scheme Location and Description

- 2.1.1. The Scheme is located between the villages of North Tuddenham and Easton, in Norfolk. It is currently a section of single carriageway forming part of the main arterial highway route connecting Norwich and Great Yarmouth to King's Lynn and then on to Peterborough, Leicester and the Midlands.
- 2.1.2. Studies have identified that this single carriageway section of the A47 no longer meets the needs of its users. It acts as a bottleneck, resulting in congestion that leads to longer journey times, and has a poor safety record.
- 2.1.3. The Scheme will upgrade the section of the A47 between North Tuddenham and Easton, west of Norwich, to a new dual carriageway running south of the existing A47 at Hockering and to the north of the existing A47 at Honingham. This will relieve congestion, reduce journey times, encourage economic growth, improve road safety and improve our customers' experience. Further details on how the Scheme meets these objectives can be found in the Case for the Scheme (**TR010038/APP/7.1**).
- 2.1.4. The layout extents are shown on the Location Plan (**TR010038/APP/2.1**) with further detail provided on the General Arrangement Plans (**TR010038/APP/2.2**). A detailed description of the Scheme is provided in Chapter 2 The Proposed Scheme of the ES (**TR010038/APP/6.1**). In summary, the Scheme comprises:
- 9km of new dual carriageway, running to the south of the existing A47 at Hockering and north of the existing A47 at Honingham
 - two new junctions where the A47 passes over the local roads: one where Berrys Lane meets Wood Lane (Wood Lane junction) and one where Blind Lane meets Taverham Road (Norwich Road junction)
 - removal of the existing roundabout at Easton to create a free-flowing road
 - building four bridges for the A47 to pass over or under: the new Mattishall Lane Link Road, the proposed Wood Lane junction, the River Tud and the proposed Norwich Road junction
 - Sandy Lane connecting to the A47 via a new side road providing access to Wood Lane junction
 - two new lay-bys on the A47, between Fox Lane and the proposed Wood Lane junction, and police observation points
 - closure to through traffic of: Church Lane (East Tuddenham), Berrys Lane, Blind Lane and Church Lane (Easton), north the of A47
 - widening of the junction of Rotten Row and Church Lane (East Tuddenham)
 - converting sections of the existing A47 for local needs, such as
 - converting to a Class B road north of Honingham, with a new cycle track between the new Dereham Road link road and Honingham roundabout

- reducing to a single lane in front of St Andrew's church, Honingham, with inclusion of passing places, parking places, turning area and security gate
- alterations to existing public rights of way and provision of new segregated routes for walkers and cyclists, including:
 - a new route for walkers and cyclists linking Honingham with St Andrew's Church below the A47 via the proposed Honingham church underpass
 - a new route for walkers and cyclists linking Easton with Lower Easton over the A47 via the proposed Easton footbridge
- new drainage systems, including:
 - new outfalls to the River Tud
 - dry culverts to maintain overland flow paths
 - new attenuation basins, with pollution control devices, to control discharges to local watercourses
- compounds, material storage areas and temporary vehicle parking located within the scheme boundary when construction is taking place
- diverting or installing new utilities infrastructure, such as a high pressure gas pipeline, electricity cables, water pipelines and electronic communications cables
- environmental measures embedded into the Scheme design to reduce the environmental effects and deliver wider benefits, such as noise barriers, low noise road surface on the A47, permanent mammal crossings and new wetland habitats
- temporary closure of access (exit and entry) to Honingham Lane at the junction with Taverham Road, Weston Road and Telegraph Hill

2.2. Scheme Objectives

2.2.1. The key objectives of the A47 North Tuddenham to Easton Dualling are:

- **Supporting economic growth:** reduce congestion related delay, improve journey time reliability and increase the overall capacity for future traffic growth to help enable regional development and growth in Norwich and its surrounding area
- **A safer and reliable network:** improve safety for all road users and those living in the local area by improving safety issues at junctions along the A47. Improve user satisfaction by quicker and more reliable journeys
- **A more free-flowing network:** increase resilience in coping with incidents such as collisions, breakdowns, maintenance and extreme weather. Support the smooth flow of traffic and improve journey times reliability by maximising the operational capability at the junctions and along the 9km carriageway
- **Improved environment:** protect the environment by minimising adverse impacts and, where possible, deliver benefits

- **An accessible and integrated network:** ensure the new road layout considers local communities and safe access to the A47. Provide a safer route between communities for cyclists, walkers, horse-riders and other vulnerable users of the network, taking into consideration how their requirements can be addressed with improved connectivity
- **Value for money:** ensure the Scheme is affordable and delivers good value for money

2.3. Geographical and Socio-economic Context

Introduction

- 2.3.1. This section summarises the geographical, environmental, socio-economic and health receptors that have the potential to be affected by the Scheme, in accordance with the criteria set out in the Design Manual for Roads and Bridges (Highways England, 2020)³.
- 2.3.2. The study areas for each topic are described in the respective chapters of the ES (**TR010038/APP/6.1**).

Air quality

- 2.3.3. There are currently no Air Quality Management Areas (AQMAs) declared in the Broadland District Council or South Norfolk Council boundaries. There is one AQMA declared in Breckland District Council, in Swaffham town centre approximately 24km west of the Scheme.
- 2.3.4. The nearest AQMA to the Scheme is the Central Norwich AQMA over 3km to the north-east, within Norwich City Centre, declared by Norwich City Council. The AQMA is not within the affected road network.
- 2.3.5. Further details can be found in ES Chapter 5 Air Quality (**TR010038/APP/6.1**).

Cultural heritage

- 2.3.6. The heritage assets located in the vicinity of the Scheme are a combination of ancient, post medieval and modern in origin with historic features including: prehistoric flint tools and flakes, Roman cropmarks, early medieval tweezers, medieval settlement, post-medieval rural land and modern industrial activities. There are no scheduled monuments, conservation areas, registered parks and gardens or historic battlefields within the DCO boundary or zone of theoretical visibility (as defined in ES Chapter 6 Cultural Heritage (**TR010038/APP/6.1**)). There are a number of listed buildings within these extents, with closest to the Scheme comprising:
- Grade I Church of St Peter, approximately 25m south of the existing A47
 - Grade II* Church of St Andrew, approximately 50m north of the existing A47

³ The Design Manual for Roads and Bridge can be viewed at:
<https://highwaysengland.co.uk/industry/design-manual-for-roads-and-bridges-dmrb/>

- Grade II Barn at Church Farm, approximately 140m north of the existing A47
- Grade II Church Farm House, approximately 100m north of the existing A47
- Grade II Berry Hall, approximately 300m to the south of the existing A47
- Grade I and Grade II buildings in the villages of Hockering and Honingham

2.3.7. Further details can be found in ES Chapter 6 Cultural Heritage (**TR010038/APP/6.1**).

Landscape and visual

2.3.8. The Scheme extents are predominantly arable land enclosed by winding lanes and hedgerows, with pockets of ancient woodland in the surrounding area and remnant heath cut through by pastoral river valleys. The broadly flat, rural landscape is an ancient countryside with a long-settled agricultural character. The eastern scheme extents are more gently undulating relative to the broadly flat landscape of the western extents. The western part of the Scheme extents lies within the Breckland District Council's landscape character assessment. The eastern extents of the Scheme coincide with the coverage of Broadland District and South Norfolk Council landscape character areas.

2.3.9. Further details can be found in ES Chapter 7 Landscape and Visual (**TR010038/APP/6.1**).

Biodiversity

2.3.10. There are valuable habitats and species of nature conservation importance within or close to the Scheme, as defined by its DCO boundary.

2.3.11. Three statutory designated sites lie within 2km of the Scheme. The River Wensum Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC) is located, at its closest, 1.6km north-east of the eastern extents of the Scheme. Paston Great Barn SAC lies 29.3km north-east of the Scheme and is designated for its barbastelle (*Barbastella barbastellus*) populations.

2.3.12. Hockering Wood SSSI lies 0.33km north of the Scheme, north-west of Hockering, and is designated for being one of the largest blocks of ancient, semi-natural woodland in Norfolk. A wide range of habitats have been identified within the DCO boundary and include, but not limited to: semi-improved natural grassland, broadleaf semi-natural woodland, hedgerows, marshy grassland and dense and scattered scrub.

2.3.13. Rosie Curston's Meadow SSSI lies 1.7km south-west of the Scheme. This is a small unimproved calcareous clay pasture grazed by cattle with a herb rich sward composed of over 60 grassland species.

2.3.14. Also within 2km of the Scheme are: 21 non-statutory designated County Wildlife Sites (CWSs) and one proposed CWS, which include a further five ancient woodlands. There are also four unnamed parcels of ancient woodland.

2.3.15. Further details can be found in ES Chapter 8 Biodiversity (**TR010038/APP/6.1**).

Geology and soils

- 2.3.16. The land around the existing A47 is predominantly agricultural the majority of which used for arable production. There are no sites designated for their geological or geomorphological importance within the Scheme DCO boundary.
- 2.3.17. Further details can be found in ES Chapter 9 Geology and Soils (TR010038/APP/6.1).

Materials and waste

- 2.3.18. The Scheme intersects part of a known sand and gravel reserve (mineral safeguarding area) designated as a mineral safeguarding area by Norfolk County Council.
- 2.3.19. Further detail is provided in ES Appendix 10.4 Mineral Impact Assessment (TR010037/APP/6.2), which also concludes it is not anticipated that any mineral safeguarding sites will be sterilised.

Noise and vibration

- 2.3.20. Sensitive receptors, such as residential properties, in proximity to the Scheme have been identified. Over 800 noise sensitive receptors have been identified within 600m of the Scheme.
- 2.3.21. 601 noise sensitive receptors were identified within the 300m of potential construction activity for the construction noise assessment. The operational noise assessment considers 1,877 noise sensitive receptors within 600m of new, physically changed road links, road bypassed by the project or 50m either side of road links.
- 2.3.22. The operational noise assessment also considers effects on: Noise Important Areas⁴ near Hockering and Easton; Hockering Wood SSSI; and the River Wensum SSSI and SAC.
- 2.3.23. Some of these receptors are located close to the existing A47 so are currently exposed to relatively high noise levels due to road traffic.
- 2.3.24. Further details can be found in ES Chapter 11 Noise and Vibration (TR010038/APP/6.1).

Population and human health

- 2.3.25. Across the Broadland district the population was estimated to be 129,464 in 2011, across Breckland it was estimated to be 130,491 and across South Norfolk it was estimated to be 124,012 (Census, 2011).

⁴ Areas identified by the Government in the below DEFRA website for action to control noise levels:
<https://data.gov.uk/dataset/fc786717-3756-4fd1-9c7d-c082331e40e4/noise-action-planning-important-areas-round-2-england>

- 2.3.26. The area is of relative affluence and high employment. There are proportionally more economically active people in Broadland (87%), Breckland (85%), South Norfolk (85%) and Norfolk (78%) than in England (77%). It also shows that employment is higher in Broadland (83%), South Norfolk (84%) and Norfolk (78%), compared to across England (77%)⁵.
- 2.3.27. Broadland is primarily an agricultural area with interspersed residential housing, community and commercial facilities.
- 2.3.28. Hockering, Honingham and Easton are the main population centres within 500m of the DCO boundary and are connected by the existing A47. Norwich is the nearest city to the east, connected by the existing A47. The villages contain primary schools, garages, churches, public houses and a small number of commercial and retail businesses.
- 2.3.29. The existing A47 provides a connection for people, places, businesses and enables access to employment, healthcare, education and other community assets. Walking, cycling and horse riding facilities are also located within the Scheme extents.
- 2.3.30. The Greater Norwich Local Plan is currently being produced collaboratively between Broadland, Breckland and South Norfolk District Councils. The plan outlines proposals for housing and employment growth in the Greater Norwich area. There is an area of allocated housing growth (Policy EAS1) located within Easton and the DCO boundary. It is allocated for 890 new dwellings, a new school, a new village hall, a retail store, areas of public open space, and the relocation and increased capacity of allotments. The land within the DCO boundary lies east of St Peter's Church and is not allocated for housing allocation requirements.
- 2.3.31. Further details can be found in Chapter 12 Population and Human Health of the ES (TR010038/APP/6.1).

Road drainage and the water environment

- 2.3.32. The main water features within the Scheme are within the River Tud catchment. The Scheme crosses the River Tud at one location to the east of Honingham and a tributary of the River Tud south-east of Hockering. There are smaller drainage channels and isolated ponds within the DCO boundary.
- 2.3.33. A small proportion of the Scheme is within the Environment Agency defined Flood Zone 2, associated with medium risk of flooding from rivers, and Flood Zone 3, which is associated with high risk of flooding from rivers.
- 2.3.34. The key groundwater receptors include Secondary superficial aquifers and the Chalk principal aquifer. The Scheme crosses Environment Agency designated source protection zones (SPZs) for public water supplies: an SPZ 3 (outer zone) between Honingham and Easton; and a new SPZ 1 (inner zone) east of Hockering.

⁵ Norfolk Insight, Economy and Employment Area Reports: <https://www.norfolkinsight.org.uk/economy-and-employment/reports/>

- 2.3.35. Further details can be found in ES Chapter 13 Road Drainage and the Water Environment (**TR010038/APP/6.1**).

Climate

- 2.3.36. The Climate Change Act 2008 is central to the UK Government's plan to reduce carbon emissions, committing the UK to a reduction of 80% against 1990 levels by 2050. On 1 May 2019, the UK Government declared a climate emergency, leading to updating the commitments in the 2008 Act to target net zero carbon emissions by 2050 under the Climate Change Act (2050 Target Amendment) Order 2019.
- 2.3.37. Climate change adaptation requires more than just managing carbon emissions. Therefore, ES Chapter 14 Climate (**TR010038/APP/6.1**) assesses the various impacts on climate change and associated mitigation measures from the Scheme.

3. DESIGN PRINCIPLES

3.1. Introduction

3.1.1. Following the first *Road Investment Strategy (RIS1) 2015/16 to 2019/20* published in March 2015, the second *Road Investment Strategy 2020 to 2025*⁶ (RIS2) published in March 2020 sets a long-term strategic vision for the network by:

- specifying the performance standards Highways England must meet
- listing planned enhancement Schemes expected to be built
- stating the funding made available during the second Road Period (RP2), covering the financial years 2020-21 to 2024-25

3.1.2. Ensuring this strategic vision is at the centre of the development and delivery of road schemes requires a design led culture to be developed by Highways England and our project teams. Highways England's *The Road to Good Design* (2018)⁷ and DMRB *GG103 Good road design* identify ten principles of good design have applied to the Scheme. Good road design:

- is safe and useful
- is inclusive
- is understandable
- fits in context
- is restrained
- is thorough
- is sustainable
- is innovative
- is long lasting
- is a collaborative process

3.1.3. Each of the above ten design principles along with an objective to reduce carbon emissions have been considered in developing the Scheme design, as set out below.

⁶ Department for Transport (2020) *Road Investment Strategy 2: 2020 - 2025* [online] available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872252/road-investment-strategy-2-2020-2025.pdf (accessed August 2020)

⁷ Highways England (2018) *The road to good design* (2018). [online] available at: <https://www.gov.uk/government/publications/the-road-to-good-design-highways-englands-design-vision-and-principles>

3.2. Good Road Design Makes Roads Safe and Useful

3.2.1. The Scheme will be useful in that it will support economic growth within Norfolk. The surrounding cities of Norwich, Cambridge and Peterborough are rapidly growing, placing further pressure on the network, which already faces high congestion during peak hours. The Scheme will decrease journey time reliability issues and improve safety issues due to the removal of direct accesses onto the A47, reducing accident-related delays.

Junction design

3.2.2. Upgrading the single carriageway along the A47 to a dual carriageway as part of the Scheme would have a significant improvement on the overall operational safety of the road. Previous studies along this section have determined that it is operating over capacity, experiences congestion and has a poor safety record.

3.2.3. Safety and traffic modelling techniques have been utilised to understand the safety implications of various junction options, whilst ensuring the junctions provide connections that are as useful as possible for local traffic. Two new junctions, separated from the main A47 dual carriageway, will be provided along the layout:

- Wood Lane junction
- Norwich Road junction

3.2.4. Both junctions utilise merge (on slip road) and diverge (off slip road) arrangements. This provides a safe means for traffic to leave or join the new A47 and minimises disruption to the flow of traffic.

A47 direct access removal

3.2.5. The existing A47 has many side roads and accesses connecting directly to the A47 carriageway, which have presented safety risks with traffic moving fast on the A47 versus slow vehicles exiting onto or turning into the junctions. The Scheme has developed a network of new and existing side roads to maintain access to the A47 for properties along the North Tuddenham to Easton corridor via the new junctions, thereby avoiding direct access safety risks.

Walking, cycling and horse riding safety

3.2.6. The Scheme incorporates safer access for walkers, cyclists and horse riders (WCH) and includes four segregated crossing points along the A47 route at:

- Mattishall underbridge
- Hall Farm underbridge
- Honingham church underpass
- Easton footbridge

- 3.2.7. Where required, the cycle tracks will be segregated from agricultural machinery in the adjacent fields with landscaping and fencing to deter interaction of cycle track users and farm machinery and animals.
- 3.2.8. The proposed WCH changes and new routes are presented in Chapter 4 of the Case for the Scheme (**TR010038/APP/7.1**) and shown on the Rights of Way and Access Plans (**TR010038/APP/2.5**).

3.3. Good Road Design is Inclusive

- 3.3.1. Document GG 142 of the DMRB sets out the walking, cycling and horse-riding assessment and review (WCHAR) process for highway schemes on motorways and all-purpose trunk roads. A WCHAR process has been undertaken as part of the Scheme. The assessment is presented in ES Chapter 12 Population and Human Health (**TR010038/APP/6.1**) and identifies the impacts of altering a public right of way and creating a new routes to improve safety for walkers and cyclists.
- 3.3.2. The Scheme design incorporates new cycle tracks to improve access for walkers and cyclists crossing the A47 or travelling between North Tuddenham and Easton. This will encourage more active travel as part of a wider network of walking, cycling and horse-riding (WCH) routes connecting to local amenities, such as St Andrew's Church. This also supports the requirements of NPS NN paragraphs 3.17 to 3.20 (sustainable transport) and 3.21 to 3.22 (accessibility).
- 3.3.3. Consultation has been undertaken with local stakeholders to ensure the design of active travel routes are inclusive and meet local community and disabled user needs. The design also needed to mitigate severance of existing rights of way by the new A47 alignment, whilst also seeking opportunities to enhance connectivity across the network and provide a safer route. When deciding on the location of the Honingham church underpass and associated WCH route, consultation was carried out with the parish council and Local Liaison Group to determine a suitable location.

3.4. Good Road Design is Understandable

Junction design

- 3.4.1. Throughout the design process, several proposed design elements have been considered and incorporated into the design of the junctions to make them more understandable for road users. Examples of these include:
- The new A47 mainline between North Tuddenham and Easton will provide a continuous dual carriageway between Dereham and Acle. This will provide a free flowing link where road users will know that the road layout ahead does not change between dual and single carriageway layout. Continuity helps road users to plan ahead and avoid making last minute manoeuvres. Further, road safety is improved through inclusion of overtaking opportunities and reduced driver frustration.

- Both the Wood Lane and Norwich Road junctions are fully grade separated from the main dual carriageway with merge (on) and diverge (off) slip roads, to current design standards, on all entry and exit points to and from the new A47 mainline. This enables road users joining the mainline from the adjacent local road network to match the speed of the mainline traffic before joining, maintaining a freer flowing corridor. Similarly, road users exiting onto the local road network can leave the mainline before having to reduce their speed, again helping to maintain a freer flowing corridor.
- The layout of the dumbbell roundabouts at the Wood Lane and Norwich Road junctions is consistent with the existing Longwater and Watton Road junctions further east providing continuity of approach and layout.

Place direction signs in wider rural road network

- 3.4.2. A drive through of the surrounding rural road network identified road signs directing drivers along rural roads leading to junctions that will be closed by the Scheme (e.g. a sign in Ringland pointing towards Easton via Church Lane). By identifying these signs for change as part of the Scheme users of the rural road network are directed towards the new relevant junctions.
- 3.4.3. Redundant signage on de-trunked sections of the existing A47 will also be removed and 'no through road' signs will be installed to advise road users where local roads have been stopped up.

De-trunking sections of the existing A47 becoming side roads

- 3.4.4. De-trunking the existing A47 where not part of the new dual carriageway will provide separation of local and regional access. This would provide clarity to drivers that the new A47 dual carriageway is a higher speed road.
- 3.4.5. The existing A47 at Honingham will have a reduced cross section to convert it to a Class B (6m) road classification. This would also facilitate construction of a new cycle track between and the new Dereham Road link road and Honingham roundabout.
- 3.4.6. The other de-trunked sections of the A47 will have either: speed limits reduced to 50mph to improve the safety and deter people from using the local roads as rat runs; or be replaced with landscape planting.

3.5. Good Road Design Fits in Context

- 3.5.1. The A47 highway corridor between North Tuddenham and Easton is located within a largely rural landscape characterised by agricultural land use and dispersed settlement. Physical features in the immediate vicinity of the existing A47 corridor which contribute to the landscape character of the wider area include agricultural fields enclosed by hedgerows with mature trees and small areas of woodland. Two Listed Buildings (St Andrew's Church and St Peter's Church) are located adjacent to the existing A47 so would be at risk of impacts upon their setting by the Scheme.

- 3.5.2. The landscape design sought to integrate the Scheme with the surrounding landscape character, minimise visual intrusion and minimise impacts on the settings of the Listed Buildings. For example, following statutory consultation, Norwich Road junction was moved 150m away from St Andrew's Church to reduce the intrusion on its setting and allow a retaining wall to be replaced by a landscaped earth bank.
- 3.5.3. The landscape design objectives include retaining notable extents of existing planting and proposing new planting to replicate existing features and establish visual screening. The environmental mitigation strategy also seeks to reinstate landscape features lost as a result of the Scheme, such as hedgerow boundaries and plantation woodland, and enhance the landscape context wherever possible.
- 3.5.4. Section 8 of this Report provides more detail on the development of the landscape design.

3.6. Good Road Design is Restrained

- 3.6.1. Sections 4, 5 and 6 of this Report outline the considerations applied during the design of the junctions, side roads and structures forming the Scheme to minimise the potential impact on existing infrastructure and the environment. The following are other examples of a restrained design.

Offline route

- 3.6.2. The new A47 will be predominantly offline to the existing A47, therefore enabling the use of the existing A47 during construction to minimise disruption to road users.
- 3.6.3. The visual impact of the existing A47 to local residents and disruption to biodiversity within the vicinity of the existing A47 will also be reduced. Local residents will be able to continue to access local amenities as per pre-construction. Of particular note, the offline Scheme alignment would:
- reduce the impact, at the western end, on Oak Farm
 - minimise, where possible, the impact on properties close to the existing A47 at Hockering
 - reduce the impact of the road on the River Tud
 - keep the road widening to the north side of the corridor as it passes Honingham
 - keep the route to the north by the existing junction at Easton to maximise the chance of the local road reconnection being alongside and to the north of St Peter's Church at Easton

Central reserve paving

- 3.6.4. The mainline central reserve will be a 'soft' central reserve, therefore making use of materials that will better blend in with the surrounding rural character than would be achieved with a paved central reserve.

Remote shared cycleways

- 3.6.5. Shared use footpaths and cycleways located west of St Andrew's Church and between Taverham Road and Church Lane (Easton) will be constructed using unbound materials and a timber edge rather than asphalt construction with a precast concrete kerb edge. This will help these paths sit better in the surrounding landscape and blend in with the rural character, enhancing the overall experience for users.

Wetland basins

- 3.6.6. The drainage strategy includes use of drainage basins that can help enhance the surrounding landscape. Two of these basins, east of Church Lane in East Tuddenham and south of the River Tud Crossing, would be developed into wetland habitats. These basins are typically shallower than other types of drainage basin meaning they can blend into the surrounding landscape and look less engineered in appearance. They can also offer improved biodiversity and amenity potential.

3.7. Good Road Design is Thorough

- 3.7.1. This design process has included teams of professionals from a wide range of disciplines including engineers, environmentalists, traffic modellers, contractors and legal advisors. This team of professionals have undertaken a collaborative and iterative design process to explore innovative approaches to be included within the Scheme. This has enabled flexibility to incorporate changes into the design, following the findings of surveys, the environmental assessment, consultation and design reviews, to achieve betterment in the design. For example, the River Tud design involved the environmental impact assessment (EIA) team working collaboratively with the design and construction teams. The team managed conflicting challenges of design and cost (small span preferred) versus the need to manage the risk posed by works in a main river floodplain. The team also accommodated Environment Agency expectations, Water Framework Directive needs, protecting water vole habitat and provision of a new WCH crossing of the A47. These discussions lead to thorough design decisions, such as setting the abutments for the River Tud Crossing at least 5m from the channel top-of-bank and avoiding undertaking any construction activities within 5m from the channel top-of-bank.
- 3.7.2. In addition to statutory consultation with stakeholders and the public, on-going technical meetings were undertaken with a wide range of external consultees, such as the Norfolk County Council, Breckland Council, Broadland District Council and South Norfolk Council, parish councils and statutory environmental bodies. For example, the Applicant consulted with the Environment Agency, Natural England and Historic England on the scope and approach of the EIA, assessment findings and proposed mitigation measures.
- 3.7.3. Norfolk Constabulary has been consulted on the design and subsequent changes since statutory consultation, such as provision of police observation points. The risk of crime was also considered as part of the Scheme design, which has sought to avoid creating areas that may attract crime or anti-social behaviours.

- 3.7.4. Further information regarding these consultations are recorded in the Consultation Report (**TR010038/APP/ 5.1**) and ES (**TR010038/APP/6.1**) for the Scheme.
- 3.7.5. Throughout the design process, options were developed and screened to identify preferred solutions based on a comparison of the options performance against safety, environmental, engineering, transportation and economic criteria. This process was supplemented by feedback from consultation with stakeholders and the public. Further details on how the consideration of alternative route options before determining the preferred route can be found in the Case for the Scheme (**TR010038/APP/7.1**).
- 3.7.6. Sections 4 to 6 of this Report outline how options were considered when assessing the design and build options for each main structure.

3.8. Good Road Design is Environmentally Sustainable

- 3.8.1. As part of the EIA and in accordance with NPS NN paragraph 3.2 (environment and social impacts), the design has been influenced through embedding environmental mitigation and enhancement measures into it as early as possible by:
- avoiding environmental constraints where possible, such as nature conservation sites and Listed Buildings
 - improving biodiversity where possible, such as with the introduction of species-rich and marshy, wet grassland
 - reducing adverse effects, such as mitigating increases in noise levels through the use of noise barriers and low noise asphalt
 - maximising opportunities, with new WCH routes to connect communities and habitat creation through careful planting design
- 3.8.2. ES Chapter 14 Climate (**TR010038/APP/6.1**) also discusses how the Scheme considered and manages its effects on the climate (i.e. carbon emissions) and potential vulnerability to climate change (i.e. resilience to projected climate changes). This supports the requirements of NPS NN paragraphs 4.38 to 4.46 (climate change adaptation) and 5.17 – 5.19 (carbon emissions).
- 3.8.3. For more detail on environmental mitigation refer to the ES (**TR010038/APP/6.1**).

3.9. Good Road Design is Innovative

- 3.9.1. Several innovative additions have been incorporated into the design which provide environmental benefits, such as:
- Providing safe mammal crossing points and protect flight and foraging routes of bats.
 - Copses of trees and woodland grassland mosaics are proposed along the scheme to act as 'stepping stones' between suitable roosting and foraging habitat.

- Hop-overs and targeted planting at underpasses and overpasses have been designed to encourage use by bats to maintain connectivity and raise flight height above the carriageway. For example, the River Tud crossing has a low headroom, so bats currently flying over the road will be encouraged to fly high above traffic by planting high trees and fencing along the bridge.

3.9.2. For more detail on environmental mitigation refer to the ES (**TR010038/APP/6.1**).

3.10. Good Road Design is Long Lasting

Maintenance requirements

- 3.10.1. Suitable maintenance facilities have been located along the route of the Scheme to make sure the interaction between maintenance vehicles and fast-moving traffic is minimised. This would enable personnel undertaking inspection activities to spend as little time in the vicinity of fast-moving traffic as possible. Two new lay-bys, located south of Hockering on each carriageway of the new A47 mainline, shall also serve as maintenance access for highways assets. Two maintenance hardstandings shall be located on the eastbound carriageway to provide maintenance operatives with a dedicated point to leave the mainline safely.
- 3.10.2. A dedicated maintenance hardstanding shall also be provided at each of the four junction roundabouts to provide access to infrastructure, including lighting and traffic signs. These locations should facilitate regular inspection and maintenance ensuring the assets are well maintained throughout the course of their operational life.
- 3.10.3. The design also includes a steel central reservation barrier with a soft verge instead of hard concrete barrier with a hardened verge. Creation of a soft verge offers biodiversity and drainage benefits, but measures such as slow and low growing grass will be used to reduce the frequency of grassland maintenance on a live central highway reservation. Lighting luminaires at the junctions will be designed to reduce lighting spread and use light emitting diodes (LED) luminaries to reduce the maintenance and replacement cycles.
- 3.10.4. Section 8 of this Report outlines how the landscape design is based on a planting strategy that is resilient and able to adapt to future needs while accommodating standard highway practices for long term operational maintenance and management.

Structures

- 3.10.5. All structures have been designed with due regard to the long-term maintenance requirements and in accordance with DMRB *CD350 The design of highway structures*. All structures have been designed to a design life of 120 years.
- 3.10.6. The structures have been designed as either integral bridges or boxes thereby removing the requirements for articulated bearings. This improves the durability of the structure and reduces maintenance requirements over the life of the structure. Seven new structures and one new culvert will be constructed as part of the Scheme. These structures and their associated materials are as follows, and shown on the General Arrangement Plans (**TR010038/AP/2.2**):

- Mattishall Lane Link Road underbridge - a precast reinforced concrete jointed portal solution with an in-situ base slab forming a box
- Wood Lane junction underbridge - a pre-stressed concrete beam bridge integral with reinforced concrete abutments
- Hall Farm underbridge - a precast reinforced concrete box
- River Tud crossing - a composite steel girder bridge integral with an in-situ reinforced concrete diaphragm supported on box sheet piles
- Honingham church underpass - a precast box
- Norwich Road junction underbridge - a pre-stressed concrete beam bridge integral with a reinforced concrete diaphragm supported on contiguous bored pile abutments
- Easton footbridge - a composite steel girder footbridge integral with reinforced concrete bankseat abutments supported on reinforced earth embankments

3.10.7. In Sections 6 of this Report outline how options were considered when assessing the design and build options for each of these structures.

Fencing, safety barriers and signage

3.10.8. Fencing will be provided at the highway boundary for safety and security. With the exception of where alternatives have been agreed with neighbouring landowners or a noise barrier has been specified for environmental mitigation, timber post and rail fence will be provided in accordance with Manual of Contract Documents for Highway Works standard details.

3.11. Good Road Design is a Collaborative Process

3.11.1. The Applicant has encouraged an open dialogue with stakeholders across all stages of the development of Scheme. This has allowed the Applicant to capture feedback on the different options proposed to inform decision-making on the most viable option. Key stakeholders throughout the process have included statutory environmental bodies, Norfolk County Council, Breckland Council, Broadland District Council and South Norfolk Council and the parish councils.

3.11.2. The Applicant has also undertaken route options and statutory Scheme design consultation with the local community and other interested organisations. This has included meetings with landowners, public consultation events and facilitating engagement with user groups.

3.11.3. The Applicant has used the feedback from the route options and statutory consultations to inform the Scheme design. This has enabled the Scheme to be designed to meet the needs of road users and local communities, such as changes to the proposed side road network post statutory consultation.

3.11.4. Further information on the consultation process and responses to feedback can be found in the Consultation Report (**TR010038/APP/5.1**).

3.12. Design Amendments to Reduce Carbon

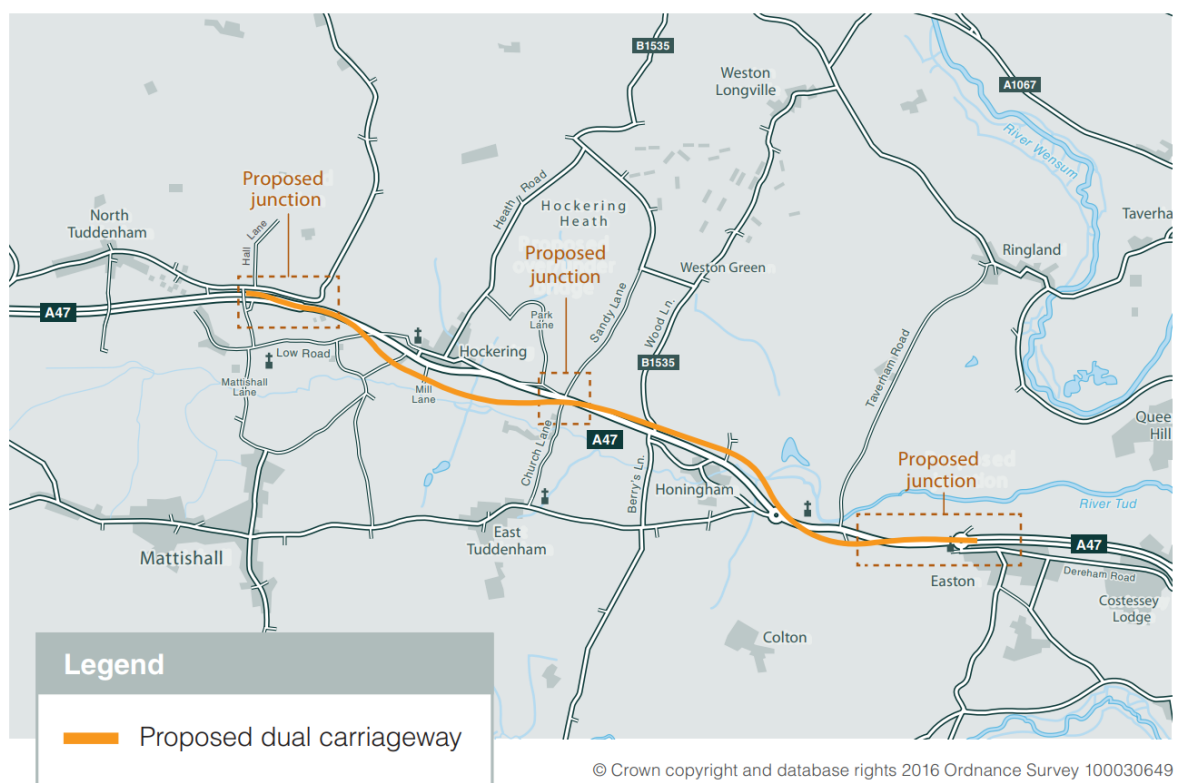
- 3.12.1. In accordance with the *DMRB LA 114 Climate* guidance document, the Applicant sought to minimise carbon emissions as far as possible in order to contribute to the UK's net reduction in carbon emissions. This approach also supports the requirements of NPS NN paragraphs 4.38 to 4.46 (climate change adaptation) and 5.17 – 5.19 (carbon emissions).
- 3.12.2. A hierarchical approach to carbon management has been applied, which applies the principles of build nothing, build less, build clever, build efficiently (as described in PAS 2080: Carbon Management in Infrastructure).
- 3.12.3. Carbon emissions for the Scheme have been calculated for the Scheme design using the Highways England Carbon Tool (version 2.3). This has allowed for the consideration of carbon in the design process, resulting in the development of a carbon baseline from which further reductions may be made.
- 3.12.4. The use of the Highways England Carbon Tool to monitor and manage carbon will continue throughout the construction period to ensure an ongoing focus on climate change mitigation. This will support Highways England requirements to meet their key performance indicator "Carbon dioxide equivalents (or CO₂e) in tonnes associated with the Supply Chain's activities" (Highways England 2019).
- 3.12.5. Further information on the assessment of carbon emissions and the impact of the Scheme on or by climate change is presented in ES Chapter 14 Climate (**TR010038/APP/6.1**).

4. JUNCTION DESIGN

4.1. Overview

- 4.1.1. The existing single carriageway along the A47 between North Tuddenham and Easton has numerous junctions with major and minor local roads, plus direct accesses from farms and properties.
- 4.1.2. The majority of the proposed dualling of the A47 is offline with the existing route retained as a parallel local link road so the majority of junctions can be retained to provide local access to other link roads. However, there is a requirement for access from the local area onto the proposed dualling of the A47.
- 4.1.3. The Preferred Route Announcement⁸, in 2017, identified three proposed junctions along the route; see Figure 4-1 below. Since that time, the junction locations were refined whilst taking account of the existing network junction locations and existing constraints.
- 4.1.4. The design of the link roads is discussed in Section 5 of this report.

Figure 4-1 : Preferred route and indicative junction locations, August 2017.



⁸ Highways England (2017) *Preferred Route Announcement A47 North Tuddenham to Easton* [on-line] Available at: <https://highwaysengland.citizenspace.com/he/a47-north-tuddenham-to-easton-dualling/results/s170173-a47-preferred-route-announcement-leaflet---tuddenham--b.pdf> (accessed December 2020).

- 4.1.5. At the western end of the preferred route for the proposed dual carriageway lies the existing A47 junction with Fox Lane; known as Fox Lane junction. Operational traffic modelling and safety assessments confirmed Fox Lane junction required no further improvements as part of the Scheme.
- 4.1.6. Meanwhile, existing constraints adjacent to the Easton roundabout, such as the Grade II* listed St Peter's Church, residential properties, Ørsted cable route, Food Enterprise Zone development and PRA commitment, informed the decision to locate the Scheme's eastern junction where the existing A47 meets Taverham Road and Blind Lane.
- 4.1.7. Therefore, the Scheme contains two new junctions onto the proposed A47 from the local roads:
- Wood Lane junction, at the existing A47 junction with Wood Lane and Blind Lane (and including a future connection to the Norwich Western Link).
 - Norwich Road junction, at the existing A47 junction with Taverham Road and Blind Lane.
- 4.1.8. These two proposed new junctions were presented at statutory consultation along with the *A47 North Tuddenham to Easton Junction & Sideroad Strategy Report*⁹ (Highways England, 2020). This report describes the existing and modelled operation of the existing junctions at the Norwich Road and the Wood Lane intersections with the A47. It also explains the need for fully graded separated options at these locations to supports our aim to create a more free-flowing, safe and serviceable, integrated network. The selection of the final preferred design of these junctions is summarised below.

4.2. Wood Lane Junction

- 4.2.1. The junction serves as an important link for people and communities using community facilities in Hockering and Honingham.
- 4.2.2. The initial junction design concept proposed a new roundabout located north-west of Honingham with connections to Wood Lane to the north and Berrys Lane to the south. This junction included the option of providing a future connection for the Norwich Western Link road scheme.
- 4.2.3. Traffic analysis of an 'at grade' roundabout, integrated with the A47 mainline, indicated that during afternoon (PM) peak hours several arms of the roundabout would be operating over the target capacity (85%) leading to unacceptable delays.
- 4.2.4. Analysis of the turning movements at this junction also indicated that the majority of traffic flow would be straight through traffic. Therefore, given the results of the traffic modelling it was determined that an 'at grade' roundabout was not suitable.

⁹ This report is available amongst the Consultation 2020 documents at: <https://highwaysengland.co.uk/our-work/east/a47-north-tuddenham-to-easton-improvement/>

- 4.2.5. Further modelling was undertaken to examine the functionality of the junctions at this location. This showed that if the Scheme was built, the mainline traffic figures for the annual average daily traffic (AADT) would be in the order of 45,000 in 2040 and 4,000 AADT for side roads. Safety design parameters in the Department for Transport's, Design Manual for Roads & Bridges (DMRB) states: 'Compact grade separated junctions should not be used on dual and single carriageway roads when mainline flows are above 30,000 AADT.'
- 4.2.6. Therefore, the design of the Wood Lane junction was developed as a full grade separation layout, where the junction is separated from the mainline dual carriageway and connected via slip roads.
- 4.2.7. Statutory consultation responses, including feedback from local stakeholders, parish councils and Members of Parliament, highlighted concerns that a direct connection between Wood Lane and Berrys Lane may provide a north-south rat run. For the same reason, statutory consultation raised concerns about a proposed side road connection to Church Lane, East Tuddenham, from Wood Lane junction.
- 4.2.8. Subsequently the final Scheme design removed both these side road connections and retained more of the existing A47 to provide a direct side road link from the southern roundabout of Wood Land junction to Honingham roundabout, where users could then travel south via Mattishall Road.
- 4.2.9. The final junction design also took into consideration various constraints, such as:
- the landscape setting of the Grade II listed Berrys Hall to the south-west
 - the presence of a high pressure gas pipeline crossing the existing A47
 - the need to retain access to Honingham via Dereham Road
 - the need to maintain walker and cyclist connection between Berrys Lane and Honingham
- 4.2.10. The final layout of Wood Lane junction is presented on the General Arrangement Plans (**TR010038/APP/2.2**).

4.3. Norwich Road Junction

- 4.3.1. With the removal of the Easton roundabout, there is a need for an A47 junction between Hockering and Easton.
- 4.3.2. The initial design concept proposed for the Norwich Road junction was a new at grade roundabout located adjacent to the Honingham roundabout, connecting the existing A47 with Norwich Road. There would be connections to Norwich Road to Honingham and Mattishall in the west and to a new diversion route leading to Church Lane (Easton) to the east.
- 4.3.3. Traffic analysis of the at grade roundabout option indicated that at morning (AM) peak hours several arms of the roundabout would be operating over the target capacity (85%), leading to unacceptable delays. Analysis of the turning movements at this junction indicated that the majority of traffic flow would be straight through traffic.

- 4.3.4. Given the above results of the traffic modelling it was determined that an at grade roundabout was not suitable.
- 4.3.5. Further modelling was undertaken to examine the functionality of the compact grade separation junctions at this location. This showed that mainline AADT traffic figures would be in the order of 45,000 in 2040 and 7,000 AADT for side roads. As stated in Section 4.2 above, compact grade separated junctions should not be used on dual and single carriageway roads when mainline flows are above 30,000 AADT.
- 4.3.6. Therefore, the design of the Norwich Road junction was developed as a full grade separation layout. The design also sought to minimise agricultural landtake within the constraints of the River Tud to the north and local plan designated development land for the Food Enterprise Zone to the south.
- 4.3.7. In response to statutory consultation feedback, the junction design was amended to remove the northern side road connection between Taverham Road and Church Lane (Easton), providing benefits of a reduced landtake.
- 4.3.8. Statutory consultation responses, including from Historic England, also highlighted concerns about the proximity of the new A47 to the Grade II* listed St Andrew's Church and inclusion of a retaining wall. Subsequently the final Scheme design moved the A47 150m away from the church and provided a landscape earth bund to reduce any harm to the setting impacts.
- 4.3.9. The final layout of Norwich Road junction is presented on the General Arrangement Plans (**TR010038/APP/2.2**).

5. SIDE ROAD DESIGN

5.1. Overview

- 5.1.1. The existing single carriageway A47 has 41 direct connections from existing side roads, farm, field and property accesses between North Tuddenham and Easton.
- 5.1.2. In order to meet the objective of creating a more free-flowing and safe A47 there will be no direct connections to the dualled A47 in the Scheme. Access will be solely via the junctions detailed in Section 4 above.
- 5.1.3. Therefore, a side road network has been developed to create a parallel local link road network between North Tuddenham and Easton by utilising the existing A47 carriageway or constructing new single carriageway roads. Existing side roads severed by the proposed A47 dual carriageway would be connected to the new link roads and the existing local road network.
- 5.1.4. The layout of the side road networks and connections to the junctions is presented on the General Arrangement Plans (**TR010038/APP/2.2**).
- 5.1.5. A summary of how the side roads have been integrated into the Scheme is presented below.

5.2. Existing A47 De-trunking

- 5.2.1. Where a road or route is no longer to be part of the strategic road network, also referred to as the trunk road network, it will be de-trunked and works may be completed to separate it from the trunk road network or to tie it in to the local road network. These works are described as 'de-trunking' works. Once a road has been de-trunked, it will be maintained by the local highway authority instead of Highways England.
- 5.2.2. In line with the preferred route, the work to the current route of the existing A47 has been designed to retain as much of the existing highway within the local road networks to minimise disruption, retain access where possible and to provide value for money.
- 5.2.3. The existing A47 at Honingham will have a reduced cross section to convert it to a Class B (6m) road classification, which will also facilitate the inclusion of a new WCH route and implement a 50mph speed restriction. Where existing sections of A47 cannot be reused, these will be landscaped.

5.3. Fox Lane

- 5.3.1. Fox Lane is located at the western extent of the proposed project and has an existing T-junction onto the A47 from the south. There is also an overbridge at Fox Lane which crosses over the A47 to join the B1147, a local distributor road north of the A47.
- 5.3.2. The existing Fox Lane junction and overbridge are to be retained, as explained in Section 4.1 above.

5.4. Low Road

- 5.4.1. The existing Low Road forms a T-junction onto the existing A47 from the south. The alignment of the proposed A47 dual carriageway severs Low Road, south of the existing A47. Though Low Road provides access to the A47 and the village of Hockering for properties south-west of the new A47 alignment, alternative routes for these properties would be available via Fox Lane junction and the new Mattishall Lane Link Road.
- 5.4.2. Therefore, the section of Low Road retained between the existing and proposed A47 would serve no properties. Therefore, it would be amended to provide agricultural field access only off the retained A47.
- 5.4.3. East of the existing A47 junction with Low Road is a side road connection between the A47 and St Michael's Church and land north-west of Hockering. This connection to the existing A47 would be altered to WCH access only, as an alternative existing A47 junction with Hockering lies 500m to the east, west of Hockering.
- 5.4.4. Between the new A47 mainline and junction of Low Road and Lyng Lane, Low Road would be shortened to retain access to a single residential property and the agricultural fields. The remainder of Low Road between the new A47 mainline and retained section would be landscaped, with the road surface removed.

5.5. Mattishall Lane

- 5.5.1. The existing Mattishall Lane forms a T-junction onto the existing A47 from the south. The route of the proposed A47 dual carriageway severs Mattishall Lane and access from the south to the existing A47 junction.
- 5.5.2. However, statutory consultation feedback highlighted the existing importance of a connection between Hockering and Mattishall via Mattishall Lane. The original A47 dualling proposal had removed access via both Mattishall Lane and Low Lane, as alternate access was available at Fox Lane junction to the west. In response to statutory consultation feedback, it was decided to provide a new link between the villages of Hockering and Mattishall via a highway underbridge beneath the A47.
- 5.5.3. The possibility of an overbridge was investigated, but to provide the minimum clearance and structural depth over the A47 the gradient along the overbridge would exceed 10%, which not be compatible with the UK Design Manual for Roads & Bridges (DMRB) safety design standards.
- 5.5.4. Two locations were considered for an underbridge: one at Mattishall Lane and the other at Low Road. The Low Road option was discounted as an underbridge as this would connect to existing sub-standard routes that would require upgrades to the wider highway network. The additional cost associated with these upgrades were outwith the project budget.
- 5.5.5. The design of the underbridge has been influenced by environmental considerations, such as minimising the length of the new link road. The underbridge has also been designed to be suitable for walkers and cyclists.

5.6. Mill Lane

- 5.6.1. The existing Mill Lane junction forms a T-junction with the existing A47 from the south. This section of the existing A47 will be retained as part of the local road network.
- 5.6.2. The section of Mill Lane that falls between the existing and proposed A47 routes does not serve any residential properties but will continue to provide access from the existing A47 to agricultural fields north of the new A47 alignment.
- 5.6.3. Access to the A47 from Mill Lane for a timber yard and agricultural land south of the new A47 mainline will be severed. In the future, access for the timber yard to the wider highway network would be via a shared access track that connects a proposed drainage basin to Mattishall Lane.

5.7. Gypsy Lane

- 5.7.1. Gypsy Lane currently forms a T-junction onto the existing A47 from the south. This section of the existing A47 will be retained as part of the local road network, thereby maintaining access for the properties that fall between the existing and proposed A47 routes.
- 5.7.2. Access to the land parcels south of the new A47 alignment will be severed, but an alternative connection would be provided via options to create a new access point onto Trap's Lane to the east or Mattishall Lane to the west. The final details of the new access between the affected land parcels would be subject to final arrangements as part of on-going land acquisition and landowner negotiations.

5.8. Church Lane, East Tuddenham

- 5.8.1. Church Lane currently forms a T-junction onto the existing A47 from the south. The new alignment of the A47 severs Church Lane, south of the existing A47.
- 5.8.2. Under the Scheme this section of the existing A47 would be retained as part of the local road network. The section of Church Lane that falls between the existing and proposed A47 routes does not serve any properties, but the existing access to agricultural land between the existing and proposed A47 routes would be retained.
- 5.8.3. The severance of Church Lane affects a number of properties and a short link road was proposed between Church Lane and the Wood Lane junction to minimise the increased travel distance to Hockering and Honingham.
- 5.8.4. However, statutory consultation feedback from affected local residents requested the removal of the link road due to concerns about traffic using Church Lane as a short-cut. Therefore, the link road was removed, leaving only the existing Church Lane access from the Mattishall Road in the south.
- 5.8.5. It was subsequently identified that articulated vehicles access Riverside Farm via Church Lane from the north. Therefore, the Scheme includes for widening the south-west corner of the Church Lane and Rotten Row junction to cater for articulated vehicles needing to access Rotten Row from the south.

5.9. Dereham Road and Berrys Lane

- 5.9.1. The existing west end of Dereham Road, in Honingham, forms a junction with Berrys Lane just south of the existing A47, where Berrys Lane has a T-junction direct onto the existing A47.
- 5.9.2. In order to connect Dereham Road to the Wood Lane junction, Dereham Road was originally proposed to be realigned to join the southern roundabout of the proposed new Wood Land junction. Berrys Lane would form a new T-junction with the realigned Dereham Road.
- 5.9.3. However, as outlined in Section 4.2 above, statutory consultation feedback led to the removal of a northern link to Berrys Lane, meaning residents along Berrys Lane would use the southern access via Mattishall Road. A new cycle track between Berrys Lane and Dereham Road would maintain direct active traveller access to Honingham.
- 5.9.4. The statutory consultation also raised concerns about increased traffic through the village of Honingham, so the final Scheme connects the southern roundabout of the proposed Wood Land junction directly to the retained section of the existing A47. Dereham Road access to Honingham would be provided via a new T-junction with the existing A47, east of Wood Lane junction. This design would direct traffic heading south from Wood Lane junction around the northside of Honingham to Mattishall Road via the existing Honingham roundabout; thereby reducing safety risks, air pollution emissions and noise impacts from traffic passing through Honingham village. The provision of new speed restrictions (gateway features) on Dereham Road, west of Honingham, and on Norwich Road, east of the village, would further discourage traffic passing through the village.

5.10. Hall Farm Access

- 5.10.1. The proposed route of the realigned A47 would sever the access from Hall Farm north of the existing A47.
- 5.10.2. The Scheme would provide a new underpass access (Hall Farm underpass) under the proposed A47 mainline, to retain the connection to the existing A47 and a diversion route for restricted byway RB1 north of Honingham. The underpass will be located west of the existing A47 and the new access track would require creation of a new junction with the existing A47.
- 5.10.3. The structure would accommodate a segregated shared use path to the west side of the carriageway to maintain existing north and south connectivity for walkers and cyclists.

5.11. Existing A47 East and West of St Andrew's Church

- 5.11.1. The proposed route of the realigned A47 will sever access along the existing A47 west of St Andrew's Church, severing access to Honingham.

- 5.11.2. The new Norwich Road junction would provide a new vehicle connection between the existing Honingham roundabout and St Andrew's Church. The existing farming operations hardstanding area in the adjacent field, used by the church as a car park under a private agreement with the landowner, would also be replaced due to being located under the new A47 alignment. A replacement hardstanding would be provided in the field west of the church.
- 5.11.3. A new direct WCH connection, including the new Honingham church underpass under the new A47 mainline near Honingham roundabout, would be provided to retain access between St Andrew's Church and residents of Honingham. The route of the new A47 prohibited retaining a connection along the existing A47 alignment. Equally, a proposal to provide a path under the new River Tud crossing was changed due to constraints, such as flood risk, restricted headroom and woodland habitat, and statutory consultation feedback concerns about the length of the diversion.

5.12. Blind Lane

- 5.12.1. The existing junction of Blind Lane and the A47 will be severed by the proposed Norwich Road junction and new A47 mainline.
- 5.12.2. Blind Lane south of the proposed A47 was originally proposed to be connected to the new Norwich Road junction southern roundabout. However, the connection to Blind Lane was subsequently removed in response to statutory consultation feedback given there is no need to connect to the proposed Food Enterprise Zone. The reason for the change is discussed further in Section 9 of this Report. Access to the land parcels adjacent to Blind Lane would be retained via its southern junction with Church Lane (Easton), which would link to the A47 via the new Norwich Road junction.

5.13. Walking, Cycling and Horse Riding Routes

- 5.13.1. Minimising the impacts of the Scheme on WCH users is an integral part of Scheme design and this has been achieved by maintaining connectivity and incorporating both new and improved facilities to enhance existing networks. This also supports the requirements of NPS NN paragraphs 3.17 to 3.20 (sustainable transport) and 3.21 to 3.22 (accessibility).
- 5.13.2. In developing the WCH strategy, consultation was undertaken with relevant officers at Norfolk County Council to ensure that accessibility issues local to the Scheme were clearly understood. Account was also taken of the concerns expressed by the Norwich Cycling Campaign on the emerging WCH strategy that was taken to public consultation. Surveys also confirmed that there are five locations where WCH users predominantly cross the A47. These are between:
- Low Road and The Street
 - Mattishall Lane and Hockering
 - Berrys Lane and Wood Lane
 - Taverham Road and Blind Lane
 - Ringland Lane and Dog Lane

- 5.13.3. Where possible, existing WCH facilities removed by the Scheme would be replaced with enhanced facilities that better reflect the accessibility needs of the area. Where possible, as part of the existing A47 de-trunking and creation of new side road connections improvements have been proposed to the local WCH network, supporting the promotion of active travel modes.
- 5.13.4. Section 4 of the Case of the Scheme (**TR010038/APP/7.1**) provides further detail on the Scheme's impacts on existing and creation of new WCH facilities along the North Tuddenham to Easton corridor.

6. STRUCTURES DESIGN

6.1. Overview

6.1.1. The Scheme contains a number of existing and proposed structures summarised as follows:

- five unaffected existing structures
- modification of Honingham Bypass which crosses over the River Tud
- seven new bridge structures
- one new culvert structure¹⁰

6.1.2. Amongst the following six existing structures within the DCO boundary, only Honingham Bypass requires modification:

- Fox Lane overbridge, conveying Fox Lane over the existing A47
- Church Farm bridge, conveying Taverham Road over the River Tud
- Berrys Lane bridge over the River Tud
- Whitford bridge, conveying Mattishall Lane over the River Tud
- Blois bridge, conveying Church Lane (East Tuddenham) over the River Tud
- Honingham Bypass, conveying the existing A47 over the River Tud

6.1.3. The modified and new structures are to be designed in accordance with current good practice and to comply with Department of Transport approved design standards; for example, DMRB CD 127 *Cross-sections and headrooms* and DMRB CD 143 *Designing for walking, cycling and horse-riding*. These will fulfil the following scheme-wide criteria:

- provide highway clearances, headrooms and loading requirements
- provide walking and cycling requirements
- comply with the requirements of third-party stakeholders where relevant

6.1.4. All structures will be designed to ensure durability requirements are met but will also ensure materials are used efficiently. Structural concrete will incorporate a cement replacement combination mix to reduce the amount of cement and therefore reduce the associated embodied carbon of the structure.

¹⁰ Newgate House culvert is a defined structure, whereby the new and extend West Culvert is just a pipe so not a engineering defined structure.

6.1.5. The following sections describe the design considerations for the modified and proposed new bridges. The design considerations for the new culvert structure (Newgate House culvert) are explored in Section 7 of this Report, along with the design consideration for the new and extended West Culvert. The structures are illustrated on the General Arrangement Plans (**TR010038/APP/2.2**) and Engineering Plans (**TR010038/APP/2.7**).

6.2. Mattishall Lane Link Road Underbridge

6.2.1. A new underbridge would be constructed to the west of the existing Mattishall Lane alignment to serve pedestrians and cyclists as well as vehicular traffic.

6.2.2. Two different construction methods were considered for the Mattishall Lane Link Road underbridge, with the main variation in the options being the structural form:

- in-situ concrete box
- jointed portal frame units with an in-situ concrete base slab

6.2.3. The estimated capital cost and comparative life cost of the jointed portal frame is marginally greater than the in-situ concrete box. However, the jointed portal frame was selected for its substantial benefits in construction simplicity and significant health and safety benefits. Precast units would be manufactured off-site or on a dedicated site compound area, therefore the labour intensive activities and risks associated with traditional concrete construction would be significantly reduced.

6.2.4. There were no key environmental differences in the options, but the natural alignment and highway levels enabled an underbridge to be provided in order to reduce the impact on the landscape character of the area and visual amenity.

6.3. Wood Lane Junction Underbridge

6.3.1. A new underbridge would be constructed as part of the new grade separated Wood Lane junction.

6.3.2. Initially, four construction methods were considered, but geotechnical investigations indicated that piles would be required at this location and as such an option to use a spread footing substructure design was discounted. A precast jointed portal was also discounted due to the geometric limitations and would not yield a cost effective solution.

6.3.3. Two construction methods were taken forward and developed further, with the main variation in the options being the substructure type:

- reinforced soil wall with reinforced concrete bankseat supported on reinforced concrete sleeved columns connected into a pile cap
- in-situ concrete abutment wall supported on a pile cap

- 6.3.4. The estimated capital cost and comparative life cost of the in-situ concrete abutment wall is marginally greater than that of the reinforced soil wall. The anticipated construction programme is not likely to differ between the two. The in-situ concrete abutment option was preferred due to the improved buildability aspects of the design. The preferred option has a shallower construction depth creating a more aesthetically pleasing structure and will produce benefits in reduced highway embankment volumes resulting in material and construction methodology efficiencies.
- 6.3.5. There were no key environmental differences influencing the preferred design Wood Lane junction underbridge.

6.4. Hall Farm Underpass

- 6.4.1. As part of the Scheme, the existing private access to Hall Farm would be severed. A new underbridge below the new A47 mainline would be provided to maintain access. The structure would accommodate a segregated shared use path to the west side of the carriageway to maintain existing north and south connectivity for walkers and cyclists.
- 6.4.2. Two construction methods were considered for the Hall Farm underpass as follows:
- In-situ concrete box
 - Precast concrete box made up of U-shaped units
- 6.4.3. The estimated capital cost and comparative life cost of precast units is marginally greater than the in-situ concrete box. However, the precast units were selected for the substantial benefits in construction simplicity and the significant health and safety benefits. Precast units would be manufactured off-site or on a dedicated site compound area, so the labour intensive activities and risks associated with traditional concrete construction would be significantly reduced.
- 6.4.4. There were no key environmental differences in the options, but the natural alignment and levels of the junction were such that an underpass could be provided to avoid the intrusion of an overbridge affecting the landscape character and visual amenity of the area.

6.5. Honingham Bypass

- 6.5.1. Honingham Bypass is an existing concrete deck bridge providing a crossing for the existing A47 carriageway over the River Tud. The use of the structure would change from just vehicular to include a cycle track over it. Consequently, the existing 1m high parapets will be reviewed and a suitable upgraded system proposed if deemed necessary to achieve a 1.8m parapet height in accordance with Department of Transport safety design guidance. No other modification works are envisaged for the structure.

- 6.5.2. Multiple options will be considered for the parapet replacement including: removal of existing parapets and replacing with a new system directly onto the existing edge beam anchorages; or leaving the existing parapets in-situ and installing the new system within the existing carriageway verges. A re-design of the carriageway layout will also be considered which would not require any modification works to the structural elements.
- 6.5.3. The preferred option would be selected following consideration of buildability, cost, environmental, and health and safety management during construction.

6.6. River Tud Crossing

- 6.6.1. The Proposed Scheme mainline crosses the River Tud east of Honingham. A new crossing would be provided over the River Tud.
- 6.6.2. For the River Tud crossing underbridge, two main structural forms were considered:
- prestressed beam bridge
 - weathering steel beam bridge
- 6.6.3. The estimated capital cost and whole life cost of the weathering steel beam bridge is lower than the prestressed beam option. The weathering steel beam bridge also has additional benefits in that it will reduce the weight and number of crane lifts. Consequently, the preferred option for River Tud crossing underbridge is a one span weathering steel plate girder structure.
- 6.6.4. The substructure options for the crossing were also rigorously investigated. Full height concrete abutments were considered initially that would be supported on bored concrete piles. However, due to buildability concerns in the area of the River Tud, an improved option was developed using box sheet piles. This option would create a connection to the steel girders above ground level which would significantly reduce the volume of excavation works required. This is a significant benefit due to the high groundwater levels recorded in the area.
- 6.6.5. The preferred design of the River Tud Crossing was developed through an iterative review of options between the design team, environmental specialists, the contractor and the Environment Agency. The aim was to achieve a design that balanced consent requirements, technical design challenges, buildability, cost, landscape integration, flood management and ecological considerations. For example, recognising the presence of water voles (a protected species) and the need to retain natural riverbanks, the design worked around a principle of no works within a 5m distance from the top of the riverbanks.

6.7. Honingham Church Underpass

- 6.7.1. Honingham church underpass is walking and cycling underpass providing a safe segregated crossing under the new A47 route between Honingham and St Andrew's Church. Consultation with the parish councils and Local Liaison Group helped ascertain an appropriate location for the structure. The dimensions of the underpass have been designed for pedestrians, cyclists and dismounted equestrian use.

- 6.7.2. Two construction methods were considered for Honingham church underpass:
- in-situ concrete box
 - precast concrete box
- 6.7.3. The comparative whole life cost of the precast option is lower than the in-situ concrete box. The precast units also have benefits in construction simplicity and significant health and safety benefits on site. Precast units would be manufactured off-site or on a dedicated controlled site compound area; therefore, labour-intensive activities and risks associated with traditional concrete construction would be significantly reduced.
- 6.7.4. There were no key environmental differences, but the natural alignment and levels of the junction were such that an underbridge could be provided to avoid the intrusion of an overbridge affecting the landscape character and visual amenity of the area.

6.8. Norwich Road Junction Underbridge

- 6.8.1. A new underbridge would be constructed as part of the new Norwich Road junction.
- 6.8.2. Initially, five options were considered, but geotechnical investigations, span requirements and complex construction methods lead to three options being discounted. Two structural solutions were taken forward and developed further, with the main variation in the options being the structural form of the substructure. These options were:
- full height in-situ reinforced concrete abutments supported on bored piles
 - reinforced concrete contiguous bored piles with a top in-situ diaphragm
- 6.8.3. The estimated capital cost and comparative life cost of the in-situ reinforced concrete substructure is greater than the reinforced concrete contiguous bored pile substructure. The reinforced concrete contiguous bored pile substructure has further benefits regarding health and safety risks as it eliminates the need to work at height by employing a top-down construction method. For this option the piles will be driven from the existing ground level to create the abutment walls prior to excavation works. Considering the improved buildability aspects of the contiguous bored pile substructure option and the reduced cost, this was selected as the preferred option.
- 6.8.4. There were no key environmental differences in the options.

6.9. Easton Footbridge

- 6.9.1. A new footbridge crossing the A47 carriageway at the existing Easton roundabout is proposed to replace the existing Ringland Lane crossing of the A47. The current route involves steps up embankments leading to an at grade crossing of the A47 through live traffic, which will increase in speed when Easton roundabout is removed. The structure would be designed to provide ramped access and sufficient shared use width for walkers and cyclists. No equestrian requirements would be necessary for this structure. Two underpass options and two footbridge options were considered initially.

- 6.9.2. The underpass options were discounted for several reasons. Site constraints meant any approach ramps would be too steep when compared to the required gradient limits. Furthermore, if constructed with switchbacks to improve the gradient this would result in long sections of deep retaining walls creating a tunnel effect which is undesirable. The footprint of the excavation works would also result in a significant proportion of the surrounding trees being affected.
- 6.9.3. The three footbridge options were developed as follows:
- steel warren truss over the A47 supported on reinforced concrete bankseats situated on reinforced earth approach embankments
 - steel warren truss over the A47 supported on steel piers with steel deck approach ramps; the ramps would be supported by steel columns and the foundation would consist of concrete pile caps with bored piles
 - steel concrete composite footbridge supported on reinforced concrete bankseats situated on reinforced earth approach embankments
- 6.9.4. The steel concrete composite footbridge would be marginally more expensive than the warren truss with reinforced embankments. However, the composite footbridge would be made integral with the substructure which eliminates the need for mechanical bearings. This improves the durability of the structure and will reduce maintenance works throughout the service life. This results in reduced disruption to the users of the A47 and the surrounding walking and cycling routes.

7. DRAINAGE DESIGN

7.1. Introduction

- 7.1.1. The drainage design is illustrated on the Drainage Plans (**TR010038/APP/2.8**). The drainage strategy, in ES Appendix 13.2 (**TR010038/APP/6.3**), was undertaken in order to outline the proposed drainage design and mitigation measures to reduce impacts upon the water environment by the Scheme.
- 7.1.2. A flood risk assessment (FRA), in ES Appendix 13.1 (**TR010038/APP/6.3**), was undertaken in accordance with the requirements of the NPS NN paragraphs 5.90 to 5.115, National Planning Policy Framework 2019 and the Environment Agency's climate change allowances.
- 7.1.3. As part of the drainage strategy and FRA a detailed hydrological and hydraulic assessment was undertaken to establish the location and sizing of culverts required to convey surface flow pathways where these pathways are intersected by the Scheme. This has been undertaken in accordance with the requirements of the Environment Agency and Norfolk County Council, as the Lead Local Flood Authority.

7.2. Climate Change Adaptation

- 7.2.1. The Scheme will increase areas of hard standing and alter ground elevations that would result in an increase in peak flow rates discharging to the local watercourses. In accordance with planning policy guidance the flood risk assessment considered a peak river flow climate change allowance of 65% and a peak rainfall intensity climate change allowance of 20% and 40%, for the central and upper end allowances, respectively.
- 7.2.2. Any increase in surface water runoff is to be attenuated using oversized pipes and drainage basins, designed to attenuate new drainage systems to the greenfield runoff rate up to a 1 in 100-year rainfall event. This includes a 20% climate change allowance and a sensitivity test undertaken to 40% climate change allowance to consider impacts to the Scheme drainage as well as downstream receptors.
- 7.2.3. For existing drainage systems that are modified as part of the Scheme, there would be no increase in existing runoff rate including a 20% climate change allowance for contributing new hardstanding areas. These standards are in accordance with DMRB *CG 501 Design of highway drainage systems*.

7.3. Newgate House Culvert

- 7.3.1. A new culvert is required to maintain an unnamed tributary link across the new A47 mainline to the River Tud at Newgate House, between Hockering and Gypsy Lane.

- 7.3.2. Newgate House culvert would be a precast concrete box culvert with internal open dimensions of approximately 2.05m by 2.05m. This would allow for placement of a natural granular bedding to be placed within the culvert. The culvert would have a total length of approximately 42m. The culvert would accommodate a mammal ledge on one side with suitable ramps situated upstream and downstream to provide access for fauna, such as otters. The ledge would be situated above the design flood levels to ensure a safe passage is available during all conditions.
- 7.3.3. The culvert would be aligned square to the carriageway to facilitate the construction method and this would require a small permanent diversion downstream of the culvert to tie back in with the existing tributary before the confluence with the River Tud. The diversion would maintain the natural general shape of the tributary in the area and has been discussed and agreed with the Lead Local Flood Authority. The construction of the culvert would require temporary diversion of the tributary during the works.
- 7.3.4. An alternative construction method was considered which would move the structure offline from the existing alignment. This was discarded due to:
- undesirable permanent diversion required
 - proximity of an existing Anglian Water pipeline
 - construction issues associated with managing flows during the transition between the existing watercourse route and the new route
- 7.3.5. The box culvert solution has been selected to manage buildability and construction health and safety risks. An allowance has been made for a natural bedding material within the culvert designed to allow pre-filling of the box units prior to final positioning, thereby removing the risk of working in a confined space.
- 7.3.6. Flood modelling remains preliminary at this stage and further analysis will be carried out at the detailed design stage to ascertain the appropriate culvert dimensions so the required freeboard is achieved during the 1 in 100 year flood level plus allowance for climate change. A location upstream, north of the existing A47, has been identified for provision of Water Framework Directive mitigation provision.

7.4. West Culverts (Oak Farm)

Existing west culvert

- 7.4.1. An existing culvert at Oak Farm under the existing A47 carriageway is to be extended to accommodate the proposed new mainline dual carriageway. The existing culvert consists of a reinforced concrete pipe with an internal diameter of 750mm. The new extension would be of similar construction to the existing and would have similar internal dimensions. The extension would continue on the same alignment of the existing culvert. A suitable manhole would be provided at the interface with the existing culvert and an appropriate headwall and wingwalls provided at the upstream end of the extension.

New west culvert

- 7.4.2. A new piped culvert would be provided to allow passage of the drain at Oak Farm under the proposed new link road north of the existing A47. The culvert would be of similar construction to the existing culvert and extension downstream with appropriate headwalls and wingwalls on upstream and downstream. The new culvert would have an internal diameter to match the culvert downstream.
- 7.4.3. In order to protect downstream properties, as well as the new road construction, the new culvert will be throttled on the upstream end. As a result, the field to the north of the proposed new link road would be allowed to flood. Additionally, a bund would be constructed between the upstream headwall and the link road to protect the road pavement from the floodwaters.
- 7.4.4. A section of the stream north of the floodplain compensation area has been identified for Water Framework Directive mitigation works, comprising conversion of an existing straight and managed watercourse into a natural meandering watercourse with additional riparian planting.

8. ENVIRONMENTAL DESIGN

8.1. Context

8.1.1. The A47 highway corridor between North Tuddenham and Easton is located within a largely rural landscape characterised by agricultural land use and dispersed settlement. Physical features in the immediate vicinity of the existing A47 corridor which contribute to the landscape character of the wider area include agricultural fields enclosed by hedgerows with mature trees and small areas of woodland. Two Listed Buildings (St Andrew's Church and St Peter's Church) are located adjacent to the existing A47 so there would be a risk of impacts upon their setting by the Scheme.

8.1.2. This section presents an overview of the environmental considerations that have influenced the design of the Scheme. This section also demonstrated compliance with the several NPS NN design requirements in the NPS NN, such as paragraphs: 5.20 to 5.38 (biodiversity and ecological conservation), 5.124 – 5.138 (cultural heritage), 5.144 to 5.161 (landscape and visual) and 5.186 – 5.200 (noise and vibration).

8.2. Embedded Environmental Mitigation

8.2.1. The EIA team has worked closely with the design team to ensure a joined up approach throughout the assessment process. This method ensured that the majority of environmental mitigation measures were raised at an early stage as constraints and opportunities were identified and incorporated into the design. This resulted in various environmental mitigation measures being embedded into the final Scheme design:

- WCH provision to enhance connectivity and provide an active travel route along the A47: upgrade and provision of WCH paths, provision of Honingham church underpass and provision of Easton footbridge to maintain connectivity for walkers and cyclists (for more details see Section 4 of the Case for the Scheme (TR010038/APP/7.1))
- ecological measures to reduce habitat fragmentation through provision of: safe mammal crossing points through mammal ledges in culverts and badger tunnels; and protecting the flight and foraging routes of bats. Also included provision of fences to protect wildlife, such as badgers, from cars and other vehicles
- re-meandering and additional riparian planting along the Oak Farm tributary and Hockering tributary
- sustainable drainage systems design, including wetland habitat creation at two drainage basins; the drainage design is discussed further in Section 6 of this Report
- landscaping with sensitive planting, native plant species and wildflowers; the landscape planting design is discussed further in Section 8.3 of this Report
- using earth banks, noise fences and low noise road surfaces to help reduce road traffic noise at receptors; noise and visual screening bunds would be added to Mattishall Lane (3m high), Church Lane (2m to 3m high in different sections) and east of Wood Lane junction (2m high)

8.3. Landscape Masterplan Design Considerations

- 8.3.1. The landscape design sought to integrate the Scheme with surrounding landscape character, minimise visual intrusion and minimise impacts on the settings of Listed Buildings. The design objectives included retaining notable extents of existing planting and proposing new planting to replicate existing features and establish visual screening. The environmental mitigation strategy also seeks to reinstate landscape features lost as a result of the Scheme, such as hedgerow boundaries and plantation woodland, as well as a general enhancement of the landscape context, wherever possible.
- 8.3.2. The design seeks to integrate the Scheme with the existing landscape by:
- making it environmentally sustainable and retaining the sense of openness where this is consistent with a balanced preference for visual screening
 - integrating Scheme infrastructure (notably elevated overbridges) through appropriate use of planting to contribute to visual screening
 - reinforcing existing plantation character with woodland planting where this is consistent with the surroundings
 - reinforcing existing field boundaries with individual trees and hedgerows where the field pattern is a notable component of the landscape
 - retaining or replacing and reinforcing existing vegetation where this contributes to the distinctive qualities of the landscape, such as the mature planting between the A47 and St Peter's Church, in Easton
 - selecting plant and grass species appropriate to the locality to maintain consistency with the appearance of the area
- 8.3.3. The planting strategy acknowledges the character of existing vegetation, which typically consists of field boundary hedgerows with individual trees, and woodland plantations. The various Scheme planting types are consistent with DMRB defined elements and compatible with standard highway practices for long term operational maintenance and management. The ultimate outcome of using locally occurring native species, which replicate existing features and are maintained in a manner consistent with that of the wider highway network, will contribute to consistency and integration of the proposals with their surroundings.
- 8.3.4. In summary, the project planting has sought to:
- provide appropriate visual, landscape, ecological and environmental mitigation whilst minimising land take and impact upon adjoining agricultural land
 - establish new planting to screen and integrate the Scheme into the landscape, whilst retaining visual cohesion with existing landscape features
 - use new planting to integrate the scale, layout, form and massing of the Scheme, to reduce the scale of earthworks and structures and filter views, as well as reinforce existing planting

- 8.3.5. The design of the planting for the Scheme would comprise native species of local provenance stock or at least of British origin, so as to safeguard the integrity and biodiversity of the landscape. The proposed environmental design planting strategy takes reference from the native plant species found in the surrounding area. Species include oak, birch, grey willow, hawthorn, blackthorn and field maple. The inclusion of diversity within planting mixes will embed an aspect of resilience and adaptation for vegetation faced with increasing pest, disease and climate change threats.
- 8.3.6. The planting design has also sought to conserve and enhance the natural environment, as well as the historic environment, through the provision of additional off-site screening measures. This will further reduce the likelihood of impacts on designated heritage assets by the Scheme.

9. INTERRELATIONSHIP WITH OTHER MAJOR DEVELOPMENTS

9.1. Overview

9.1.1. This chapter explores how the Applicant has engaged with and will manage the interaction with the following major developments directly interacting with the Scheme. This in turn influenced the design and construction strategy for the Scheme and assumptions in the ES (**TR010038/APP/6.1**). The major developments are:

- Norwich Western Link Road¹¹
- The Greater Norwich Food Enterprise Zone¹²
- Ørsted's Hornsea Project Three Offshore Wind Farm¹³
- Vattenfall's Norfolk Boreas¹⁴ and Norfolk Vanguard¹⁵ offshore wind farms
- Equinor's Sheringham Shoal and Dudgeon wind farms extensions onshore cabling¹⁶

9.2. Norwich Western Link

9.2.1. The Norwich Western Link (NWL) would provide a higher standard highway between the western end of Broadland Northway, formerly known as the Northern Distributor Road, from the A1067 to the A47 west of Norwich. This would significantly improve travel between these two major roads as traffic congestion, rat-running and delays to journeys are all significant issues on minor roads to the west of Norwich.

9.2.2. In July 2019 Norfolk County Council announced the preferred route for their NWL (a new 3.8 mile dual carriageway road) and in May 2020, the Department for Transport approved the Strategic Outline Business Case.

9.2.3. As a consequence, under the Department of Transport traffic modelling process, the NWL has to be considered as a 'certain development' in the traffic model determining the need case for the A47 North Tuddenham to East dualling scheme. The Applicant is on the NWL local liaison group to ensure a joined-up approach.

9.2.4. However, as the NWL does not currently have consent to be constructed, the Applicant is working with Norfolk County Council as it is important to understand how the two schemes would interact. For example, while both schemes are modelled on similar software, the traffic models are independent of one another and will vary due to different development timelines (e.g. base year model, assumptions as to opening year) and different effects on the surrounding local network. However, the Applicant has been working collaboratively with the NWL project delivery team to make sure there is a consistent traffic modelling methodology for both schemes.

¹¹ <https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/norwich/norwich-western-link>

¹² <https://www.foodenterprisepark.com/>

¹³ <https://infrastructure.planninginspectorate.gov.uk/projects/eastern/hornsea-project-three-offshore-wind-farm/>

¹⁴ <https://infrastructure.planninginspectorate.gov.uk/projects/eastern/norfolk-boreas/>

¹⁵ <https://infrastructure.planninginspectorate.gov.uk/projects/eastern/norfolk-vanguard/>

¹⁶ <https://infrastructure.planninginspectorate.gov.uk/projects/eastern/sheringham-and-dudgeon-extension-projects/>

- 9.2.5. The A47 North Tuddenham to Easton project is not dependent on the NWL and would still proceed without the NWL coming forward. However, as the local highway authority has a well advanced scheme that will connect with the A47, it is both sensible and pragmatic for the Scheme to anticipate that the NWL may come forward. Through this approach the Applicant is striving to be as efficient as possible with public money and ensure the community benefits from our joined up working with regards planning new major developments and cost control both for the short and long term.
- 9.2.6. In addition, the reconfiguration of roundabouts on a strategic highway junction to incorporate a new arm would incur many significant impacts that could be avoided if the junction was designed upfront. Provision of a stub off Wood Lane junction would not only cater for inclusion of the NWL, but would avoid:
- additional costs from amending Wood Lane junction after its construction
 - impact on customers and delays to journey times during construction to traffic using the junction after the Scheme opening
 - demolition of recently built highways, drainage systems, utility services to create the new connection to Wood Lane junction
 - associated adverse environmental impacts (e.g. construction plant emissions, waste arisings for disposal and embedded carbon emissions) from removing recently built road surfaces, earthworks and utility infrastructure when tying into Wood Lane junction after the Scheme opening
- 9.2.7. Therefore, in recognition of the efficiency benefits to the UK Government finances and climate change objectives our Scheme has incorporated the option to provide of a 50m stub to cater for the future inclusion of the Norwich Western Link. However, the stub would only be created if the NWL obtained planning consent prior to the Scheme commencing the main construction works.
- 9.2.8. A 50m stub would be provided to provide a suitable construction tie in section and connection point off the line of the junction radii. The length ensures that live construction works are suitably back from live carriageway of Wood Lane junction's northern roundabout, minimising disruption to road users. In addition, it allows NWL construction vehicles to access their site via Wood Lane junction, but without the risk of queuing back onto the junction if queues form at the construction site entrance.
- 9.2.9. If the stub is not required, the permanent landtake associated with Work Nos. 26a and 98 on the Works Plans (**TR010038/APP/2.4**), would be reduced accordingly. However, the extent of the reduction would need to be determined at the detailed design stage as it would depend on: the local topography determining the re-alignment of the WCH route; and extent of the revised landscape planting provision would be developed in discussion with the landowner and local planning authority.

- 9.2.10. Through analysis of traffic modelling scenarios and engagement with the local liaison group, the concerns related to safety and disturbance from increased traffic passing through Ringland, via Honingham Lane and onto Taverham Road during the period between the Scheme opening and Norwich Western Link opening were identified and explored. As an outcome of this process, the Applicant proposes to implement the temporary closure of Honingham Lane to through traffic, in the interim period between the A47 and Norwich Western Link schemes opening. If the Norwich Western Link scheme does not obtain planning consent, the applicant would continue to engage with the local highway authority, Norfolk County Council on the implementation of this proposal.

9.3. The Greater Norwich Food Enterprise Zone

- 9.3.1. Food Enterprise Zones (FEZs) are an initiative introduced by DEFRA to:

- enhance rural development
- encourage greater collaboration between food and farming businesses
- allow local decision making
- attract inward investment

- 9.3.2. The Greater Norwich FEZ was designated by DEFRA in March 2015. Its stated purpose is to facilitate growth in the agri-food, agri-tech as well as food and drink processing sectors. Additionally, it aims to contribute towards economic and employment growth in the Greater Norwich area, and in Norfolk more generally.

- 9.3.3. The FEZ itself is not tied to a specific geographical location, but a local development order (LDO) has been made by Broadland District Council in 2017 for approximately 19 hectares south-west of Easton for the Greater Norwich FEZ. The LDO grants planning permission for an initial period of 15 years (to October 2032).

- 9.3.4. The LDO is subject to two conditions relating to access and highways:

- (a) Condition 2.20 reads:

"Prior to the commencement of development, a scheme of works shall be submitted and agreed in writing with the local planning authority in consultation with the Highway Authority and, where appropriate, Highways England. The scheme of works shall include the following elements, unless otherwise agreed in writing with the local planning authority, and identify triggers for the implementation of each component:

- realignment/change of priority at the junction of Dereham Road/Church Lane;
- right turn from Dereham Road into Church Lane;
- a scheme of widening improvements to Church Lane;
- vehicular access to the LDO site either off Church Lane/Red Barn Lane or directly from the A47;
- enhanced footway and cycle facilities to connect with Dereham Road;
- the closure of Blind Lane to vehicular traffic.

Reason – in the interest of highway safety, to safeguard residential amenity, to provide adequate protection to the natural environment and to ensure the satisfactory development of the site, having regard to the rural setting."

(b) Condition 2.21 reads:

"The scheme of works required above shall be implemented in accordance with the triggers agreed in writing with the local planning authority in consultation with the highway authority and, where appropriate, Highways England.

Reason – in the interest of highway safety, to safeguard residential amenity, to provide adequate protection to the natural environment and to ensure the satisfactory development of the site, having regard to the rural setting."

9.3.5. On 21 December 2018, Broadland District Council approved details of the vehicular access to the LDO site, which were expressed to be submitted and discharged under Condition 2.20 of the LDO. The approved plans provided for creation of visibility splays at the LDO site access, as well as passing places on Church Lane.

9.3.6. The discharge of Condition 2.20 is itself expressed to be subject to a further condition:

"(2) Further details in respect of scaled plans are required to be submitted under Condition 2.20 of the LDO, to the Local Planning Authority and agreed, in consultation with the Highway Authority and, where appropriate Highways England, to identify:

- Realignment/change of priority at the junction of Dereham Road / Church Lane
- A right turn lane from Dereham Road into Church Lane
- A scheme of widening improvements to Church Lane
- Enhanced footway and cycle facilities to connect with Dereham Road, including a pedestrian island to the east of St Peters Church, Easton
- The closure of Blind Lane.

These works shall be carried out as approved and brought into use upon completion of 10,000m² of development floorspace on the LDO, unless otherwise determined by the Local Planning Authority where appropriate circumstances apply, including but not limited to, if a high traffic generator is proposed within the LDO or if direct access to the A47 can be achieved."

9.3.7. The implementation of the LDO is also subject to the provisions of a section 106 agreement dated 31 October 2017 (the S106). The principal purpose of the S106 is to secure vehicle routing obligations for all vehicles exceeding 7.5t visiting the LDO Site. Notably, Clause 9 of the S106 states that the S106 itself is expressed to only be operative:

"until such time as vehicular access is provided between the Site and the A47 Trunk Road in accordance with the requirements of conditions 2.20 and 2.21 of the [LDO] so that as soon as that vehicular access has been provided to the satisfaction of the Council and is in use the obligations and provisions of [the S106] shall thereupon be of no effect".

- 9.3.8. During such period as the S106 is operative, all relevant vehicles are required to enter and leave the LDO Site using a 'Permitted Route' (being the existing A47 Easton roundabout – Dereham Road – Church Lane).
- 9.3.9. In light of the above, there is no existing or contingent requirement that the LDO requires the Greater Norwich FEZ site to be accessed directly from the A47 given the approved alternative route along Church Lane. However, it is recognised that the developer of the FEZ site may wish to obtain consent to create their own connection to the Scheme in the future. The Scheme's traffic modelling has therefore taken this into account at the Norwich Road junction to provide capacity.

9.4. Ørsted's Hornsea Project Three Offshore Wind Farm

- 9.4.1. Ørsted's Hornsea Project Three is proposing a new offshore wind farm off the north Norfolk coast. The onshore cabling connection route to the National Grid substation crosses the Scheme, north to south, west of Easton roundabout. Ørsted are planning to start construction of the onshore cabling in 2023 and currently plan to access their works areas north and south of the existing A47 via Church Lane from Easton roundabout.
- 9.4.2. As a consequence, the Applicant is working with Ørsted to manage the following risks:
- overlap of works areas where the Scheme has identified potential material storage areas and needs to create the new A47 mainline, utilities diversions and new WCH route
 - loss of access to Church Lane, north of the A47, when Easton roundabout is removed
 - cumulative construction traffic movements
- 9.4.3. The Applicant and Ørsted have agreed to work together, under a non-disclosure agreement, through regular meetings and exchange of information during their respective detailed design and construction stages. This will help minimise the cumulative effects and that key activities are scheduled to not adversely affect each other. Cumulative construction traffic management risks will also be managed through a construction Traffic Management Plan (**TR010038/APP/7.5**). The Applicant has also amended the material and soil storage areas for the Scheme to avoid overlap of those areas with the Ørsted works corridor. The Applicant and Ørsted have also agreed to work together to manage the implementation and phasing of the Ørsted temporary works to Taverham Road, and access across the respective sites so as to minimise disruption to their respective activities, neighbouring land uses, the local community and environmentally sensitive sites.
- 9.4.4. However, loss of access to land between the A47 and River Tud via Church Lane requires provision of alternative access following closure of Easton roundabout. Several options were considered and discounted.

- Access to Church Lane via Ringland Road – as well as the local road network not being suitable for large heavy good vehicles (HGVs) with large cable drums, Ørsted advised that Norfolk County Council had already stated this would not be an acceptable route.
- Access to Church Lane via a restricted access from the new A47 dual carriageway – this option was dismissed as it would not be possible without significant additional permanent landtake to facilitate the occasional need for large HGVs to get up speed to join a free flowing dual carriageway travelling at the national speed limit (70 mph). Aside from the costs and challenges associated with introducing traffic management measures to make safe use of a restricted access, this was not desirable from a road user perspective as it would reduce the flow of traffic at this location to single carriageway, creating congestion and delays, for several years after the Scheme is open and contrary to the objectives of the Scheme.
- Access directly off the new A47 mainline dual carriageway – this option was dismissed as it was not feasible to deliver without departures from safety design standards due to the proximity of Norwich Road junction slip road.

9.4.5. The Applicant therefore identified and incorporated within the Scheme the ability to support provision of a 10m wide temporary haul route and long-term maintenance easement rights for Ørsted from Taverham Road to the Ørsted works corridor north of the A47. This would utilise the previously proposed access off Taverham Road to the drainage basin and WCH route. It would run parallel to and along the north side of the Scheme's corridor for installing the new WCH route and utility diversions between Taverham Road and Church Lane, Easton.

9.5. Vattenfall's Norfolk Boreas and Norfolk Vanguard offshore wind farms

9.5.1. Vattenfall's Norfolk Boreas and Norfolk Vanguard are proposed new offshore wind farms off the north Norfolk coast, with onshore cabling crossing the A47 west of Dereham and a new substation connecting into the A478 west of Dereham.

9.5.2. There would be no direct interaction with the Scheme, but their construction programmes may overlap during the construction of the Scheme. Vattenfall will be importing material (such as cable drums) from overseas via ports in Great Yarmouth or Lowestoft, so these materials will pass along the A47 between North Tuddenham and Easton. Some of these loads will include large abnormal deliveries, such as 80m long low loaders with new electricity substation transformers.

9.5.3. Therefore, the Applicant will work with Vattenfall through regular meetings and exchange of information during their respective detailed design and construction stages. Construction traffic management will also be managed through a Traffic Management Plan (**TR010038/APP/7.5**). This will ensure effective construction traffic management to minimise the cumulative effects and that key activities are scheduled to not adversely affect each other.

9.6. Equinor's Sheringham Shoal and Dudgeon Extensions

- 9.6.1. The existing Equinor's Dudgeon and Sheringham Shoal offshore wind farms are currently preparing to seek a DCO to extend their sites with an associated a grid connection to the existing grid at Norwich Main substation in Norfolk.
- 9.6.2. The proposed onshore cabling corridor would cross the A47 between the proposed new Norwich Road junction and Easton. However, Equinor are anticipated to be submitting their DCO application after Highways England, so would need to design their proposal to accommodate the final design of the A47 North Tuddenham and Easton dualling scheme.
- 9.6.3. Therefore, the Applicant will work with Equinor through regular meetings and exchange of information during their respective detailed design and construction stages. This will also help minimise the cumulative effects and that key activities are scheduled to not adversely affect each other. Cumulative construction traffic management risks will also be managed through a Traffic Management Plan (**TR010038/APP/7.5**).

10. STATUTORY UNDERTAKER (UTILITIES) CONSIDERATIONS

10.1. Overview

- 10.1.1. Table 10-1 summarises the statutory undertakers' apparatus which is envisaged to be affected by the Scheme.

Table 10-1: Statutory undertakers apparatus affected by the Scheme

Statutory undertaker	Asset type	Affected asset
Anglian Water	Water	Significant strategic clean and wastewater assets along this section of the A47 requiring diversion of affected assets. Diversion proposals outlined and ongoing diversion development with asset owner.
BT Openreach	Telecoms	Substantial amount of localised assets affected, with scope of diversionary works under development as detailed within this chapter.
National Grid	Gas	High pressure gas main, on the east side of the proposed Wood Lane junction, to be diverted below the proposed A47 mainline and junction slip roads in this area.
UKPN	Electricity (buried cables and overhead lines)	No strategic assets are affected by the Scheme. Significant number of local low and high voltage assets affected and outline diversion have been developed with asset owner. Interface between the proposed highway alignment and the existing 132kV overhead lines at the Easton end to be reviewed to ensure sufficient safe clearance can be achieved, and avoid diversion works.
Vodafone, O2, THREE, T-Mobile & Orange.	Mobile Mast Transmitter	Four mobile mast sites have been identified within close proximity of the Scheme, but none of which are expected to be directly impacted by the construction activities.

- 10.1.2. The following sections explore the options considered to manage the impacts on the utility assets described in Table 10-1, along with the key consultations, environmental constraints, technical and safety requirements.
- 10.1.3. These considerations determine the method, route and extent of works to relocate or alter these assets and have in turn influenced the DCO boundary and assumptions in the ES (**TR010038/APP/6.1**).
- 10.1.4. Engagement with the Statutory Undertakers continues, further refining the detailed designs, programme and construction methods for creating new or diverting existing utility assets.

10.1.5. The interactions with the utility providers associated with wind farm developments crossing or near the Scheme are explored in Section 9 of this Report.

10.2. Anglian Water

10.2.1. There are a number of Anglian Water potable water mains and foul sewers along the length of the Scheme. In a substantial length of the existing A47, Anglian Water assets follow the alignment of the A47, either within the verge or within adjacent land.

10.2.2. A 355mm diameter potable trunk main conflicts with the Scheme at five locations and requires substantial diversions. There are also various smaller distribution mains, ranging from 100mm to 180mm in diameter, along the Scheme. These would conflict with the construction activities and so require diversion or protection works.

10.2.3. In addition to the potable water, there are two foul sewers affected by the Scheme. A 250mm diameter gravity outfall from the sewage treatment works, along Gypsy Lane, crosses the line of the proposed A47 and there are two locations where a 100mm diameter PVC foul rising main (pumped sewer) requires diversion.

10.2.4. Diversion design discussions continue with Anglian Water to minimise the overall local impact, diversion cost and disruption to the Scheme. As an example, the 355mm diameter trunk main and the adjacent 100mm diameter rising main both require diverting between Taverham Road and Easton. Two options were considered and reviewed with possible diversion routes either north or south of the proposed Norwich Road junction. Although the southern option provided a lower diversion cost and moved the Anglian Water assets away from construction activities, this option would also have compromised any future opportunity for the Food Enterprise Partnership to build their own highway connection to the A47 beside the Norwich Road junction. Therefore, the northern diversion option was assessed to be the preferred route. This option also offers the potential to lay the trunk and rising main under or adjacent to the proposed cycle track between Taverham Road and Easton, minimising land take and providing Anglian Water with future access for maintenance.

10.2.5. Anglian Water's access, easement requirements for their assets outside the adopted highway limits, are continually being reviewed as well as the Anglian Water planting restrictions impact on the Scheme landscaping.

10.2.6. Safe digging practices and suitable permitting will be required during the works, along with thorough site investigations prior to the works, as non-intrusive survey methods seldom manage to locate plastic mains.

10.3. BT Openreach

- 10.3.1. BT Openreach has existing underground and overhead network apparatus throughout the length of the Scheme, with a significant network of assets between Church Lane (East Tuddenham) and the proposed Wood Lane junction. This local distribution apparatus includes a number of overhead lines connecting residential and business properties. There is also a network of 1, 2, 3 and 7 way duct routes. The 7way duct network follows the existing A47 alignment from Honingham roundabout, before departing the A47 and heading to St Peter's Church. Nine separate locations of conflict have been identified along the Scheme, each requiring separate coordinated diversions.
- 10.3.2. There are two main areas requiring substantial diversion. The first is between Church Lane (East Tuddenham) to the east of the proposed Wood Lane junction. The second major area of works requires the Openreach apparatus to be diverted from Honingham roundabout to east of the proposed Norwich Road junction. These large areas of diversionary works have been split into smaller diversions to maintain existing cable routes to the different parts of the Openreach network. To maintain the existing supplies south of the Scheme within Blind Lane, a lengthy overhead line diversion is required. This is proposed to follow the existing north verge within Church Lane (Easton), south of the A47, and then along Red Barn Lane to the southern end of Blind Lane. Use of the north verge would avoid loss of established hedgerow or trees in the southern verge. The connection would require a buried one-way duct to pass under the UKPN 132kV high voltage overhead electricity lines.
- 10.3.3. Diversion design discussions are continuing with BT Openreach.

10.4. National Grid

- 10.4.1. There is a National Grid national high pressure gas transmission pipeline crossing the Scheme east of the Wood Lane junction. The 900mm diameter steel pipeline operates at pressures between 40 to 80 bar (580 to 1160 pounds per square inch). This is a strategic asset and currently passes under Berrys Lane, Dereham Road and the existing A47 east of the proposed Wood Lane junction. The following elements of the Scheme would be constructed over the proposed diverted alignment of the gas pipeline: A47 dualling; Wood Lane junction eastbound on slip road; Wood Lane junction westbound off slip road; and Wood Lane junction link road to the existing A47 for local traffic.
- 10.4.2. A National Grid Conceptual Design Study has identified the need for a major diversion for this gas main. The proposed works involve a combination of horizontal directional drilling and deep open-cut excavations to position the main at a suitable depth to mitigate the risk of damage to the pipeline from construction activities.
- 10.4.3. The development of the diversion design is still progressing and the final design will be informed by a number of surveys and investigations:
- ground investigations (completed)
 - surveys of the operational and logistic requirements

- mitigation measures to minimise the impact of construction activities on the local residents.

10.4.4. These design and operational activities will be continually reviewed to identify potential opportunities to minimise the impact on residents of neighbouring properties and reduce programme duration.

10.5. UKPN 132kV

10.5.1. A high voltage 132kV overhead electricity line crosses the existing and proposed A47, on pylons, between Norwich Road junction and Easton roundabout. Initially, these overhead lines were thought to be unaffected by the works, but it has since been identified that there is a potential issue with the minimum 6.7m clearance required between the finished carriageway levels and the overhead lines. There will also be a short section of the working area directly under the overhead lines, where site plant has the potential to encroach within the 2.4m safe clearance zone along the eastbound carriageway.

10.5.2. Design discussions are on-going with UKPN to assess the potential opportunity of raising the height of the overhead lines, to provide the minimum 6.7m safe clearance. UKPN is currently investigating whether the vertical insulators connecting the cables to the towers, can be changed to horizontal. With the towers being erected shortly after the Second World War, very limited as-built data is available and this type of procedure is rare within UKPN. The option to temporarily divert the cables offline on temporary towers would be extremely costly and disruptive to the construction programme. For the DCO application, the anticipated worst-case environmental effects have been assumed based on a full restringing exercise on the cables between two towers either side of the A47. However, the works are assumed to extend beyond these towers and the work area for this activity has assumed the three towers to the north of the existing A47 and two towers to the south may need to be accessed by UKPN. It is expected that ground-based vegetation clearance works would be similar to those required by UKPN's standard easement maintenance needs. The impact on the River Tud has been considered and the DCO boundary allows for the option to undertake works from a tower north of the river to minimise works at the tower beside the river.

10.5.3. The opportunity for the project team to review the carriageway levels and achieve the minimum of 6.7m clearance while maintaining the existing height of the overhead cables remains a possibility. However, more accurate information relating to the overhead line levels is required to confirm the minimum adjustment to the carriageway levels and impact on the adjacent Norwich Road junction design. Therefore, the Applicant has requested a detailed survey from UKPN.

10.6. UKPN 11kV & LV

10.6.1. Discussions are on-going with UKPN to progress the nine locations identified where UKPN's 11kV (high voltage) and low voltage (LV) network conflicts with the Scheme and are likely to require diversions.

- 10.6.2. The majority of these diversions are straight forward undergrounding of existing 11kV overhead lines, which cross the Scheme alignment. The most complex location requires a combination of underground 11kV and LV cables to be diverted from the Honingham roundabout to St Andrew's Church. Approximately 1300m of 11kV cable diversion is required to maintain the UKPN circuit, severed by the removal of the 11kV overhead line north of St Peter's Church. Other smaller 11kV and LV diversions along the Scheme are also required.
- 10.6.3. All construction works near electricity lines will be undertaken in accordance with standard safety protection measures and following consultation with the plant protection section of the asset owner.

10.7. Mobile Mast Transmitters

- 10.7.1. Four mobile mast sites have been identified within proximity of the Scheme, but only one is within the DCO boundary and none would be directly impacted.
- 10.7.2. However, there is a small risk, elevated elements of the Scheme could cast a shadow on the transmission area of these transmitters. Further engagement with the individual mast management organisations will confirm this.
- 10.7.3. A mobile mast south of the A47 and west of Lyng Road currently requires maintenance vehicles to reach it via a private access off the A47 beside Oak Farm. In order to avoid turning within Oak Farm, these vehicles then exit Lyng Lane via the junction of Lyng Lane with Low Road. A mobile mast south of the A47 and west of Lyng Road currently requires maintenance vehicles to reach it via a private access off the A47 beside Oak Farm. In order to avoid turning within Oak Farm, these vehicles then exit Lyng Lane via the junction of Lyng Lane with Low Road. In order to retain sufficient maintenance access once the direct access off the A47 is removed, the access to the Scheme's proposed drainage basin east of Lyng Lane would be designed to provide a turning area for heavy good vehicles accessing this mast.

11. CONSTRUCTION CONSIDERATIONS

11.0. Introduction

11.0.0. This section explores the key issues and decision-making that determined the location and extent of the following construction features, which in turn influenced the DCO boundary and assumptions in the ES (**TR010038/APP/6.1**):

- site compounds
- material storage and handling areas
- work areas to build the Scheme
- construction traffic management
- construction work area requirements

11.1. Site Compounds

Overview

- 11.1.1. Table 11-1 summarises the proposed site compounds required to facilitate the construction of the A47 Tuddenham to Easton scheme; see location and extent shown on the General Arrangement Plans (**TR010038/APP/2.2**) and Works Plans (**TR010038/APP/2.4**).
- 11.1.2. Development of compound proposals have taken place to account for the requirements of the construction works, and in particular the location of the new structures, junctions and major utility diversions. The presence of local community receptors and environmental constraints have also been accounted for in the planning of the compound areas. Feedback from Highways England on local landowner considerations has also been factored into the selection and extent of the compound locations.
- 11.1.3. For example, land north-east and south-east of the proposed Wood Lane junction would be used by National Grid a construction work area to facilitate the diversion of the high pressure gas main. These locations were also considered as options for subsequent occupation as Scheme wide compound locations following completion of the gas pipeline diversion works. However, these areas were discounted for such use as the southern field was too close to a residential property, while the northern field was required as a construction work area.
- 11.1.4. It is currently estimated that approximately 90 employees would be working permanently on the site during the construction period, with an expectation of an additional 10% for visiting staff. It is currently expected that a ratio of permanent employees to other personnel, including personnel from supply chain partners, statutory authorities and support functions, of 1:5 is likely, resulting in a peak expectation of around 550 people on site.

Table 11-1: Proposed temporary site compounds

Compound number	Approximate area (m ²)	Purpose and justification	Access arrangements	Further details
1	25,000	<p>Traffic management (TM) compound to:</p> <p>Provide a base for traffic management and vehicle recovery operations.</p> <p>To serve the construction of Mattishall Lane Link Road underbridge and the new Mattishall Lane side road.</p>	Off the existing A47 junction with Low Road.	<p>TM compound required to be in operation on a 24/7 basis to service the TM and recovery requirements of the Scheme.</p> <p>Shown as Work No. 59 on the Works Plans (TR010038/APP/2.4).</p>
2	33,700	<p>Satellite compound to serve the construction of the Wood Lane junction and underbridge.</p>	Off the existing A47 westbound (left in, left out only).	Shown as Work No. 62 on the Works Plans (TR010038/APP/2.4).
3	50,400	<p>Main compound for the Scheme including site offices and storage and processing facilities for earthworks materials and aggregates.</p> <p>Also serves the construction of:</p> <p>River Tud crossing</p> <p>Norwich Road junction and underbridge</p> <p>Honingham church underpass and associated WCH route</p>	Off Norwich Road from the Honingham roundabout on the existing A47.	Shown as Work No. 65 on the Works Plans (TR010038/APP/2.4).
4	17,600	<p>Satellite compound to serve the construction of the Easton footbridge, including delivery and assembly of structural steel members for the bridge approach ramps and main span.</p>	Off Church Lane, north of the A47 from Easton roundabout on the existing A47.	Shown as Work No. 71 on the Works Plans (TR010038/APP/2.4).

Compound 1 – traffic management compound

- 11.1.5. Compound 1 has been located to service the traffic management facilities and construction of the western extents of the scheme, including Mattishall Lane Link Road underpass. This compound is expected to serve approximately 60 people. The compound has been sized to allow sufficient space for:
- storage of traffic management equipment and vehicles requiring 24 hour access
 - recovery vehicle and accommodation, including emergency vehicle refuges
 - 24 hour welfare facilities
 - parking and welfare facilities
 - storage of high value plant, equipment and materials.
- 11.1.6. The compound has been located in the south-east corner between Low Road and the existing A47 with the main access directly off Low Road. This would minimise the disruption of the 24 hour operation on local residents along Mattishall Lane and in Hockering. Receptors identified below have been considered, but it was deemed measures could be taken to avoid or minimise any risk of significant impacts. Further, consideration of the measures outlined in the Environmental Management Plan (**TR010038/APP7.4**) will be taken into account during the detailed planning and construction of the compound:
- residential dwellings along Mattishall Lane and west of Low Road
 - area of botanical interest south of Mattishall Lane
 - area of high potential for terrestrial invertebrates south of Mattishall Lane
- 11.1.7. Other factors that will be considered in the detailed planning of the layout and construction of the compound includes:
- local traffic management and minor carriageway improvements around the A47/Low Road junction
 - control of compound run off
 - siting of topsoil storage to provide screening
 - siting of noise and light emitting equipment to avoid or minimise disturbance to nearby receptors

Compound 2 - satellite compound

- 11.1.8. Compound 2 has been located to service the western section of the Scheme, including Wood Lane junction and Hall Farm access, and is expected to serve approximately 140 people. The compound has been sized to allow sufficient space for:
- parking and welfare facilities
 - satellite office and supply chain partner offices

- storage of high value plant, equipment and materials
- concrete wash out and vehicle washdown facilities
- delivery vehicle stacking and waiting facilities

11.1.9. The compound has been located immediately south of the existing A47 and between Hillcrest Cottage and Berrys' Hall. The main access would be directly onto the A47 westbound with a left turn only facility required to access and exit the compound. Receptors identified below have been considered, but it was deemed measures could be taken to avoid or minimise any risk of significant impacts. Further, consideration of the measures outlined in the Environmental Management Plan (TR010038/APP7.4) will be taken into account during the detailed planning and construction of the compound:

- residential dwellings to the east and west, including Hillcrest Cottage and Berry Hall Cottages
- deciduous woodland to the north-east and south-east
- area of botanical interest west of Hillcrest Cottage
- area of high potential for terrestrial invertebrates west of Hillcrest Cottage

11.1.10. Other factors that will be considered in the detailed planning of the layout and construction of the compound includes:

- local traffic management and minor carriageway improvements around the A47 access, including localised vegetation clearance
- control of compound run off
- siting of topsoil storage to provide screening
- siting of noise and light emitting equipment

Compound 3 – main compound

11.1.11. Compound 3 has been located to service the overall Scheme with additional provisions for the eastern section of the Scheme, including River Tud crossing and Norwich Road junction. This compound is expected to serve approximately 308 people. The compound has been sized to allow sufficient space for:

- parking and welfare facilities
- employer, contractor and supply chain partner office facilities
- induction and medical facilities
- materials testing facilities
- storage of high value plant, equipment and materials
- concrete wash out and vehicle washdown facilities
- delivery vehicle stacking and waiting facilities
- material processing and storage areas

- cement bound granular mixture batching plant and associated storage area

11.1.12. The compound has been located immediately south of the existing Honingham roundabout with access directly from the roundabout. Receptors identified below have been considered but are not deemed to be in sufficient proximity to be detrimentally affected. Consideration of these will be taken into account in the detailed planning and construction of the compound:

- deciduous woodland to the south-west
- existing water body to the south-east

11.1.13. Other factors that will be considered in the detailed planning of the layout and construction of the compound includes:

- local traffic management and minor carriageway improvements or alterations around the A47 access, including localised vegetation clearance
- control of compound run off
- siting of topsoil storage to provide screening
- siting of aggregate storage and batching facilities
- siting of noise and light emitting equipment

Compound 4 - satellite compound

11.1.14. Compound 4 has been located to service the eastern extents of the Scheme, including Easton footbridge, and is expected to serve approximately 40 people. The compound has been sized to allow sufficient space for:

- parking and welfare facilities
- storage of high value plant, equipment and materials
- concrete wash out and vehicle washdown facilities
- assembly and fabrication facilities for Easton footbridge

11.1.15. The compound has been located north of the A47 and west of Church Lane with the main access directly to Church Lane. Receptors identified below have been considered but are not deemed to be in sufficient proximity to be detrimentally affected. Consideration of these will be taken into account in the detailed planning and construction of the compound:

- residential dwellings to the south of the A47 in Easton
- Slow Worm and Grass Snake habitat east of Church Lane
- high value deciduous woodland east of Church Lane

11.1.16. Other factors that will be considered in the detailed planning of the layout and construction of the compound includes:

- local traffic management and minor carriageway improvements around the Church Lane access, with sufficient allowance to import structural components.
- control of compound run off
- siting of topsoil storage to provide screening
- siting of noise and light emitting equipment

11.1.17. Compounds have been sized to allow for the facilities to undertake the works and to cater for the peak expected workforce, as detailed above.

11.2. Material Storage and Processing Areas

11.2.1. Table 11-2 summarises the proposed soil storage and processing areas which are required to facilitate the construction of the A47 Tuddenham to Easton scheme; see location and extent in the Works Plans (**TR010038/APP/2.4**).

11.2.2. The mainline highways works for the Scheme will involve a significant proportion of earthworks associated with the construction and development of the designed alignment through excavation (cuttings) and filling (embankments). In addition, there are earthworks relating to necessary and ancillary construction works including structures (culverts, bridges, etc), drainage works, utilities and services placement and diversions, and various accommodation works which are required to support, enable and facilitate the mainline construction.

11.2.3. In addition to the construction related earthworks, there is a requirement to strip existing topsoil within the proposed extent of the Scheme to permit construction to be carried out. The topsoil is required for landscaping and restoration of the Scheme post construction and as such will need to be stockpiled and managed appropriately to preserve and maintain the pedological characteristics and value in accordance with applicable standards and best practice.

11.2.4. Overall, the constructive earthworks and the topsoil stripping when taken together present a significant volume of materials to efficiently and expediently manage as part of the execution and delivery of the Scheme. Moreover, the distinctly different requirements for managing the topsoil from other earthworks materials imposes additional challenges and constraints on how the two broad material types need to be managed.

11.2.5. The design of the Scheme will as far as is practicable aim to deliver an earthworks plan whereby material export and import to construct the Scheme is minimised. In this regard the materials that are excavated will as far as is practicable be used within the areas where filling is needed, with the respective volumes matched where possible. In addition, the topsoil stripped will be used within the Scheme landscaping and restoration such that there is as far as possible no excess or shortfall.

11.2.6. This notwithstanding, whilst the design may ultimately achieve a material balance as far as practicable, carrying out the earthworks themselves will require appropriate mass-haul planning (economical movement and use of materials). It will also require phasing of the mass haul linked to the construction programme to ensure efficient and effective earthworks delivery.

Table 11-2: Temporary soil storage and processing areas

Area	Approximate total plan area (m ²) ⁽¹⁾	Details	Indicative likely usage and justification ⁽²⁾	Further details
1	38,800	Land between south of the proposed new A47 mainline, east of Lyng Road and north of Low Road. Access off Lyng Road integrated with adjacent main line construction.	Parcel of land for materials storage and processing. Offers proximal location for efficient material management for works in western section of the Scheme.	Shown as Work No. 58 on the Works Plans (TR010037/APP/2.4).
2	15,000	Land between existing A47, proposed new A47 mainline, Mattishall Lane Link Road and existing Mattishall Lane from which access will be gained.	A smaller area for materials storage and predominantly topsoil. In addition, the topsoil storage is expected to afford additional screening for TM compound (Compound 1) from receptors immediately to the east.	Shown as Work No. 60 on the Works Plans (TR010037/APP/2.4).
3	91,000	Land between existing A47 and proposed new A47 mainline, south-east of Hockering. Access as part of main works.	Large rectilinear parcel of land for efficient materials management including necessary processing and marshalling of soils (including topsoil) proximal to works required in the western part of the Scheme.	Shown as Work No. 61 on the Works Plans (TR010037/APP/2.4).
4	16,800	Land south and west of southern roundabout on proposed Wood Lane junction. East of proposed Compound 2. Access as part of main works or Berrys Lane.	A rectilinear parcel of land providing space primarily for material storage (topsoil) adjacent to major element of works involving significant earthworks and more generally offers proximal location for material storage within the central section of the Scheme.	Shown as Work No. 63 on the Works Plans (TR010037/APP/2.4).

Area	Approximate total plan area (m ²) ⁽¹⁾	Details	Indicative likely usage and justification ⁽²⁾	Further details
5	97,600	Land north of proposed A47 mainline and east of the northern roundabout on proposed Wood Lane junction. Access as part of main works.	Large rectilinear parcel of land for materials storage and management including necessary processing and marshalling of soils (including topsoil) adjacent to major grade separated junction involving considerable earthworks and proximal to other works required in the central part of the Scheme.	Shown as Work No. 64 on the Works Plans (TR010037/APP/2.4).
6	61,500	Land south of existing A47 and Honingham roundabout. Adjacent to main works compound (Compound 3). Access as part of the main work.	A large rectilinear parcel of land providing space for material storage and management including necessary processing and marshalling of soils (including topsoil) which is proximal to works in eastern section of the scheme including Norwich Road junction and River Tud crossing, both of which would involve a significant element of earthworks.	Shown as Work No. 66 on the Works Plans (TR010037/APP/2.4).
7	23,000	Land north-east of proposed Norwich Road Junction. Access as part of main works.	Materials storage (topsoil predominantly) proximal to works in eastern section of the Scheme.	Shown as Work No. 67 on the Works Plans (TR010037/APP/2.4).
8	34,400	Land south-east of proposed Norwich Road junction. Access as part of main works.	Materials storage (topsoil predominantly) proximal to works in eastern section of the Scheme.	Shown as Work No. 68 on the Works Plans (TR010037/APP/2.4).
9	21,400	Land north of proposed A47 mainline and west of Church Lane (Easton). Access off Church Lane and as part of	Three parcels of land located within a larger overall area north of the works for material storage and management including necessary	Shown as Work No. 69 on the Works Plans (TR010037/APP/2.4).

Area	Approximate total plan area (m ²) ⁽¹⁾	Details	Indicative likely usage and justification ⁽²⁾	Further details
10	12,600	main works.	processing and marshalling of soils (including topsoil) which is directly adjacent and proximal to works in eastern section of the Scheme and works around Easton. The area is also subject to works to be carried out by Ørsted and as such flexibility is required to maintain sufficient space for A47 related materials management and storage whilst facilitating access for Ørsted works.	Shown as Work No. 70 on the Works Plans (TR010037/APP/2.4).
11	25,700			Shown as Work No. 72 on the Works Plans (TR010037/APP/2.4).

Notes:

- (1) Functional working area for materials storage, management and processing is taken as around 90% of the plan area to allow for plant movement, safe operations, plant/personnel segregation, security, etc.
- (2) The likely usage and justification is based on the commentary provided in Section 11.1 of this Report.

- 11.2.7. The development and subsequent execution of the mass haul is predicated on having working space within the curtilage of the works for handling and managing materials; marshalling the movement of soils within the works, temporarily stockpiling materials and if necessary processing and conditioning of the materials to render them suitable for use.
- 11.2.8. In light of the storage requirements, the areas allocated within the DCO boundary for the materials management have been selected to meet one or more of the following criteria.
- minimise as far as possible adverse environmental impact, and in this regard location in areas where any impact can be ameliorated as necessary
 - Dedicated space is required, as far as possible, outwith the immediate footprint of the permanent works and working areas. This is so stockpiling, management and processing of the earthworks materials do not frustrate, restrict or prevent the efficient construction of the scheme as programmed.
 - The size and shape of any area used for materials storage, management and processing must be suitable for the safe execution of the various activities required. This includes access and egress linked closely to the main construction works, space for safe plant operation and movement, space for appropriate segregation of plant and personnel.
 - The areas for materials storage, management and processing need to provide sufficient space for stockpiling and processing commensurate with the nature of the materials concerned. This is to enable the properties and characteristics of the materials to not be impaired and rendered unsuitable.
 - The materials storage, management and processing areas need to be located optimally to support the earthworks. In this regard the areas need as far as possible to be proximal to the main works to avoid excessive and inefficient haulage, particularly Wood Lane and Norwich Road junctions. Inevitably as a consequence of the linear nature of the Scheme, this will necessitate a number of areas established at suitable locations but working simultaneously to support the construction efficiently.
- 11.2.9. In addition to the general criteria to be satisfied for the materials storage areas, the specific technical requirements that apply to the management and storage of topsoil impose additional requirements to have areas to be primarily used for managing topsoil. These specific technical requirements include:
- restrictions on storage mound geometry and height
 - the need to ensure no over-compaction and loss of structure
 - avoiding cross-contamination and degradation in quality
 - safeguarding against self-seeding

- 11.2.10. These require additional areas to be defined for this specific topsoil storage use which cannot practically be combined within those areas where other materials storage, management and processing is taking place. Also given the construction sequence, dedicated topsoil storage areas will need to be preserved and maintained throughout the course of the works.
- 11.2.11. The preliminary assessment of earthworks requirements and volumetric analysis for the Scheme based on the current design is summarised in Table 11-3. This has been used to identify the quantum of areas needed for materials storage, management and processing.

Table 11-3: Summary of principal earthworks volumes

Material, origin and use		Estimated volume (m ³)
1	Total topsoil from stripping within the Scheme to allow construction	235,000
2	Topsoil for immediate use at point of origin not requiring stockpiling (i.e. short-term retention within the immediate workspace)	29,000
3	Surplus topsoil from stripping to be used in Scheme landscaping, restoration etc which will need to be retained and stockpiled pending incorporation into scheme.	206,000
4	Volume of non-topsoil material to be excavated from within the Scheme (excludes full assessment of earthworks in and around structures – volume may increase).	700,000
5	Volume of earthworks for scheme construction – fill to create the design alignment.	824,000
6	Volume of site won material which may not be suitable for direct placement (i.e. out of specification or U1 Classification) and will require treatment to render it useable or otherwise retained pending use or disposal (estimated at 15% of dug volume)	105,000
7	Volume of material to be imported to Scheme (balance of materials not sourced from site excavation).	124,000

- 11.2.12. Considering the storage and management of topsoil, the estimated volume involved is 206,000m³; see item 3 in Table 11-3. If this is to be stockpiled temporarily or for the duration of the works the approximate area required for stockpiling with an allowance for working space is 170,000m². This is based on assuming a stockpile height not exceeding 2m, based on the specification in DMRB Series 600, and an assumed safe slope angle for topsoil of 1V:2H.

- 11.2.13. The larger volume of material to manage pursuant to the requirements set out above is that associated with the constructive earthworks. There is a shortfall in overall volume requiring material import of approximately 124,000m³; see item 7 Table 11-3. The importation of this material will need to be managed and planned to provide for efficient construction. Although some imported material may be used directly as it is brought in, it is expected that a larger proportion of this imported material will need to be temporarily stored and managed on site as the works progress.
- 11.2.14. In addition to the imported soils to make up the total volume required, there is a volume 'as dug' materials of around 105,000m³; see item 6 Table 11-3, which is currently classified as being potentially unsuitable for direct reuse. As far as possible, this will be used in the Scheme to avoid further import and will be subject to necessary processing, treatment and marshalling/storage to render it suitable for use and to be in specification.
- 11.2.15. With regard to the requirements for managing the materials required for constructive earthworks, it is considered that the expected working space needed for the management of earthworks materials, excluding the topsoil, is around 150,000 to 200,000m². This is based on best construction practice, calibrated against specific and comparable schemes elsewhere (e.g. A14 Cambridge to Huntingdon improvement scheme), and related to phased construction, efficient execution and programme.
- 11.2.16. In summary, the areas identified for materials storage, management and processing provide in total an estimated functional working area of approximately 437,800m²; see Table 11-2. This is broadly balanced against the assessed spatial requirements as determined from the earthworks volumes.

11.3. Construction Programme and Methods

- 11.3.1. The Scheme could be constructed over two years, with an assumed start of January 2023 and opening end of 2024 depending on award of the DCO.
- 11.3.2. The construction programme, phasing and methods are described works in ES Chapter 2 The Proposed Scheme (TR010038/APP/6.1). The approach described is indicative, but it is representative of the likely approach to be adopted.

11.4. Construction Site Management

- 11.4.1. An Environmental Management Plan (EMP) (TR010038/APP/7.4) has been prepared to include construction, operational and maintenance good practice and mitigation measures. These have been identified in part by the assessments presented in the ES (TR010038/APP/6.1). The EMP includes the register of environmental actions and commitments.
- 11.4.2. In line with DMRB LA 120 *Environmental Management Plan*, the EMP establishes a suitable mechanism to link assessment assumptions, DCO Requirements and obligations. The EMP is secured by a requirement in the Draft DCO (TR010038/APP/3.1) and is a live document which will be revised as more information becomes available throughout the lifetime of the Scheme.

- 11.4.3. The DCO application also contains an outline Traffic Management Plan (**TR010038/APP/7.5**) that defines the measures used to reduce the impacts from construction traffic, such as reducing worker vehicle and HGV movements, particularly at peak periods. This will be implemented by the contractor.
- 11.4.4. The construction traffic will be managed to limit noise and dust (as well as mud and the cleanliness of the local roads), in line with industry best practice. This will include the use of wheel washing and similar controls as set out in the EMP (**TR010038/APP/7.4**). Specific construction site management plans will be produced prior to the start of construction.

12. OPERATION OF THE SCHEME

12.1. Maintenance and Management

- 12.1.1. Once the proposed A47 mainline is opened, it would form part of the A47 trunk road and the wider strategic road network. The new A47 mainline would be managed by Highways England on a day to day basis using the monitoring and control systems in accordance with the relevant design standards.
- 12.1.2. The Scheme has been designed with maintenance and safe operation in mind, with liaison having taken place with Highways England's Operations Directorate (the day-to-day maintainers), at multiple points in the Scheme development and the feedback incorporated into the submitted proposals. Maintenance is defined as actions needed to inspect, repair, adjust, alter, remove, replace or reconstruct all aspects that relate to the Scheme. The Scheme has also provided platforms for police observation points and Highways England Enforcement Officer use.
- 12.1.3. Long-term maintenance and repairs to the highways and associated assets (including drainage) would be undertaken as required to maintain the appropriate standards for the relevant highway authority. It is currently anticipated that the de-trunked A47 and new side roads would become the responsibility of Norfolk County Council.
- 12.1.4. Maintenance access has generally been provided from the local road network where possible, however there are a couple of locations where access is taken directly from the dual carriageway. In these locations, this has been done to avoid significant lengths of access tracks and reduce the Scheme footprint.
- 12.1.5. Facilities for maintenance include the following:
 - vehicular access tracks for the maintenance of ponds and drainage outfall works
 - maintenance strips for access alongside highways drainage ditches
 - hardstanding and layby access with dedicated walkways for maintaining equipment along the Scheme
 - mobile elevated working platform access with lane 1 closure for ANPR camera heads on masts
 - hardstanding areas for proposed feeder pillars for power to lighting installations
 - hardstanding areas and access footways or steps for structures
 - level strips for the provision of acoustic barriers, enabling a level surface side of the barriers to be used for inspection and maintenance

12.2. Boundary Treatments

- 12.2.1. During the design attention has been paid to the space required between the earthwork footprint and Scheme boundary. As well as providing a highway boundary for safety and security, the permanent landtake requirements have considered the need for earthworks drainage and maintenance access strip between new structures and the Scheme operational land boundary.

12.2.2. With the exception of where alternatives have been agreed with neighbouring landowners or special fencing is specified for environmental mitigation, timber post and rail fence will be provided in accordance with the Manual of Contract Documents for Highway Works standard details.

12.3. Decommissioning

12.3.1. It is considered highly unlikely that the Scheme would be demolished before the end of its design life of 60 years as the road would have become an integral part of the strategic road network.

12.3.2. In the event of the Scheme needing to be demolished, this would conform to the statutory process at that time, including a separate EIA if required.