

A47 Blofield To North Burlingham Preliminary Environmental Information Report

PINS project reference number: TR010040

Highways England document reference: HE551490-MMSJV-EGN-000-RP-LX-00005

August 2018

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1 Introduction

1.1 The scheme

- 1.1.1 The A47 from Blofield to North Burlingham, comprising of a single carriageway (as shown in Figures 1.1 and 1.2) is located approximately 9km to the east of Norwich and forms part of the main arterial highway route connecting Norwich and Great Yarmouth. The route currently experiences delays and high levels of congestion during peak hours. The situation is predicted to get worse with proposed growth in residential development.
- 1.1.2 It is proposed to upgrade the existing 2.6km section of single carriageway between Blofield and North Burlingham to dual carriageway. The new section of dual carriageway with junction improvements is proposed to be constructed to the south of the existing carriageway. This scheme will henceforth be referred to as the 'Proposed Scheme'.
- 1.1.3 The Proposed Scheme is considered to be a Nationally Significant Infrastructure Project (NSIP) under the Planning Act 2008 and therefore requires a Development Consent Order (DCO), issued by the Secretary of State, before construction and operation can commence.
- 1.1.4 Subject to successfully passing through the DCO process, the key timescales for the Proposed Scheme are as follows:
- Start of construction work – 2021
 - Open for traffic – 2022

1.2 The purpose of the preliminary environmental information report

- 1.2.1 The purpose of this Preliminary Environmental Information Report (PEIR) is firstly to meet the requirements of the Infrastructure Planning (Environmental Impact Assessment) EIA Regulations 2017, but also to inform the public, landowners, prescribed bodies and other stakeholders about the ongoing Environmental Impact Assessment (EIA) work and the preliminary information on the environmental impacts of the development proposals.
- 1.2.2 Preliminary Environmental Information is defined by the Infrastructure Planning EIA Regulations 2017, Regulation 12(2), with advice updates to some chapters (Biodiversity, Climate, Materials, People and Communities – Social, and Geology & Soils) in Advice Note Seven (EIA: Process, Preliminary Environmental Information and Environmental Statements – The

Planning Inspectorate (PINS), December 2017). This is defined as ‘information referred to in regulation 14(2) which:

- (a) has been compiled by the applicant; and
- (b) is reasonably required to assess the environmental effects of the development (and of any associated development)’

1.2.3 This PEIR therefore provides a preliminary assessment of the potential environmental impacts and known receptors within each of the environmental topic study areas. This document gives stakeholders an understanding of the potential environmental impacts of the Proposed Scheme and of the measures proposed to reduce those impacts at this early stage of the EIA.

1.3 Availability of the PEIR

1.3.1 Copies of the PEIR will be available as part of the consultation material produced for the A47 Blofield to North Burlingham statutory public consultation to be carried out in September and October 2018. Details of the consultation events will be available in the Statement of Community Consultation.

1.4 Summary of the EIA process

1.4.1 EIA is a process that identifies the likely environmental effects (both adverse and beneficial) of a proposed development. Environmental effects are assessed through understanding of the potential impacts and the sensitivity of the receptors for a given scheme. It ensures that the importance of effects are properly considered and that the opportunity for reducing any adverse effects are taken into account as part of the design development process.

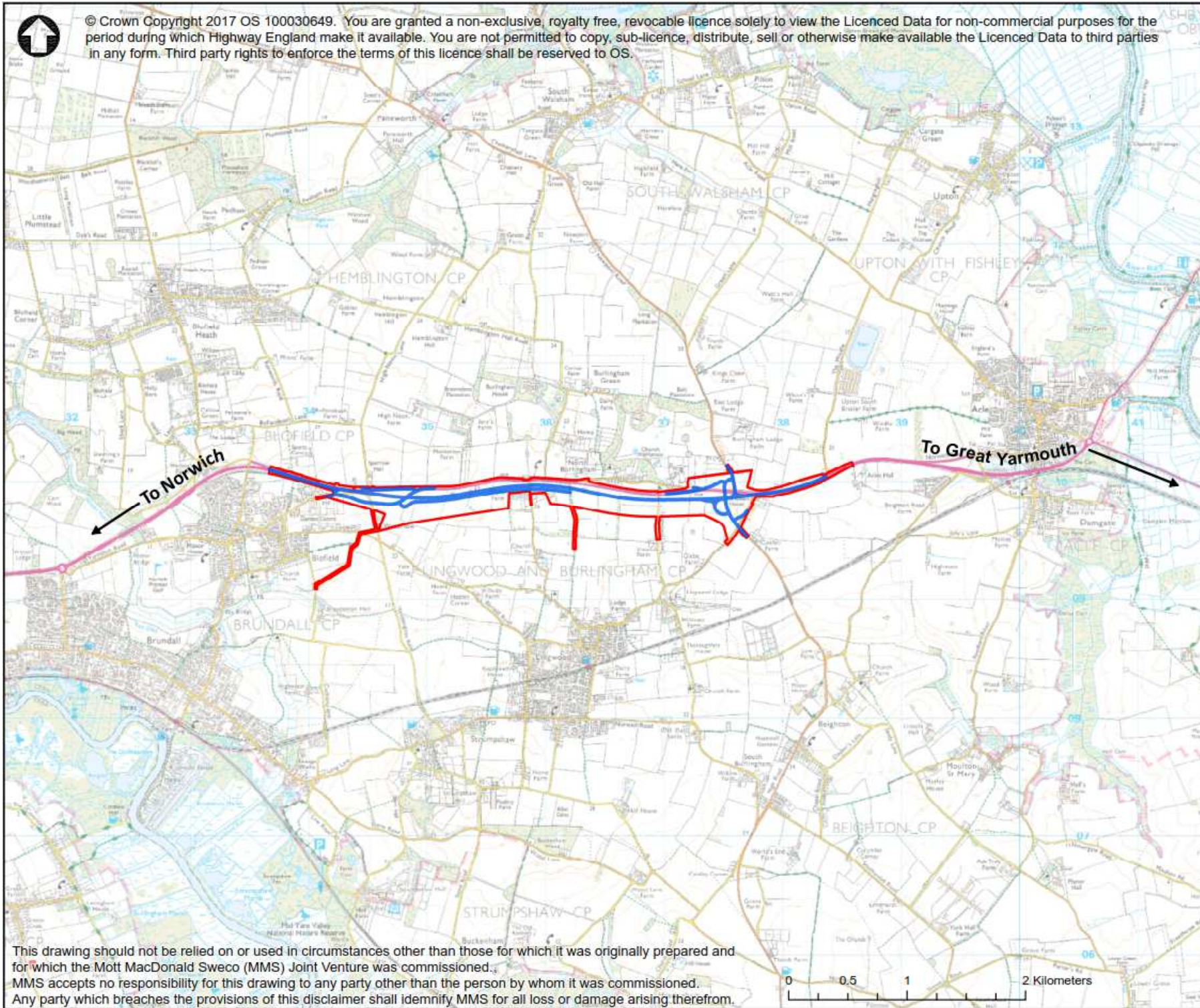
1.4.2 EIA also ensures effects considered during the design development process are understood by the public, the relevant competent authorities, statutory authorities and other interested parties. The EIA is undertaken in accordance with relevant legislation and guidance and includes a spatial and temporal scope for its assessment.

1.4.3 Scoping is an important part of the EIA process and determines which environmental topics are to be examined during assessment. The Scoping Report describes how the EIA is to be undertaken, and identifies the technical environmental disciplines to be considered. Defining the environmental scope is one of the most critical parts of the EIA as it sets out the method for the detailed assessment.

-
- 1.4.4 An EIA Scoping Report was submitted to PINS on 6 February 2018 to inform its Scoping Opinion. Highways England received the Scoping Opinion from PINS on 19 March 2018. The scope of the EIA has been adjusted to take into account comments received from both PINS and relevant consultees.
- 1.4.5 The Proposed Scheme is defined as a NSIP under Section 14(1)(h) and Section 22 of the Planning Act 2008 (PA 2008) (as amended) by virtue of meeting the following criteria:
- It comprises the alteration of a highway
 - The highway is to be constructed wholly in England
 - The Secretary of State will be the highway authority for the highway
 - The speed limit for any class of vehicle on the highway is to be 50 miles per hour or greater, and the area of development is greater than 12.5ha
- 1.4.6 In accordance with the legislation, a DCO is therefore required to allow the construction and operation of the Proposed Scheme.
- 1.4.7 Following the completion of the EIA Scoping Report, the subsequent Scoping Opinion from PINS and the EIA work undertaken to date, the EIA for a DCO is reported in 2 stages:
- The PEIR, prepared to inform the consultation with the public, prescribed consultees and other stakeholders on the characteristics of the Proposed Scheme
 - The Environmental Statement (ES), prepared to accompany the DCO application
- 1.4.8 Each environmental topic chapter of this PEIR describes the local environment and identifies any sensitive receptors such as Sites of Special Scientific Interest, people living in the vicinity of the Proposed Scheme and local environment management areas such as Air Quality Management Areas or Noise Important Areas.
- 1.4.9 Environmental surveys that have been carried out for each topic are included along with detail of consultation with the Statutory Environmental Bodies, Local Authorities and other stakeholders. Likely impacts of the Proposed Scheme on the local environment are then described.
- 1.4.10 The significance of environmental effects is not addressed within the PEIR; however, this is to be considered in the ES.



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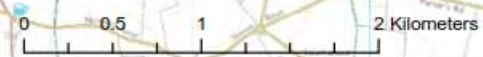
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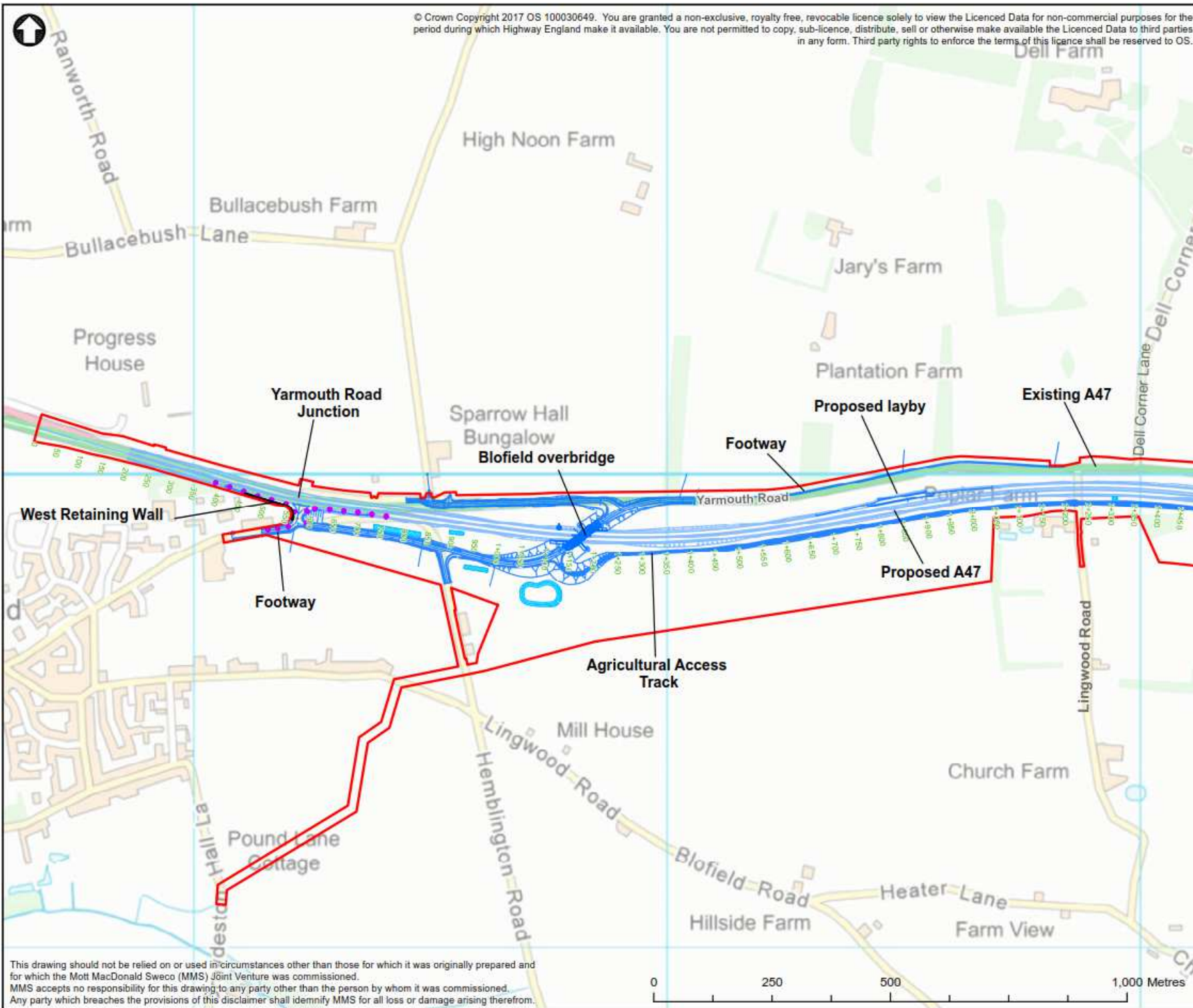
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Drawing Status	Drawing
For information	S2
Project Title	
A47 Blofield to North Burlingham	
Drawing Title	
Figure 1.1 - Site Location	

Scale	1:30,000	Designer	Whitley, Zoe	Drawn	Mason, Jack	Checked	Murphy, Matt	Approved	Jones, Bryn
Original Issue	A4	Date	25/09/18	Date	09/08/2018	Date	09/08/2018	Date	25/07/18
Drawing Number	HE551490	Originator	MMSJV	Industry	EGN	Project Ref. No.			
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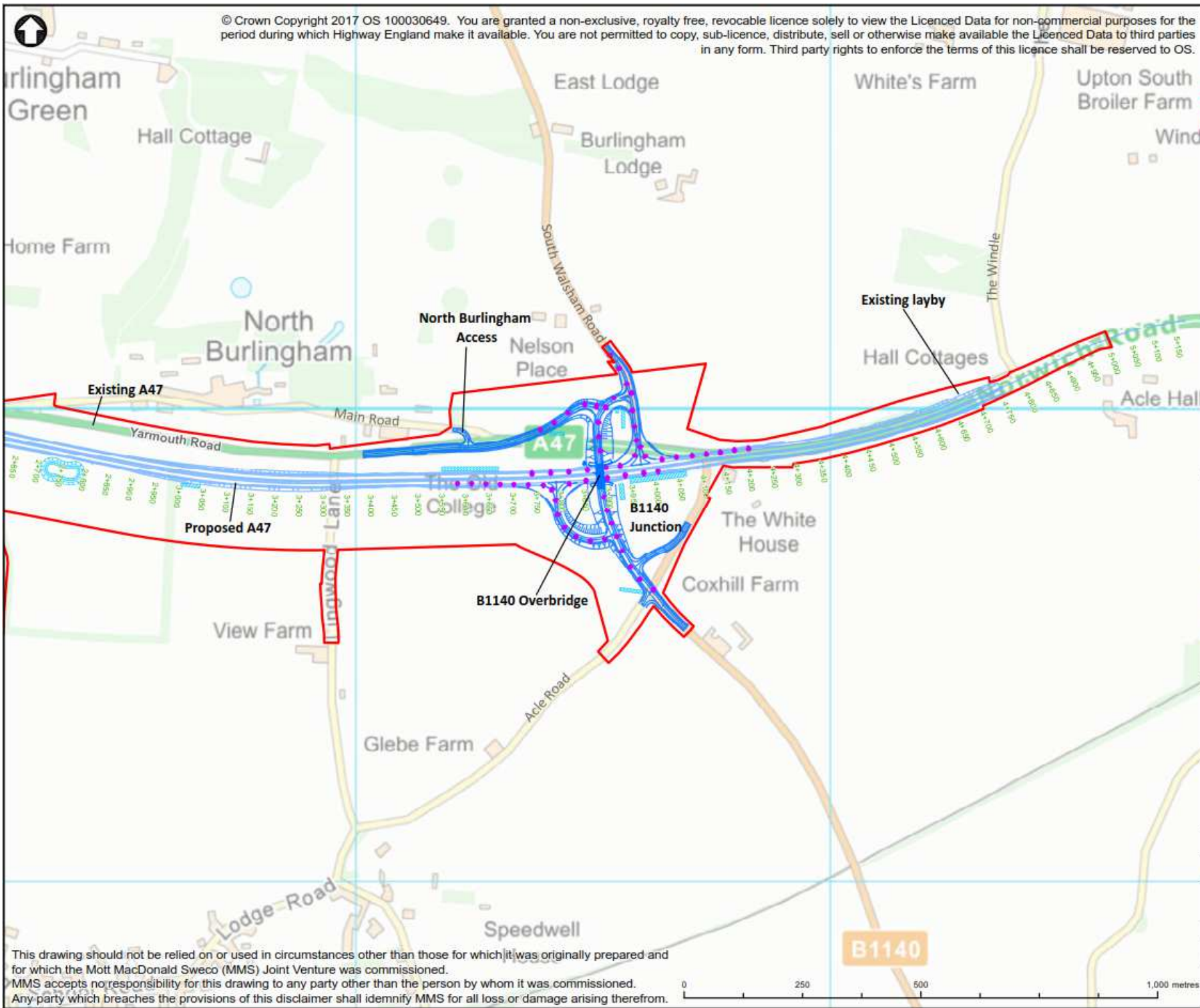
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Drawing Name	For Information	Assembly	S2
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Project Title: A47 Blofield to North Burlingham

Drawing Title: Figure 1.2 - Design Fix B General Layout Plan (East)

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2 The Proposed Scheme

2.1 Overview

- 2.1.1 In the immediate vicinity of the existing A47 there are agricultural fields enclosed by hedgerows with mature trees and small areas of woodland. The existing A47 is partially lined by mature trees and hedgerows, but is more widely characterised by a context of open arable farmland with limited field boundary vegetation. The surrounding area is generally flat and low-lying landscape. It has limited topographic variation and slopes gently from west to east, becoming flatter as it merges with the Broads. The area is also characterised by isolated farmsteads and small, nucleated villages with large medieval churches which are linked by a dense network of lanes. Larger populations include Blofield to the west, Acle to the east and North Burlingham centrally located, adjacent to the eastbound carriageway of the existing A47.
- 2.1.2 Currently, the existing A47 from Blofield to North Burlingham experiences delays and high levels of congestion during peak hours. The situation is predicted to get worse with proposed growth in residential development.
- 2.1.3 The Proposed Scheme comprises:
- 2.6km of dual carriageway on the A47
 - de-trunking of the existing A47 section between Blofield and North Burlingham
 - improvements at Yarmouth Road Junction (see Figure 2.1), including closure of the central reserve, closure of High Noon Lane direct access, merge lane, Hemblington Road realignment and local access improvements at the Sparrow Hall properties
 - introduction of a compact grade separated junction at B1140 Junction (see Figure 2.2), including the B1140 Overbridge
 - a new overbridge at Blofield traversing the proposed A47 dual carriageway, connecting Yarmouth Road with the existing A47
 - provision of new drainage systems including an attenuation pond and retention of existing drainage systems where possible
 - a retaining wall in the western extents
 - introduction of lighting at the Yarmouth Road Junction and new lighting layout at the B1140 Junction
 - closure of an existing layby and provision of a new layby
 - a footway connecting Blofield and North Burlingham via the Blofield Overbridge
 - provision of North Burlingham Access
 - Agricultural Access Track

- boundary fencing, safety barriers and signage

2.2 Roads

Realigned A47

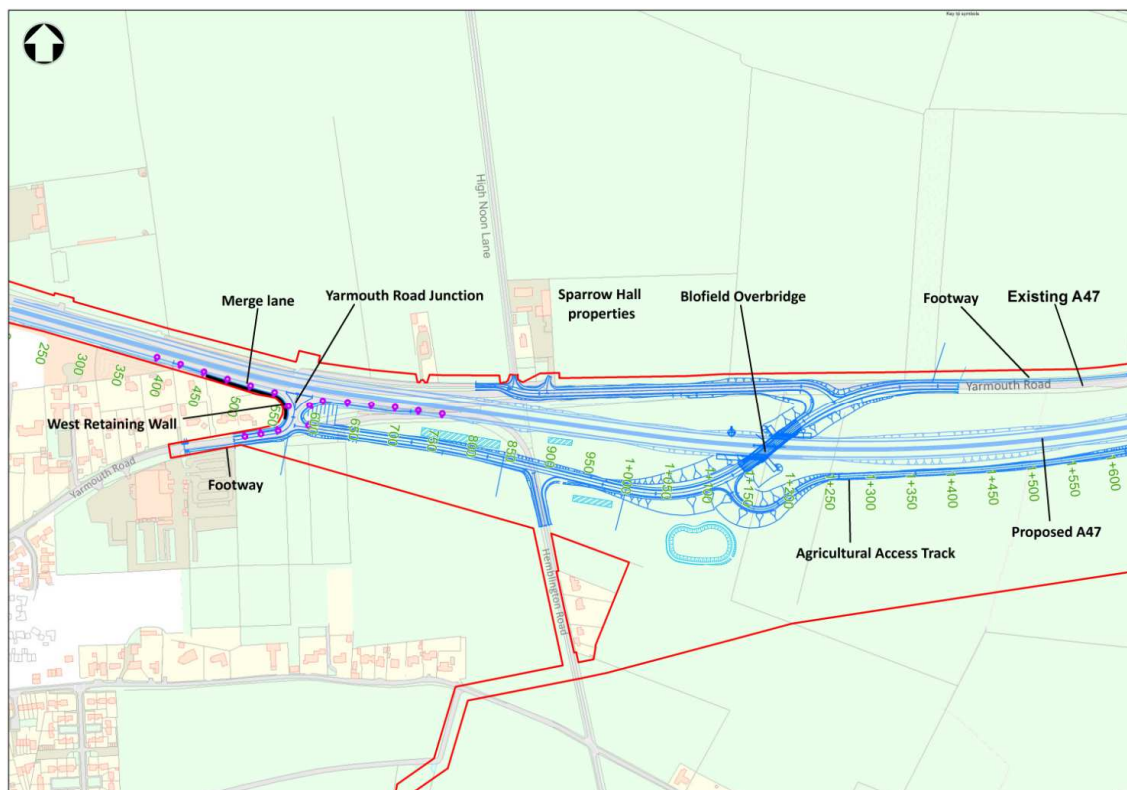
- 2.2.1 The proposed A47 dual carriageway alignment design moves off-line from Yarmouth Road, and continues parallel to the south of the existing A47, re-joining the existing alignment east of the B1140, replacing the single carriageway alignment.
- 2.2.2 The alignment removes right turns across this section of the A47 and allows for safer and easier merging and diverging to and from the proposed A47.
- 2.2.3 The alignment contains one new layby for use by all.
- 2.2.4 Where the existing A47 is unaffected by the dualling, it is proposed to be de-trunked and serve as a local access road for residents, with a new footway provided adjacent to the eastbound carriageway connecting Yarmouth Road to the existing footway at the Dell Corner Lane junction.

Fencing, barriers and road signage

- 2.2.5 Boundary fencing will be provided to delineate the highway boundary.
- 2.2.6 Safety barriers and road signage are also included in the Proposed Scheme. This will be reported in more detail in the Environmental Statement (ES) as the design is refined.

Yarmouth Road junction

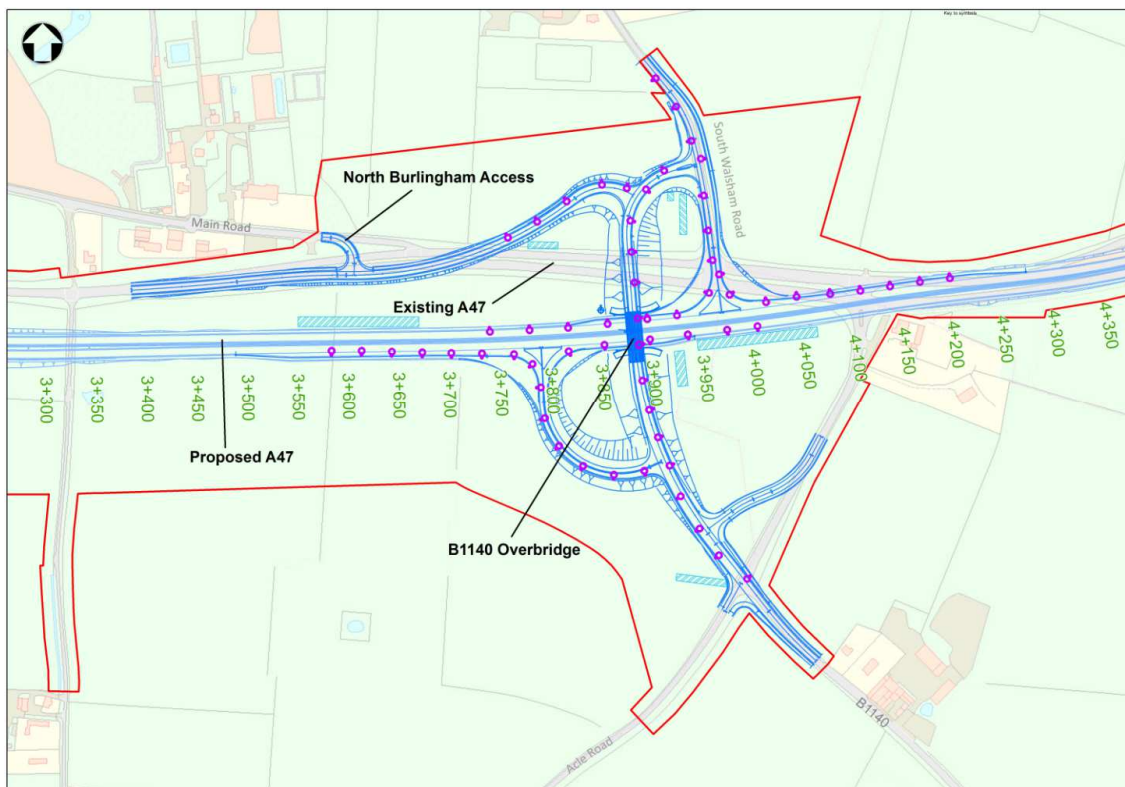
Figure 2.1 : Proposed Yarmouth Road junction



- 2.2.7 The Yarmouth Road junction is proposed to be adjusted to suit the re-aligned A47, with the gap in the central reservation closed to right turning vehicles. The Blofield Overbridge is provided east of the junction to allow for vehicles and non-motorised users to access north of the re-aligned A47.
- 2.2.8 The private means of access to High Noon Lane with existing direct, at grade access on the eastbound carriageway of the A47 would be stopped up. The Proposed Scheme would provide access from the realigned Yarmouth Road North. General improvements to the surrounding local junctions and accesses at the Sparrow Hall properties would also be made.
- 2.2.9 A merge lane is to be provided, to allow vehicles to join the A47 without the need to stop.

B1140 junction

Figure 2.2: Proposed B1140 junction



- 2.2.10 The existing staggered cross-roads at the B1140 is to be replaced with a compact grade separated junction, allowing for safer and easier merging and diverging to and from the proposed A47. This junction arrangement also provides an overbridge for traffic travelling north / south crossing the A47. The existing A47 would be de-trunked and realigned to tie into the compact grade separated junction.
- 2.2.11 Parallel merge and diverge lanes will be provided to mitigate speed differentials between side road and mainline traffic.
- 2.2.12 Revised access arrangements will be provided for residents.

North Burlingham Access

- 2.2.13 The existing junction at the eastern extent of North Burlingham connecting the Main Road to the existing A47 is a one-way single carriageway travelling out of North Burlingham. The Proposed Scheme introduces a new junction, North Burlingham Access that provides vehicle access in both directions and reduces diversion time for vehicles travellers approaching North Burlingham from the east.

Agricultural Access Track

- 2.2.14 Access at the southern approach to the proposed Blofield Overbridge would provide agricultural access south of the proposed A47 mainline.

Structures

- 2.2.15 The Proposed Scheme includes three new structures. These structures comprise the Blofield Overbridge (S01) and B1140 Overbridge (S03), as well as the West Retaining Wall (S04).

Blofield Overbridge (S01)

- 2.2.16 Comprised of a two-span pre-cast pre-stressed beam composite deck, proposed to carry Yarmouth Road over the new A47 dual carriageway mainline. A 3m wide footway is proposed to be included as part of this structure.

B1140 Overbridge (S03)

- 2.2.17 Comprised of a two-span pre-cast pre-stressed beam composite deck, proposed to carry the B1140 over the new A47 dual carriageway mainline.

West Retaining Wall (S04)

- 2.2.18 Located at the west end of the Proposed Scheme and comprising of a series of L shaped pre-cast units founded on a concrete base, the wall retains the new A47 dual carriageway mainline. The structure is approximately 125m long and retains a soil height of approximately 1.3m.

2.3 Lighting

B1140 junction

- 2.3.1 The provision of new road lighting is proposed along the A47 mainline, adjacent to both the eastbound (approximately ch3+750 to ch4+200) and westbound carriageways (approximately ch3+600 to ch4+000).
- 2.3.2 The provision of new road lighting is proposed on the B1140 at the 2 junctions located north of the A47 mainline and the 3 junctions located to the south. The approach to each junction would be illuminated for the length of carriageway necessary to provide 5 seconds of driving distance at the posted speed limit.

-
- 2.3.3 The existing lighting on the A47 (approximately equivalent to ch3+500 to ch4+500 of the proposed mainline) will be removed as part of the Proposed Scheme.

Yarmouth Road junction

- 2.3.4 New lighting is proposed at the Yarmouth Road junction (approximately ch400 to ch750). The proposed lighting is located on the verge of the approach and exit on the A47 westbound carriageway. There are 3 lighting columns which extend down Yarmouth Road adjacent to the eastbound carriageway and a single lighting column adjacent to the eastbound carriageway of Hemblington Road.
- 2.3.5 Proposed columns on Yarmouth Road and A47 back onto residential properties but would be fitted with back light shields to mitigate light spill.

Lighting design

- 2.3.6 The lighting design is ongoing. The current indications are that 8m and 10m tall columns with LED luminaires would be located in verges (or at the back of footways where applicable) and oriented perpendicular to the carriageway. It is assumed that luminaires would be mounted with 0 degree tilts to ensure upward light spill is minimised.
- 2.3.7 Electrical supply to the lighting columns would be connected to a feeder pillar with outgoing circuits routed through ducting that is buried in verges and beneath the carriageway where applicable.

2.4 Drainage

Existing drainage

- 2.4.1 Where possible, existing drainage on the A47 will remain in place at the tie-ins with the existing A47. This excludes the approaches to junctions at the eastern and western extents of the Site where filter drains and soakaways will be relocated to maintain the operation of the drainage on the existing A47.
- 2.4.2 Where existing direct discharges to streams are not taking any increased road run-off from the Proposed Scheme, these outfalls will remain in place.

Surveys

- 2.4.3 Drainage surveys, including infiltration tests, for the Proposed Scheme will be undertaken in Summer 2018 and will confirm where existing drainage would be severed and if connections would be required into the new drainage networks. As a consequence, some assumptions regarding the design have been made, which will be confirmed and the final design described in the ES.

Infiltration rates

- 2.4.4 Estimated infiltration rates from historical information have been used to inform the initial estimated sizing of infiltration systems. These infiltration rates are to be confirmed with the results of the Ground Investigation and will be reported in the ES.
- 2.4.5 Although infiltration rates are expected to be poor, they are an acceptable option for drainage at the western and eastern ends of the Site. Ponds or frequent soakaways are included in the design, which emulates the existing drainage regime at these locations on the existing A47. In between the extremities of the Site, drainage channels / ditches and attenuation is proposed for the surface water discharges from the new road, to maintain existing greenfield rates.
- 2.4.6 Treatment in the form of filter drains, petrol interceptors or ponds / soakaways and separate spillage containment are also considered to be appropriate.

Flood improvements

- 2.4.7 It is expected that road run-off from approximately 400m of existing A47 may have to be brought into the new section of the drainage system due to the Proposed Scheme. These discharges would be attenuated along with the new section of widened roadway. This would reduce the likelihood of flooding downstream and reported in the ES.

Structure drainage

- 2.4.8 Deck drainage will be provided on the bridges.
- 2.4.9 Back of wall drainage is proposed for the West Retaining Wall (S04) and will drain to an existing ditch at this location.

Road drainage

- 2.4.10 Suitable outfalls have been identified such as existing ditch channels, streams, ponds or routed to natural valleys which slope southwards.
- 2.4.11 The new carriageways will discharge to attenuation ponds or to infiltration basins / soakaways via bypass petrol interceptors (if required), providing treatment of the surface water run-off, to maintain greenfield rates.
- 2.4.12 Ponds will incorporate shut off facilities e.g. penstocks to allow for the containment of spillages.
- 2.4.13 Kerbed sections of the mainline will include gullies or combined kerb and gully, discharging to the filter drains or carrier drains in the verges.
- 2.4.14 Filter drains will be provided at the toe of any cuttings along the mainline. The filter drains would drain the cuttings and collect the road run-off. Median drainage will be provided where the road is in super-elevation. Gullies or concrete channels would drain down into a drainage pipe in the central reserve.
- 2.4.15 Toe drains, where required, draining embankments greater than 1.5m, would drain via ditches to soakaways or along existing surface water pathways.
- 2.4.16 Side road links to the new carriageway would drain to soakaways provided infiltration tests are favourable at the proposed locations.
- 2.4.17 Natural overland drainage and existing ditches / streams between the existing A47 and the proposed new mainline will be intercepted by new ditches and conveyed along the natural drainage paths as far as possible. This will involve pipe crossings of the proposed new mainline. Additional measures (e.g. soakaways) may be required at the outfall where a defined link cannot be met with existing flow pathways.

3 Context of the Proposed Scheme and consideration of alternatives

3.1 The need for the Proposed Scheme

3.1.1 The single carriageway section of the A47 from Blofield to North Burlingham acts as a bottleneck resulting in congestion, particularly at peak times and leads to longer and unreliable journey times. The congestion is predicted to get worse with proposed growth in residential development. This section of the A47 also has a poor safety record.

3.1.2 There are a number of reasons for these delays and investigations have highlighted these reasons as:

- Difficulty of accessing and crossing the A47
- Standard of the road and junctions
- Traffic levels outgrowing the capacity of the road, causing tailbacks and delays
- Limited opportunities for overtaking slower moving vehicles
- Development in the local area

3.1.3 If nothing is done to improve capacity and connectivity, these delays are forecast to get worse in future years. In developing the Proposed Scheme, Highways England aim to address these issues by improving the traffic flow, reducing journey times on the route, increasing the route safety and resilience and improve the environment. The Proposed Scheme is also intended to support economic growth by making journeys safer and more reliable.

3.2 Background to the Proposed Scheme

3.2.1 The Road Investment Strategy announced in December 2014 includes a package of 6 schemes along the A47 to be delivered by Highways England during Roads Period 1 (2015 – 2020) and the early part of Roads Period 2 (2020 – 2025). The 6 proposed schemes are:

- A47 Wansford to Sutton
- A47 / A141 Guyhirn Junction
- A47 North Tuddenham to Easton
- A47 / A11 Thickthorn Junction
- A47 Blofield to North Burlingham
- A47 Great Yarmouth Junctions

- 3.2.2 The schemes have been branded as the A47 Improvement Programme, and together the proposals relieve congestion and improve the reliability of journey times for drivers on the 115 mile section of the A47 between Peterborough and Great Yarmouth.

Objectives of the Proposed Scheme

- 3.2.3 The objectives of the Proposed Scheme are:

Supporting economic growth

Contributing to sustainable economic growth by supporting employment and residential development opportunities. The Proposed Scheme aims to reduce congestion-related delay, improve journey time reliability and increase the overall capacity of the A47.

A safe and serviceable network

Improving road safety for all road users by designing to modern highway standards appropriate for a major A road.

A more free-flowing network

An improved route between Blofield and North Burlingham would be more reliable, reduce journey times and provide capacity for future traffic growth. The resilience of the road in coping with incidents such as collisions, breakdowns, maintenance and extreme weather would be improved.

Improved environment

Protecting the environment by minimising adverse impacts and where possible deliver benefits. This includes minimising the impact of new infrastructure on the natural and built environment, capitalising on potential improvement opportunities, and improving the connectivity for those living within the route corridor.

An accessible and integrated network

Ensuring the Proposed Scheme takes into account local communities and access to the road network, providing a safer route between communities for cyclists, walkers, equestrians and other non-motorised groups.

Value for money

Ensuring that the Proposed Scheme is affordable and delivers good value for money.

3.3 Alternatives considered

3.3.1 In seeking to resolve the transport problem between Blofield and North Burlingham, 8 potential options were developed. These were assessed to identify their performance against safety, environmental, engineering, transportation and economic criteria so that they could be compared and contrasted. These options can be reviewed in the Scheme Assessment Report at the following link;

<https://highwaysengland.citizenspace.com/he/a47-blofield-to-north-burlingham-dualling/results/a47blofieldtonorthburlinghama47sarimps2-ame-bb-zz-do-j00061.pdf>

3.3.2 Four of the 8 options were taken forward for more detailed assessment and non-statutory public consultation:

- Option 1: online dualling of the existing A47
- Option 2: offline dualling to the north and to the south of the A47
- Option 3: offline dualling to the south of the existing A47
- Option 4: offline dualling to the south running near and predominantly parallel to the existing A47

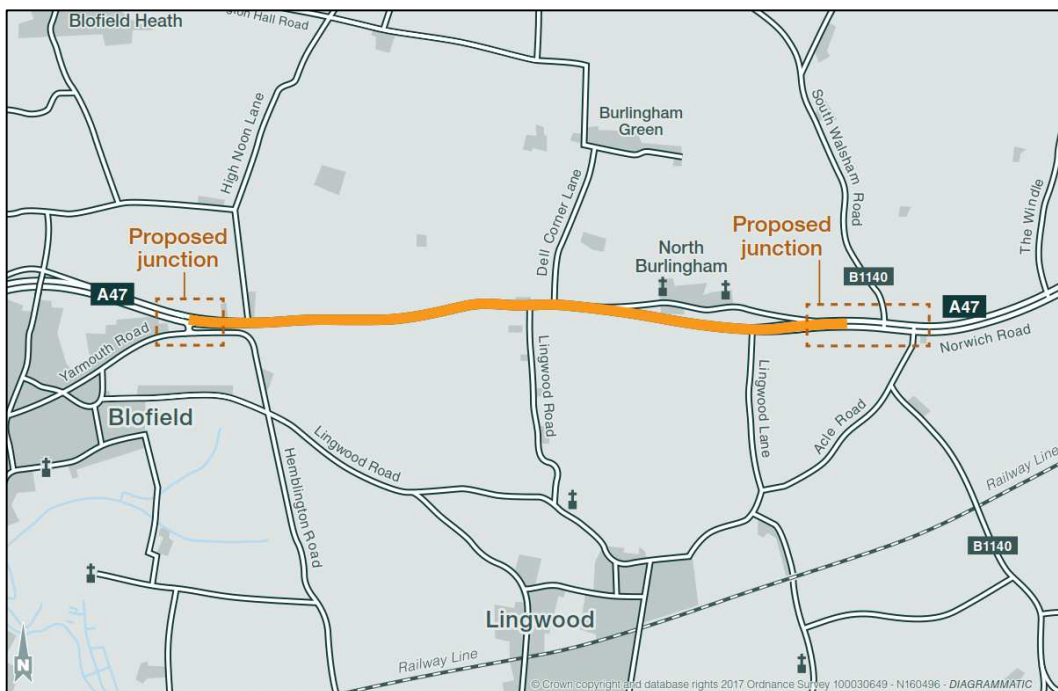
Summary of options considered

- 3.3.3 All 4 options resolved the transport problem; in that they would allow for a safer, swifter movement of traffic along the route corridor.

Option 1

- 3.3.4 This option as shown in Figure 3.1 comprised online dualling of the existing A47 between Blofield and North Burlingham.
- 3.3.5 The option proposed improving the existing single carriageway section by constructing a new section of online dual carriageway with junction improvements.
- 3.3.6 There would be 2 main junctions situated on the A47 at either end of the Site and a new local access link road would be created to the north of the newly dualled A47.

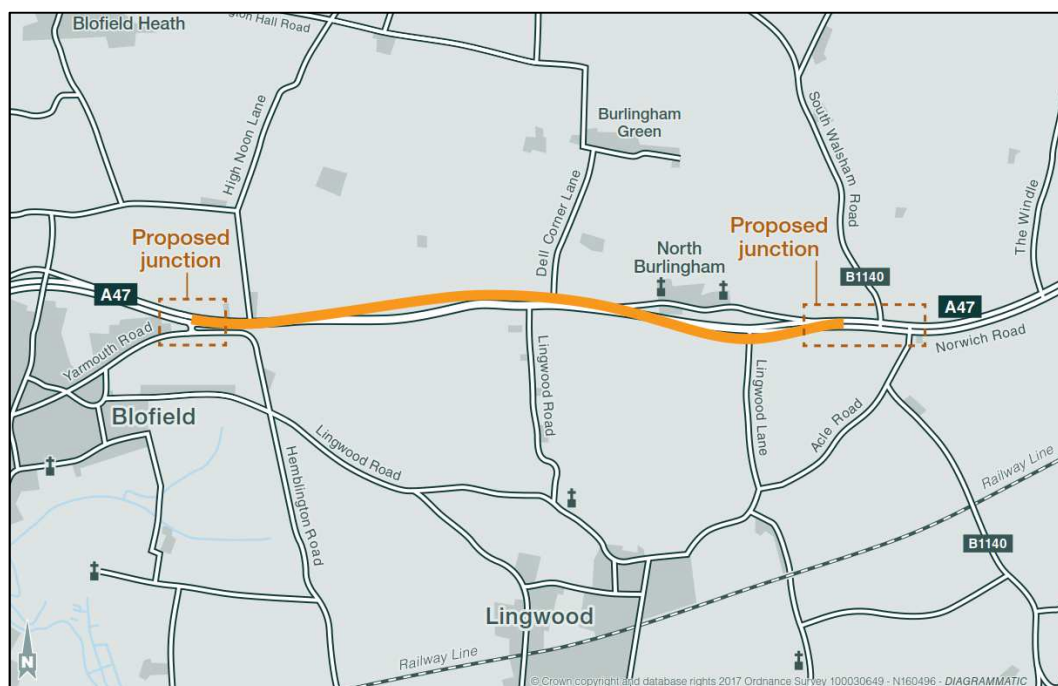
Figure 3.1: Option 1



Option 2

- 3.3.7 This option, shown in Figure 3.2, comprised an offline dualling to the north of Blofield and south of North Burlingham with junction improvements.
- 3.3.8 There would be 2 main junctions situated on the A47 at either end of the Proposed Scheme with new local access roads constructed.
- 3.3.9 The existing A47 where unaffected by the new dual carriageway would remain as part of the local road network.

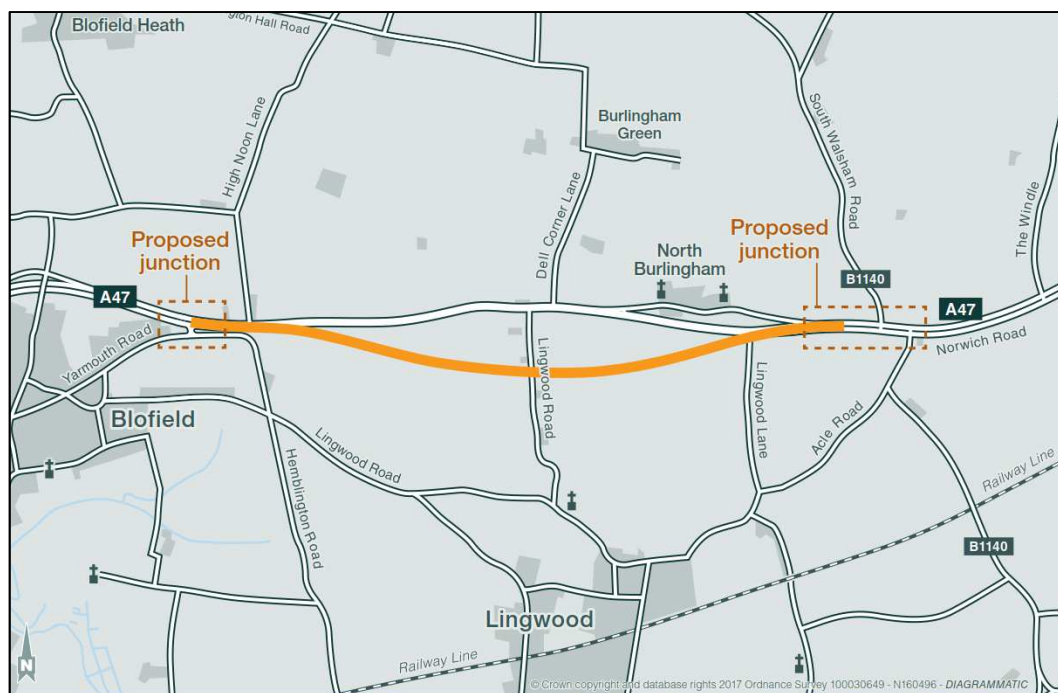
Figure 3.2: Option 2



Option 3

- 3.3.10 This option comprised offline dualling to the south of the existing A47. See Figure 3.3.
- 3.3.11 The proposed route runs south of the existing A47 corridor. The existing A47 would remain where unaffected by the new dual carriageway, become part of the local road network.

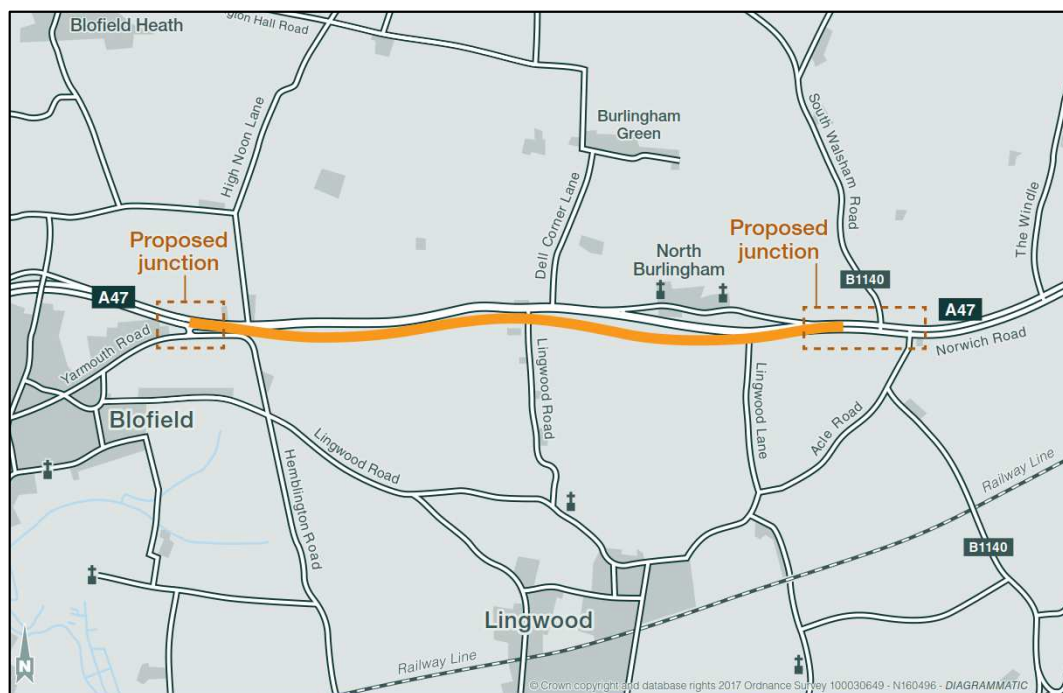
Figure 3.3: Option 3



Option 4

- 3.3.12 This option comprised offline dualling to the south with the new section of offline dual carriageway running parallel to the existing A47. See Figure 3.4.
- 3.3.13 The proposed alignment closely follows the existing alignment of the A47 and where the existing A47 is unaffected by the dualling, it would become part of the local road network.

Figure 3.4: Preferred route (Option 4)



- 3.3.14 Upon review of the non-statutory consultation feedback and route option assessments, the preferred option was Option 4.
- 3.3.15 It is considered that the preferred route can be built with the least disruption to drivers during construction as the existing road can remain for local traffic. This option also has the least impact on the environment.

3.4 Design intervention

3.4.1 The design of the Proposed Scheme is an iterative process that evolves with technical and engineering considerations and with environmental constraints. To better describe the decision-making process, this Preliminary Environmental Information Report (PEIR) makes a distinction between mitigation and design intervention.

3.4.2 In the context of this PEIR and the subsequent Environmental Statement, a design intervention is defined as a change to the design of the Proposed Scheme to reduce or remove an identified environmental effect or improve / introduce an environmental benefit. Examples of this include:

- Moving a Sustainable Drainage System (SuDS) pond location away from existing vegetation to allow the retention of the vegetation
- Changing the alignment of the design to avoid an identified receptor
- Introducing a noise bund to protect an identified receptor

3.4.3 Mitigation is defined as an action or future intent to reduce an identified effect. Examples of this include:

- A Construction Environmental Management Plan (CEMP)
- Specific operational and maintenance measures
- Aspects of the design that would reduce / avoid identified impacts that have not been detailed at the application submission stage.

4 Consultation

4.1 Consultation undertaken to date

Non-Statutory Consultation

- 4.1.1 An extensive stakeholder mapping exercise was undertaken to identify relevant stakeholders and their key interests. This list was used to inform the participants of a 6 week non-statutory public consultation, which was held between 13 March and 21 April 2017 and included public information exhibition events held on the 29 and 31 March, and 1 April 2017. On conclusion of the non-statutory consultation period, a consultation report was completed that can be accessed via the following link:

https://highwaysengland.citizenspace.com/he/a47-blofield-to-north-burlingham-dualling/results/a47-blofield-cons-report_final_080817.pdf Scoping/

- 4.1.2 A Scoping Report was submitted to the Planning Inspectorate (PINS) on 6 February 2018. PINS subsequently issued the scoping report to statutory consultees, with a deadline to respond with comments. The resulting Scoping Opinion from PINS with consultee responses was received by Highways England on 19 March 2018, a copy of which can be accessed via the following link:

<https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010040/TR010040-000008-BLOF%20-%20Scoping%20Opinion.pdf/>

Responses

- 4.1.3 Responses received from the non-statutory consultation and Scoping Opinion have been considered and are included in the ongoing assessment and design process.

4.2 Proposed consultation

- 4.2.1 A consultation strategy has been developed which outlines the organisations, methodology and the proposed timeline for the consultation. Methods for promoting the consultation include the Primary Consultation Zone, which outlines an area within which all properties directly receive information about the consultation and the public exhibitions. This strategy has been agreed with the relevant statutory consultees through the development of the project's Statement of Community Consultation.

-
- 4.2.2 Consultation required to support individual assessments is set out within each technical chapter of this report.

Engagement with hard to reach groups

- 4.2.3 It is anticipated that the Proposed Scheme's Equality Impact Assessment will identify the relevant hard to reach groups. Host local authorities will be consulted about identification of relevant groups. Categories identified and contacted include non-motorised users groups, ethnic organisations, local Traveller communities', disability groups and groups representing children and the elderly.
- 4.2.4 Policy guidance documents and other relevant technical documents will be available online and at various information points stationed at local community venues. These documents will be added to throughout the course of the project. The project web site address is:
<https://highwaysengland.citizenspace.com/he/a47-blofield-to-north-burlingham-dualling/>

5 Air Quality

5.1 Introduction

5.1.1 This chapter presents the preliminary findings of the air quality assessment. This comprises a review of the existing environment and identification of potential impacts of the Proposed Scheme upon air quality. Potential impacts are discussed considering relevant policy and legislation, and in the context of existing air quality in the study area and relevant consultation.

5.2 Guidance and best practice

Legislation

5.2.1 In the UK, the presence of pollutants in ambient air is managed through legislation (including that transposed from EU Directives) and government policy. Air quality limit values and Air Quality Objectives (AQO) specify the ambient concentration of a pollutant, a time period over which that concentration is measured, and a date by which compliance with the limit value or objective should be achieved.

5.2.2 The AQO and limit values relevant to the Proposed Scheme are summarised in Table 5.1.

Table 5.1: Air quality objectives and limit values

Pollutant	Averaging Period	Air Quality Objectives and Limit Values		Attainment Date	
		Concentration	Allowance	Air Quality Objectives	EU Limit Values
Nitrogen Dioxide (NO ₂)	Annual	40 µg/m ³	-	31 December 2005(a)(b)	1 January 2010(c)
	1 Hour	200 µg/m ³	18	31 December 2005(a)(b)	1 January 2010(c)
Nitrogen Oxides (NO _x)(d)	Annual	30 µg/m ³	-	1st January 2001(c)	
Particulate Matter (PM ₁₀)	Annual	40 µg/m ³	-	31 December 2004(a)(b)	1 January 2005(c)
	24 Hour	50 µg/m ³	35	31 December 2004(a)(b)	1 January 2005(c)

Notes: ^(a) Air Quality (England) Regulations 2000 as amended in 2002 (Statutory Instrument 2002)

^(b) Air Quality Strategy 2007 (Defra,2007)

^(c) EU Directive 2008/50/EEC on ambient air quality and cleaner air for Europe and The Air Quality Standards Regulations 2010. Derogations (time extensions) have been agreed by the EU for meeting the NO₂ limit values in some zones/agglomerations. (European Commission, 2008)

^(d) Designated for the protection of vegetation and ecosystems and referred to as the 'critical level' for NO_x.

Policy

- 5.2.3 The National Policy Statement for National Networks (NPSNN) notes that the applicant should undertake an assessment of the impacts of the Proposed Scheme describing:
- *Existing air quality levels*
 - *Forecasts of air quality at the time of opening, assuming that the scheme is not built (the future baseline) and taking account the impact of the scheme*
 - *Any significant air quality effects, their mitigation and any residual effects, distinguish between the construction and operation stages and taking account of the impact of road traffic generated by the project*

Guidance

- 5.2.4 The air quality assessment follows the guidance provided by the DMRB Volume 11, Section 3, Part 1, the Department for Environment, Food and Rural Affairs (Defra) technical guidance for undertaking air quality assessments (LAQM-TG (16)) (Defra 2016), and the Interim Advice Notes relevant to air quality (IAN 170/12 (Highways England 2012), IAN 174/13 (Highways England 2013), IAN 175/13 (Highways England 2013) and IAN 185/15 (Highways England, 2015)).
- 5.2.5 Highways England's IAN 174/13 (Highways England, 2013) and 175/13 (Highways England, 2013) informs decision making on the judgements of air quality impacts and determining whether the Proposed Scheme will affect the UK's reported ability to comply with the Air Quality Directive, in line with the requirements of the NPSNN.

5.3 Study area

- 5.3.1 The Proposed Scheme boundary see Figure 1.1 and 1.2, hereafter referred to the Site.

Local assessment

- 5.3.2 The air quality study area is determined based on changes in traffic flows on the local road network. For this report, traffic data is not currently available and therefore affected roads have not been identified. For the Environmental Statement (ES), the traffic data will be available and the affected road network be determined based on DMRB Volume 11, Section 3, Part 1 (HA 207/07). Affected roads are defined where at least one of the following criteria is met:

- road alignment will change by 5m or more
- daily traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) flow or more
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more
- daily average speed will change by 10kph or more
- peak hour speed will change by 20kph or more

5.3.3 The assessment work undertaken to date comprises a qualitative review of the potential impacts on air quality at sensitive receptors based on:

- existing baseline conditions (based on publicly available information)
- the location of receptors
- changes to road layout and potential traffic changes

Regional assessment

5.3.4 The regional air quality assessment assesses the change in total emissions resulting from the Proposed Scheme. This is required as emissions not only affect local air quality, but also have an impact on a regional, national and international scale.

5.3.5 DMRB Volume 11, Section 3, Part 1 (HA 207/07), is used to determine the regional affected road network and is used to determine the changes in regional emissions. The criteria are defined as:

- A change of more than 10% in AADT
- A change of more than 10% to the number of HDVs
- A change in daily average speed of more than 20kph

5.3.6 As no traffic data is currently available, the assessment provides a qualitative review of the potential impacts on regional air quality.

5.4 Assumptions and limitations

5.4.1 Assessment work to date has been undertaken qualitatively as traffic data for the Proposed Scheme is not yet available. Assessment work to date has been based on an understanding of the baseline conditions, location of sensitive receptors and potential changes in emissions due to the road layout and traffic flows.

5.5 Baseline

Human health

5.5.1 A range of potentially affected sensitive receptors have been identified within the A47 Blofield to North Burlingham study area. These include:

- approximately 25 residential properties (approximately 15m to 200m from the Site) in Blofield.
- there are approximately 6 properties located further along the A47 to the north of, and along Hemblington Road (approximately 50 to 200m from the A47).
- there is a residential receptor located approximately 15m to the north of the A47 opposite the Lingwood Road junction.
- approximately 20 residential properties are located at North Burlingham, to the north of the A47. Residential properties in North Burlingham extend to within approximately 20m of the A47.
- two properties are located to the south of the A47 (approximately 10m and 100m from the A47) on the junction with the B1140.
- two residential properties are located approximately 10m of the A47 and The Windle junction.
- Acle Hall Farm is located approximately 60m to the south of the A47.

5.5.2 There are additional receptors located close to the A47 and other surrounding roads adjacent to the Site. Following the finalisation of the traffic data and confirmation of the affected road network, these receptors are to be included in the ES as required.

Designated ecological sites

5.5.3 There are no internationally or nationally designated ecological sites located within the Site. The nearest designated sites are the Yare Broads and Marshes Sites of Special Scientific Interest (SSSI) and the Broadland Ramsar and Special Protection Area (SPA). These are located approximately 2km from the Site to the south-west. The Damgate Marshes and Decoy Carr SSSIs, are located approximately 3km east from the Site. Once the traffic data is available for the Proposed Scheme, and if these designated sites fall within the affected road network, air quality impacts at these sites will be assessed.

Local air quality

5.5.4 There are currently no declared Air Quality Management Area (AQMA) within the Broadland District Council administrative area. The closest AQMA is located over 9.5km to the northeast within Norwich city centre declared by Norwich City Council for exceedances of the annual mean nitrogen dioxide (NO₂) objective.

5.5.5 Broadland District Council collects monitoring data within its boundary. The data is collected through a combination of automatic monitoring stations and passive NO₂ diffusion tubes. At the local authority monitoring site considered to be most representative of the Scheme study area, a

concentration of 30.6µg/m³ was reported for 2016, which is below the annual NO₂ air quality objective.

5.5.6 A Scheme specific NO₂ diffusion tube monitoring survey has also been commissioned by Highways England and commenced in January 2017. The monitoring consists of four diffusion tubes placed at suburban and roadside locations along the proposed route. Currently, nine months of annualised data is available (January to September 2017). The maximum annualised concentration at these sites is 31.7µg/m³, which is below the annual NO₂ air quality objective.

Defra projected background concentrations

5.5.7 In addition to the data above, Defra provides estimates of background pollution concentrations for NO_x, NO₂ and PM₁₀ across the UK for each 1km grid square, for every year from 2015 to 2030. Future year projections have been developed on the base year for the background maps, which is currently 2015. This data can be used to provide specific background pollutant concentrations at receptors included within the assessment and to supplement local monitoring data.

5.5.8 The maximum background concentrations for the areas covered by the Proposed Scheme for the year 2015 are presented in Table 5.2. Background concentrations are well below the relevant objectives and expected to reduce further in future years as older vehicles are replaced with newer ones which meet more stringent standards.

Table 5.2: Defra background data

NO _x	NO ₂	PM ₁₀
16.2	12.0	16.1

Note: The results presented above are taken from the grid squares which have the greatest pollutant concentrations for 2015. Grid squares used = 634500, 309500 & 635500, 310500

EU limit value compliance

5.5.9 Defra's Pollution Climate Mapping (PCM) is used to report compliance with the EU limit values and provides NO₂ concentrations for a number of roads across the UK for a selection of future years. The most up to date PCM model outputs were released in August 2017, following the release of the UK Plan for tackling nitrogen dioxide concentrations (Defra, 2017).

5.5.10 The PCM link closest to the Proposed Scheme, (on the A1042) is located approximately 6.5km from the Proposed Scheme and has a reported annual

mean NO₂ concentration in 2015 of 31µg/m³, which is below the annual mean limit value of 40µg/m³ for NO₂.

5.6 Consultation

- 5.6.1 Further to the consultation already undertaken (paragraph 4.1.2), discussions with Broadland District Council are to be undertaken on the choice of receptors included in the assessment, once the affected road network is defined.

5.7 Design interventions

- 5.7.1 At the time of writing this report, no design interventions have been included for air quality. Future iterative design as a result of environmental considerations will be reported in the ES.

5.8 Potential mitigation measures

Construction

- 5.8.1 No additional mitigation measures during the construction phase other than those in accordance with the Best Practicable Means, as described in Section 79 (9) of the Environmental Protection Act 1990 are likely to be required.

Operation

- 5.8.2 At the time of writing this report, no operational air quality specific mitigation measures have been designed into the Proposed Scheme. Proposed mitigation in the future design mitigation will be reported in the ES.

5.9 Potential impacts

Construction

- 5.9.1 An indicative construction assessment has been undertaken following best practice guidance using a risk based approach which takes into account the dust raising potential of the likely construction activities, the embedded mitigation and the location of potentially sensitive receptors. Implementation of appropriate good practice mitigation measures would reduce air quality impacts.

Operation

- 5.9.2 The redistribution of traffic as a result of the Proposed Scheme is likely to have an impact on air quality, depending on where the changes in flows occur.
- 5.9.3 The Proposed Scheme is likely to increase traffic flows on the A47 and will move the road alignment closer to receptors in some locations. Considering the existing concentrations in the study area, and future improvements in vehicle emissions as a result in improvements in technology and the uptake of new cars in the vehicle fleet, these impacts are not expected to be significant in accordance with IAN174/13.
- 5.9.4 Any roads that fall within the affected road network of the Proposed Scheme and overlap with road links included in the PCM model will be assessed for compliance with the Air Quality Directive in accordance with IAN 175/13. Considering the location of the closest links included in the PCM model and the current reported concentrations, the Proposed Scheme is unlikely to cause a non-compliance with the Air Quality Directive.

5.10 Chapter summary

- 5.10.1 This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated qualitative impacts upon air quality. The Proposed Scheme would impact air quality around the A47 and surrounding roads as a result of changes in the road layout and redistribution of traffic. A review of existing ambient monitoring data, and the likely changes in traffic flows as a result of the Proposed Scheme suggests that there is the potential for both positive and negative air quality impacts however, the annual mean air quality objective for NO₂ would not be exceeded.
- 5.10.2 Further work will be undertaken to develop design interventions to limit or reduce impacts and promote opportunities for the environment within the study area wherever possible. Design development and potential mitigation will be reported in the ES as well as further detailing of baseline conditions and likely changes during both construction and operation for all identified receptors.

6 Cultural Heritage

6.1 Introduction

6.1.1 This chapter presents the preliminary findings of the cultural heritage assessment. This comprises a review of the existing environment and identification of the potential impacts of the Proposed Scheme upon surrounding cultural heritage receptors. The chapter also outlines proposed design measures to help mitigate these potential impacts and relevant consultation.

6.2 Guidance and best practice

6.2.1 The overarching legislation in relation to the historic environment in the UK is provided by:

- The Ancient Monuments and Archaeological Areas Act 1979
- The Planning (Listed Buildings and Conservation Areas) Act 1990

6.2.2 The assessment is undertaken in accordance with the published standards and guidance:

- *National Planning Policy Framework*, Section 16 Conserving and enhancing the historic environment (Ministry of Housing, Communities and Local Government (MHCLG) (formerly the Department of Communities and Local Government, DCLG), 2018)
- National Planning Policy Guidance (NPPG) (MHCLG, 2013)
- *Design Manual for Roads and Bridges, Environmental Assessment* (Volume 11, Section 3, Part 2 – Cultural Heritage) (Department for Transport (DfT), 2007)
- *Conservation Principles* (Historic England, 2008)
- Historic Environment Good Practice Advice in Planning note 2 (GPA2) – Managing significance in decision taking in the historic environment (Historic England, 2015)
- Historic Environment Good Practice Advice in Planning Note 3 (GPA3) – The setting of heritage assets (Historic England, 2017)
- *Standard and Guidance for historic environment assessment* (Chartered Institute for Archaeologists, 2014) (updated 2017)

6.2.3 The local planning policies for the historic environment presented in the Joint Core Strategy for Broadland, Norwich and South Norfolk (Greater Norwich Development Partnership 2014) include Policy 1: Addressing climate change and protecting environmental assets, Policy 2: Promoting good design and Objective 9: To protect, manage and enhance the natural,

built and historic environment, including key landscapes, natural resources and areas of natural habitat or nature conservation value.

6.3 Study area

6.3.1 The land within the Proposed Scheme boundary is hereafter referred to as 'the Site'. The study area comprises a 1km buffer around the Site.

6.4 Assumptions and limitations

6.4.1 With no intrusive evaluation surveys yet completed, the archaeological potential within the Site cannot be considered to have been fully examined or determined.

6.4.2 The assessment is based upon Design Fix B, prepared May 2018. As such further development of the Proposed Scheme has the potential to alter the predicted impacts of the construction and operation upon the cultural heritage resource. Any changes to the design will be reported in the Environmental Statement (ES) and will require further engagement with relevant stakeholders.

6.4.3 Information provided by Historic Environment Records (HER) can be limited because it depends on available opportunities for research, fieldwork, and discovery. Where nothing of historic interest is shown in a particular area, this can be down to a lack of targeted research or investigation rather than the genuine absence of heritage assets.

6.4.4 The only non-designated buildings of local heritage interest presented within this assessment are those identified within the HER. Further assessment will need to take into consideration any such assets.

6.4.5 Documentary sources are rare before the medieval period, and many historic documents are inherently biased. Older primary sources often fail to accurately locate sites and interpretation can be subjective.

6.4.6 Where archaeological sites have been identified solely from aerial imagery without confirmation from archaeological excavation or supporting evidence in the form of find-spots etc., it is possible the interpretation may be revised in the light of further investigation.

6.5 Baseline

Survey

- 6.5.1 An archaeological site walk-over survey was carried out on 13 February 2018. This type of visit informs the management of archaeological and geophysical surveying associated with the Proposed Scheme. In addition, the walk-over survey informs the assessment of potential heritage settings impacts across the study area.
- 6.5.2 A programme of geophysical survey is currently underway across the area of the Proposed Scheme. This will inform the baseline assessment in the Environmental Statement (ES) as well as assisting in the targeting of further archaeological evaluation.
- 6.5.3 The completion of the programme of geophysical survey has been postponed due to land access issues. It is anticipated that the remaining survey area will be completed in August 2018 once access to the remaining land plots has been granted.

Topography and geology

- 6.5.4 The Site is situated on gently rolling agricultural landscape between the Rivers Yare, to the south and west, and Bure, to the north and east. The western end of the Site is situated at around 25m above ordnance datum (AOD), falling away to 15m AOD around Sparrow Hall, crossing an apparently dry stream valley, and rising to 25m AOD at Poplar Farm and maintaining that level until the end of the Site east of North Burlingham.
- 6.5.5 The British Geological Survey identified that the underlying bedrock comprises Crag Group sand and gravel overlain by Lowestoft Formation Diamicton for the majority. Though, Happisburgh Sand and Diamicton deposits are recorded over the sand and gravel of the dry valley (NERC 2017).
- 6.5.6 One soil type dominates: freely draining slightly acid loamy soil. This soil type has low fertility with arable and grassland landcover, also suited to heathland and deciduous woodland (Cranfield Soil and Agrifood Institute 2017).

Archaeological and historic overview

- 6.5.7 A previous evaluation of the HER has been undertaken for the Proposed Scheme. This identified that there is high potential for archaeological

remains dating from between the prehistoric period and Roman periods in particular, within the study area.

- 6.5.8 References used in this section refer to the National Heritage List for England list entry numbers (NHLE numbers) and Norfolk HER reference numbers (NHER numbers).

Designated assets

- 6.5.9 There is a total of 21 designated assets identified within 1km of the Proposed Scheme boundary. Of which, 19 are grade II listed buildings and 3 are grade I listed buildings. The grade I listed buildings are:

- Church of St Andrew (NHLE 1051522), 160m to the north of the A47, on the north-western edge of North Burlingham
- Church of St Peter (NHLE 1051521), 960m to the south of the A47, on the northern edge of Lingwood
- Church of St Andrew and St Peter (NHLE 1304595), 900m south of the A47, on the southern edge of Blofield

Non-designated assets

- 6.5.10 The corridor of the Site has seen little in the way of historic intrusive archaeological investigation and as such there is limited data available. However, many of the fields within, and surrounding, the Site have been subject to metal detector survey. This has accumulated a mixed artefact assemblage, not exclusively metallic. For example, metal detectorists recovered Early Neolithic, Late Bronze Age / Early Iron Age and general prehistoric flints around 200m to the east of the Site (NHER 49800). A prehistoric flint flake was also found during the geophysical survey within the Site (NHER 60805). Field survey within the Site (not part of the Proposed Scheme) found very little archaeological material on the surface, however a small number of prehistoric flints were recovered from the fields to the south of the eastern end of the Site (Norfolk Archaeological Unit, 2003). During the February 2018 walkover, a small number of Roman grey ware pottery sherds were observed within the topsoil.
- 6.5.11 A geophysical magnetometer survey within the Site, but not carried out for the Proposed Scheme, was undertaken in 2006 (APS 2006). Much of the survey detected a large buried service running parallel to, and south of, the road. Disturbance from this modern intrusion rendered the remainder of the survey area either side of the service illegible. However, several possible archaeological linear features were identified: 1 situated to the south of the eastern end of the route, aligned north-east to south-west; 2 situated to the

north-west of Poplar Farm, 1 aligned north-east to south-west, the other north to south; another couple of possible archaeological features were identified to the south of North Burlingham; and a loose concentration of possible features was recorded in the fields at the eastern end of the Site, to the north and south of the A47. Preliminary results from the on-going geophysical survey has identified a number of potential archaeological features. One linear feature identified by geophysical survey at the western end of the Site, to the east of Hemblington Road, is possibly the north-east corner of a rectilinear feature. Further evaluation is required; however, this may potentially reflect the location of an Iron Age or Roman homestead enclosure. The feature does not align with later medieval or post-medieval adjacent road systems which suggests an earlier date.

- 6.5.12 The National Mapping Programme, a survey of available aerial photography and transcription, identified several clusters of cropmarks including those to the north of the existing A47, to the west of North Burlingham. These are indicative of possible late prehistoric or Roman field systems (NHER 49445). Linear features recorded to the north-west of Poplar Farm through geophysical survey, south-west of NHER 49445, could represent a continuation of this cropmark field system.
- 6.5.13 The main focus of Roman activity was at Caistor St Edmund, the Roman town of Venta Icenorum, approximately 12.5km to the south-west of the Site. However, archaeological evidence indicates that the area surrounding the Site was rural and understood to be dotted with small farmsteads or villas. Metal detecting to the east of Poplar Farm, to the north of the A47 revealed a Roman coin indicating an ephemeral Roman presence (NHER 561870).
- 6.5.14 Records of Anglo-Saxon activity within the study area, are limited to an Early Saxon brooch recovered through metal detecting 50m to the south of the Site (NHER 25942) at North Burlingham.
- 6.5.15 Blofield is described in the Domesday Survey of 1086 as a large settlement of 61 households. The majority of the local economy was supported by farming as evidenced by the presence of 9.5 plough teams (Open Domesday 2018a). There is no church described within the Domesday entry. North Burlingham was also a large settlement comprising 57.5 households. Similar to Blofield, it was a farming community with 8 plough teams. A church is also recorded (Open Domesday 2018b). This could have been the precursor to the grade II* listed Church of St Andrew (NHLE 1051522), situated 160m to the north of the A47, on the north-western edge of North Burlingham, or to the grade II listed Church of St Peter (NHLE 1304547), situated to the east of the Church of St Andrew, some 200m north of the Proposed Scheme.

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- 6.5.16 The line of a former medieval road is identified as cropmarks following a north-east to south-west alignment (NHER 45143) to the east of Sparrow Hall Bungalow and through the Site, to connect to the Blofield Cross. The Cross was situated at the end of High Noon Lane, at a point that would have originally formed a crossroads with the original road layout, within the Site (NHER 13378). Medieval pottery and coins (NHER 32029) have been recovered within the Site to the west, north of Blofield.
- 6.5.17 The landscape appears to have remained rural agricultural from the Roman period onwards; historical maps show little alteration to the landscape from the 19th century onwards. A group of farm buildings (NHER 12283), part of Poplar Farm, are shown on the 19th century maps around 20m to the south of the Site, and are thought to date to 1740, the same date as the St Peter's Church Rectory to the north of the A47. The Norfolk Historic Landscape Characterisation project (NLA 2009) identifies approximately half of the land affected by the Proposed Scheme as 20th century agriculture and the remainder as 18th to 19th century enclosure. This suggests that many of the field boundaries that survive would have originated in the 18th or 19th centuries, though some would have been lost due to 20th century field enlargement and boundary removal.
- 6.5.18 The increasing popularity of landscaped parks during the 18th century introduced new parkland to the area. Burlingham Hall parkland is situated on the northern side of the eastern end of the A47 (NHER 55630). The estate was designed in the 18th century and was sold in 1919.
- 6.5.19 Modern undesignated assets include the former horticultural school (NHER MNF46969) situated in the southern part of the Burlingham Hall parkland.
- 6.5.20 An early 20th century milestone is situated on the northern side of the A47, at the junction of Main Road, Burlingham and the A47 (NHER MNF62995). The milestone marks 9 miles from Norwich and 13 miles from Great Yarmouth.

6.6 Consultation

- 6.6.1 Consultation has been undertaken to date with the Norfolk County Council Environment Team and Historic England in relation to the Proposed Scheme. Table 6.1 summarises the consultation to date. Further consultation with Norfolk Environment Team and Historic England would be undertaken and reported in the ES.

Table 6.1: Consultation detail

Cosultee	Comment	Date	Response
Norfolk Environment Service	Requested addition of a small area to the geophysical survey.	22/01/18	Agreed addition to the survey.
Historic England	Requested that Landscape and Visual Impact Assessment (LVIA) viewpoints be considered in relation to churches within study area, if necessary. Requested that screening mitigation be considered.	26/02/18	LVIA to include churches.
Norfolk Environment Service	Email consultation and request for brief for archaeological trenching.	31/05/18	Preliminary geophysical survey results to be issued to Norfolk Environment Service to assist production of brief for trial trenching.

6.7 Design interventions

6.7.1 Design intervention is mitigation embedded into the design of the Proposed Scheme and is achieved through an iterative process. Mitigation is currently being developed for Cultural Heritage assets and any relevant developments will be reported in the ES.

6.8 Potential mitigation measures

6.8.1 Construction would be carried out using industry best practice and in accordance with a Construction Environmental Management Programme (CEMP) to reduce any potential adverse effects. Mitigation measures for the historic environment will be reported in the ES and incorporated throughout the design and construction stages.

6.8.2 In addition to the identified scheme mitigation measures, archaeological investigation (such as excavation of buried remains) would be undertaken if required to help understand the value of assets where there is a potential loss.

6.8.3 Mitigation recommendations which have been put forward through the early design phases, are:

- Sensitive vegetation screening to be planted in order to screen the Proposed Scheme from designated assets Owls Barn and House at Owls Barn, both grade II listed buildings, and the Church of St Andrew and St Peter, grade I listed building, situated in Blofield, as well as the Church of St Andrew, grade I listed building, and the Church of St Peter, grade II listed building, both situated in North Burlingham.

- Limit impact to historic hedgerows and boundaries by restricting permanent loss to the footprint of the Proposed Scheme, avoiding loss for temporary purposes such as haul routes and compounds.
- Managing lighting levels to be the similar or lower than current levels, in order to reduce impact to the nearby designated assets and to the historic landscape.

6.9 Potential impacts

Construction

6.9.1 Construction impacts may arise as a result of the following activities:

- Temporary and permanent land-take
- Demolition and site clearance
- Excavation, ground disturbance and compaction
- Use of plant and machinery
- Building up site levels with made-ground
- Constructing new infrastructure or modification of existing infrastructure
- Visual intrusion and disruption to access during construction
- Diversion / alteration of existing services or installation of new services
- Landscaping and planting

6.9.2 These activities could lead to the following effects on the historic resource:

- Loss / damage or long-term burial of archaeological remains
- Structural damage to historic buildings due to proximity of works
- Severance or loss of features such that, the physical or visual integrity of a site is compromised and the ability to understand and appreciate the remaining elements is diminished
- Temporary alteration and / or visual intrusion into the historic setting/character of a designated asset or undesignated site of national or regional significance
- Temporary effects on the access to, and amenity of, designated sites or undesignated sites of national or regional significance

6.9.3 Cumulative effects are also a consideration and will be reported accordingly in the ES.

Sensitive receptors during construction

6.9.4 Table 6.2 sets out the key sensitive receptors that could potentially be affected by construction of the Proposed Scheme. The ES will assess the potential effects of the Proposed Scheme on the identified receptors and provide recommendations for mitigation.

Table 6.2: Sensitive receptors - construction

Receptor	Location	Value / Sensitivity	Description
Owls Barn, 270m to the south of the proposed side road linking the Blofield Overbridge with Yarmouth Road, Blofield. Grade II listed building.	TG 34309, 09597	Medium	Early 18th century barn. Modern houses constructed to the east and west but setting to the north is rural up to the existing A47. Bringing the side road of the Proposed Scheme to the south of the current A47 will encroach further upon the original rural setting of the asset.
House at Owls Barn, 270m to the south of the proposed side road linking the Blofield Overbridge with Yarmouth Road, Blofield. Grade II listed building.	TG 34308, 09601	Medium	Early 18th century farmhouse. Modern houses constructed to the east and west but setting to the north is rural up to the current A47. Bringing the side road of the Proposed Scheme to the south of the current A47 will encroach further upon the original rural setting of the asset.
Home Farm House, 375m north of the mainline alignment of the Proposed Scheme, south of Burlingham Green. Grade II listed building.	TG 36136, 10344	Medium	Early 17th century farmhouse. Altered and subdivided in 20th century. Possible temporary impact from construction noise.
Church of St Andrew, 200m north of the mainline alignment of the Proposed Scheme, North Burlingham. Grade I listed building.	TG 36535, 10105	High	14th century church with later additions and alterations. Possible temporary impact from construction noise.
Church of St Peter, 200m north of the mainline alignment of the Proposed Scheme, North Burlingham. Grade II listed building.	TG 36834, 10045	Medium	15th century church, restored in 19th century. Now disused and in ruins. Possible temporary impact from construction noise.
Church of St Peter, 900m south-west of the Proposed Scheme. Grade I listed building.	TG 36076, 09034	High	14th century, possibly earlier, church. Later additions and alterations. Construction of the Proposed Scheme will affect the visual setting of the receptor. Possible increase in noise during construction would adversely impact the setting of the asset.
Burlingham Park, 18th century parkland associated with Burlingham Hall. Northern end of B1140 Overbridge constructed in the south-eastern corner of the parkland.	TG 37009, 10341 (centred)	Low	Non-designated parkland, altered during the 20th century. Construction of the B1140 Overbridge and the side road of the Proposed Scheme will adversely impact the south-eastern corner of this asset.
Buried archaeological remains identified through aerial photography and geophysical survey. Prehistoric to post-medieval in date. Across the Site.	Throughout the study area	Low	Non-designated assets. Cropmarks identify field systems of prehistoric to Roman date and geophysical survey identified features of unknown date. Construction of the Proposed Scheme would partially or totally destroy these assets.
Unknown buried archaeological remains. Prehistoric to post-medieval in date. Across the Site.	Throughout the study area	Low	Non-designated assets. Construction of the Proposed Scheme would partially or totally destroy these assets.
Farm buildings at Poplar Farm (NHER 12283)	TG 35797, 09896	Low	Non-designated assets. Dated 1740. Construction of the Proposed Scheme would bring the road adjacent to the historic buildings. Potential damage to the structures, which are in poor condition and

Receptor	Location	Value / Sensitivity	Description
			have been partially structurally supported, would result from the operation of the road in such close proximity.
Historic landscape character	Throughout the study area	Low	The historic landscape character is late post-medieval enclosure with some 20th century alterations. Construction of the Proposed Scheme would require partial loss of field boundaries and, if present, historic hedgerows.

Operation

6.9.5 The Proposed Scheme could lead to the following impacts on the historic resource:

- Increased visual intrusion both to and from sites / buildings of national or regional importance
- Alteration to the historic setting / character of a designated site or undesignated site of national or regional significance
- Increase or decrease in noise, vibration or dust such that the amenity or physical fabric of a nationally or regionally important site is either adversely affected or improved
- Opportunities to enhance the character and setting of a designated site or undesignated site of national or regional significance
- Opportunities for heritage related education and tourism

6.9.6 At time of writing, the noise modelling is still underway. The results of which will be assessed in the context of cultural heritage in the ES. The design of the Proposed Scheme and proposed mitigation is not yet finalised. Development of the design is ongoing and will be reported in the ES.

Sensitive receptors during operation

6.9.7 Table 6.3 sets out the key sensitive receptors that could potentially be affected by the Proposed Scheme. The ES will assess the potential effects of the Proposed Scheme on the identified receptors and provide recommendations for mitigation.

Table 6.3: Sensitive receptors - operation

Receptor	Location	Value / Sensitivity	Description
Owls Barn, 270m to the south of the proposed side road linking the Blofield Overbridge with Yarmouth Road, and from 400m to the south-west of the Blofield Overbridge itself. Grade II listed building.	TG 34309, 09597	Medium	Early 18th century barn. Modern houses constructed to the east and west but setting to the north is rural up to the current A47. Operation of the Proposed Scheme would potentially increase noise and lighting and therefore affect the setting of the asset.

Receptor	Location	Value / Sensitivity	Description
House at Owls Barn, 270m to the south of the proposed side road linking the Blofield Overbridge with Yarmouth Road, and from 400m to the south-west of the Blofield Overbridge itself, Blofield. Grade II listed building.	TG 34308, 09601	Medium	Early 18th century farmhouse. Modern houses constructed to the east and west but setting to the north is rural up to the current A47. Operation of the Proposed Scheme would potentially increase noise and lighting and therefore affect the setting of the asset.
Home Farm House, 375m north of the mainline alignment of the Proposed Scheme, south of Burlingham Green. Grade II listed building.	TG 36136, 10344	Medium	Early 17th century farmhouse. Altered and sub-divided in 20th century. Operation of the Proposed Scheme could increase noise and lighting and therefore affect the setting of the asset.
Church of St Andrew, 200m north of the mainline alignment of the Proposed Scheme, North Burlingham. Grade I listed building.	TG 36535, 10105	High	14th century church with later additions and alterations. Operation of the Proposed Scheme could increase noise; traffic would be able to flow at higher speed which could result in greater noise impacts to the setting of the asset. Increased lighting along the stretch would affect the setting of the asset.
Church of St Peter, 200m north of the mainline alignment of the Proposed Scheme, North Burlingham. Grade II listed building.	TG 36834, 10045	Medium	15th century church, restored in 19th century. Now disused and in ruins. Operation of the Proposed Scheme could increase noise; traffic would be able to flow at higher speed which could result in greater noise impacts to the setting of the asset. Increased lighting along the stretch would affect the setting of the asset.
Farm buildings at Poplar Farm (NHER 12283)	TG 35797, 09896	Low	Non-designated assets. Dated 1740. Potential damage to the structures, which are in poor condition and have been partially structurally supported, would result from the operation of the road in such close proximity. Increased lighting along the stretch would affect the setting of the asset.
Historic landscape character	Throughout the study area	Low	The historic landscape character is late post-medieval enclosure with some 20th century alterations. Increased lighting during operation would affect the rural, historic character of the landscape.

6.10 Chapter summary

- 6.10.1 This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon Cultural Heritage.
- 6.10.2 The Site is situated in an area with a paucity of archaeological evidence. The lack of recorded archaeological remains is understood to be due to limited archaeological investigation, rather than a true reflection of the actual archaeological buried resource. Cropmarks indicate that the land has most likely been farmed from the prehistoric period. The Domesday Survey records a largely agricultural economy for the settlements of Blofield and

North Burlingham, and post-medieval mapping presents an agricultural landscape interspersed with rural settlements and manor house estates.

- 6.10.3 There are a number of designated assets that are likely to be adversely affected by the Proposed Scheme as there is potential for them to experience permanent visual and / or noise intrusion which would adversely affect their settings.
- 6.10.4 Further work will be undertaken to develop design interventions to limit or reduce impacts and promote opportunities for the environment within the study area wherever possible. Design development and potential mitigation will be reported in the ES as well as further detailing of baseline conditions and likely changes during both construction and operation for all identified receptors.

7 Landscape

7.1 Introduction

7.1.1 This chapter presents the preliminary findings of the Landscape and Visual Impact Assessment (LVIA). This comprises a review of the existing environment and identification of the potential impacts of the Proposed Scheme upon surrounding landscape and visual receptors. The chapter also outlines proposed design measures to help mitigate potential landscape and visual impacts and relevant consultation.

7.2 Guidance and best practice

7.2.1 No single prescribed methodology exists for assessing landscape and visual impact; however, this assessment follows best practice guidelines as set out in:

- Design Manual for Roads and Bridges (DMRB) Volume 11 Section 3 Part 5 Landscape Effects (Highways England, 1993)
- DMRB Interim Advice Note 135/10 (IAN 135/10) Landscape and Visual Effects Assessment (Highways England, 2010)
- Guidelines for Landscape and Visual Impact Assessment Third Edition (Landscape Institute & Institute of Environmental Management and Assessment, 2013)
- An Approach to Landscape Character Assessment (Natural England and Department for Environment, Food and Rural Affairs, 2014)

7.3 Study area

7.3.1 The land within the Proposed Scheme boundary is hereafter referred to as 'the Site'. In recognition of the guidance given in DMRB Volume 11 Section 3 Part 5 Landscape Effects, the study area for the LVIA extends 1km from the boundary of the Site. The focus of the assessment on key issues typically associates more locally with the immediate setting of the Site.

7.4 Assumptions and limitations

7.4.1 Visual impacts have been considered based on a site visit to publicly accessible areas, therefore it has not been possible to validate the potential for views from all receptors.

7.4.2 Existing vegetation survey data was not available at the time of this assessment therefore assumptions have been made about the potential extent of vegetation loss associated with the Proposed Scheme.

7.5 Baseline

Landscape character

- 7.5.1 The study area lies within National Character Area (NCA) 79; North East Norfolk and Flegg. The NCA comprises a generally flat, low-lying landscape. It has limited topographic variation and slopes gently from west to east, becoming flatter as it merges with the Broads. The area is notable for its deep, loamy, free draining and highly fertile soils which support productive arable farming. The rich agricultural land generally comprises small to medium scale fields which are bordered by high hedgerows and prominent hedgerow oaks. The area is also characterised by isolated farmsteads and small, nucleated villages with large medieval churches which are linked by a dense network of lanes.
- 7.5.2 In terms of local landscape character, the study area lies within the Broadlands District Council (BDC) Landscape Character Assessment 'Blofield Tributary Farmland' and 'Freethorpe Plateau Farmland' Landscape Character Areas (LCA).
- 7.5.3 The BDC landscape character assessment describes the Blofield Tributary Farmland LCA (which coincides with the western extents of the Site) as associating with a shelving and gently undulating landform, occasionally cut by small tributary valleys. Landcover is dominated by arable farmland, with medium to large fields bounded by hedgerows. Woodland cover typically associates with river corridors and the peripheries of settlements.
- 7.5.4 The eastern extents of the Site associate with the Freethorpe Plateau Farmland local LCA which is characterised by a flat, elevated landform that stands above the surrounding landscape. Landcover in the area is mainly arable farmland, with medium to large fields typically bounded by hedgerows, although many hedges have been lost due to the intensification of arable agriculture. Small woodland clumps of mixed or deciduous trees are infrequently scattered across the area. The landscape pattern of the area is therefore quite simple and open, affording the potential for long distance views in places.

Landscape features

- 7.5.5 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. The existing A47 is partially delineated by mature trees and

hedgerows, but is more widely characterised by a context of open arable farmland with limited field boundary vegetation.

Landscape designations

- 7.5.6 There are no landscape designations associated with the Proposed Scheme study area.

Visual

- 7.5.7 Towards the eastern extents of the study area the broad plateau topography and openness of the agricultural landscape affords extensive views across the area. Closer to Blofield and towards the western extents of the study area the rolling topography creates a more diverse visual experience with extensive views from high points and enclosed views associated with valley features. The extent of views across the landscape to the north of the Site are influenced by the partial screening effect of woodland and mature hedgerow trees.
- 7.5.8 The potential for views of the Proposed Scheme most notably associate with residential properties and users of the local Public Rights of Way (PRoW) network. The potential for views from residential properties includes the settlements of Blofield and Lingwood, the smaller grouping of residential properties at North Burlingham and a wider, dispersed pattern of individual properties and small hamlets spread extensively across the study area. Various PRoW footpaths and bridleways coincide with the extent of the study area, with notable concentrations of routes near Blofield, Lingwood and North Burlingham (those in the vicinity of Burlingham forming part of a signposted network of 'Burlingham Woodland Walks').
- 7.5.9 Views of the Proposed Scheme would also be experienced by users of St Andrew & St Peter's Church in North Burlingham, business users of Burlingham Business Centre and road users of the A47, B1140 and various minor roads within the extent of the study area.
- 7.5.10 Table 7.1 lists the main visual receptors with potential to experience views of the Proposed Scheme.

Table 7.1: Main visual receptors

Receptor
Residential properties on the north-eastern edge of Blofield
Residential properties on the northern edge of Lingwood
Residential properties in North Burlingham
Dispersed residential properties to the north and south of the existing A47

Receptor
Users of PRow on the north-eastern edge of Blofield, to the north of Lingfield and forming part of the 'Burlingham Woodland Walks'
St Andrew & St Peter's Church, North Burlingham
Users of the allotments on the north-eastern edge of Blofield
Indoor workers at Burlingham Business Centre, North Burlingham
Outdoor workers at Norwich Camping and Leisure, Blofield
Outdoor workers at Atlantic Truck and Van Centre, Blofield
Outdoor workers at Church Farm Units, North Burlingham
Users of the A47 road
Users of the B1140 road
Users of the various minor roads to the north and south of the existing A47

7.6 Consultation

- 7.6.1 Non-statutory public consultation on the Proposed Scheme was undertaken in March and April 2017. Where relevant, points arising are carried forward in the development of mitigation measures for the Proposed Scheme and will be reported in the Environmental Statement (ES).
- 7.6.2 A Scoping Report was submitted in February 2018, the outcomes of which have guided the development of the methodology and focus of both PEIR and ES assessments.
- 7.6.3 Representative viewpoints to inform the assessment of visual impacts are to be discussed and agreed in consultation with the Local Planning Authority and consequently reported in the ES.

7.7 Design interventions

- 7.7.1 The scope to incorporate design interventions is considered as part of the ongoing design development process and will be presented in the ES. Typical landscape and visual related interventions include minor changes in highway alignment to assist integration with existing features, the adaptation of earthworks to contribute to screening and input to the positioning of highway elements such as lighting or signage to minimise their visual impact.

7.8 Potential mitigation measures

- 7.8.1 A comprehensive environmental masterplan and subsequent detailed planting design will be produced to develop a robust landscape mitigation strategy. Potential mitigation measures would seek to reduce impacts during

both construction and operation phases. Measures would potentially include the following:

Construction

- sensitive colouring of welfare facilities and temporary office units within site compounds
- keeping a tidy and organised site
- materials delivered on an 'as needed' basis to prevent unnecessary stockpiling
- protection of retained vegetation in accordance with BS 5837:2012

Operation

- advance planting where possible
- use of screening vegetation to limit views of the Proposed Scheme
- use of native species appropriate to the local environment to aid integration with neighbouring landscape
- design of balancing ponds for landscape and ecological enhancement
- smoothly profiled cuttings and embankments to soften earthwork grading with the surrounding landscape

7.9 Potential impacts

Construction

Landscape impacts

- 7.9.1 The removal of existing vegetation, earthworks and presence of construction plant, materials, machinery, construction compounds and construction lighting would potentially result in local landscape elements and character being impacted upon during construction.
- 7.9.2 The Proposed Scheme would potentially result in a loss of field boundary trees adjacent to Yarmouth Road / Hemblington Road on the north-eastern edge of Blofield. More extensively along the length of the Proposed Scheme the combined loss of hedgerows, mature trees and localised areas of woodland would result in an increased sense of openness within the landscape.
- 7.9.3 Construction would result in earthworks along the length of the Proposed Scheme, which would be locally accentuated at the site of the Blofield and B1140 overbridges where the elevated landform would be graded up to 9m above the existing ground level.

Visual impacts

- 7.9.4 The removal of existing vegetation, earthworks and presence of construction plant, materials, machinery, construction compounds and construction lighting, would potentially result in visual impacts on; occupiers of residential properties, recreational users of PRoW, users of local community facilities, workers in commercial premises and vehicle travellers.
- 7.9.5 Receptors with potential to experience visual impacts during construction are listed in Table 7.2.

Table 7.1: Receptors with potential to experience visual impacts

Receptor	Construction	Year 1	Year 15
Residential properties on the north-eastern edge of Blofield	✓	✓	✓
Residential properties on the northern edge of Lingwood	✓	✓	
Residential properties in North Burlingham	✓	✓	
Dispersed residential properties to the north and south of the existing A47	✓	✓	✓
Users of PRoW on the north-eastern edge of Blofield, to the north of Lingfield and forming part of the 'Burlingham Woodland Walks'	✓	✓	✓
St Andrew & St Peter's Church, North Burlingham	✓		
Users of the allotments on the north-eastern edge of Blofield	✓	✓	
Indoor workers at Burlingham Business Centre, North Burlingham	✓		
Outdoor workers at Norwich Camping and Leisure, Blofield	✓	✓	
Outdoor workers at Atlantic Truck and Van Centre, Blofield	✓	✓	
Outdoor workers at Church Farm Units, North Burlingham	✓		
Users of the A47 road	✓	✓	
Users of the B1140 road	✓	✓	
Users of the various minor roads to the north and south of the existing A47	✓	✓	

Operation

Landscape impacts

- 7.9.6 At year 1 of operation, there would potentially be impacts on landscape character due to the relative prominence of Proposed Scheme infrastructure (including overbridges) prior to the establishment of integrating Proposed Scheme mitigation planting. The impact would also be associated with the initial year 1 loss of mature trees and hedgerow landscape elements relative to the existing baseline and to the localised loss and fragmentation of agricultural land.

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- 7.9.7 By year 15 of operation, the establishment of Proposed Scheme landscape mitigation would contribute to a reduction in the extent and magnitude of landscape impacts. There would however remain the potential for localised residual landscape impacts as an outcome of the relative increase in road infrastructure associated with enlarged junctions and overbridges within a relatively flat, open, agricultural landscape.

Visual impacts

- 7.9.8 At year 1 of operation, prior to the establishment of Proposed Scheme landscape mitigation, there would be potential for visual impacts associated with views of the road infrastructure, including overbridges and vehicles from occupiers of residential properties, recreational users of PRow, users of local community facilities, workers in commercial premises and vehicle travellers.
- 7.9.9 Receptors with potential to experience visual impacts during year 1 of operation are listed in Table 7.2.
- 7.9.10 By year 15 of operation, the establishment of Proposed Scheme landscape mitigation would contribute to a reduction in the extent and magnitude of visual impacts. There would however remain the potential for residual visual impacts on the receptors listed in Table 7.2.
- 7.9.11 There would also be potential for night time visual impacts as a result of the influence of vehicle headlights and Proposed Scheme lighting. Night time lighting impacts would reduce over time following establishment of screening afforded by Proposed Scheme mitigation planting.

7.10 Chapter summary

- 7.10.1 This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon landscape character and visual amenity. Impacts on local landscape character are likely during both the construction and operational phases as a result of the enlarged junctions and overbridges within a relatively flat, open, agricultural landscape. Visual impacts on occupiers of residential properties and recreational users of PRow are likely during both the construction and operational phases. Visual impacts during construction would be associated with the removal of existing vegetation, earthworks and construction activity. Visual impacts during operation would be associated with views of the road infrastructure and vehicles.

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- 7.10.2 Further work will be undertaken to develop design interventions to limit or reduce adverse impacts and promote opportunities to enhance the environment in the study area wherever possible. Design development and potential mitigation will be reported in the ES as well as further detailing of baseline conditions and likely changes during both construction and operation for all identified receptors.

8 Biodiversity

8.1 Introduction

8.1.1 This chapter presents the preliminary findings of the ecological assessment. This comprises a review of the existing environment and identification of the potential impacts of the Proposed Scheme upon surrounding ecological receptors. The chapter also outlines proposed design measures to help mitigate potential ecological impact and relevant consultation.

8.2 Guidance and best practice

8.2.1 Surveys and assessment follows best practice guidelines as set out in:

- Design Manual for Roads and Bridges Volume 11, Section 2, Part 4
- Design Manual for Roads and Bridges Volume 11, Section 3, Part 4
- Interim Advice Note 130/10 Ecology and Nature Conservation: Criteria for Impact Assessment
- Handbook for Phase 1 Habitat Survey: A Technique for Environmental Audit, Joint Nature Conservation Committee (2010)
- Surveying Badgers, An occasional publication of the mammal society Harris, S. Cresswell, P. and Jefferies, D. (1989)
- Surveying for Bats in Trees and Woodland – Guide, British Standards Institute (2015)
- Bat Surveys for Professional Ecologists: Good Practice Guidelines, 3rd edition. The Bat Conservation Trust, London
- Great Crested Newt Mitigation Guidelines, English Nature (2001)
- Evaluating the suitability of habitat for the Great Crested Newt (*Triturus cristatus*), Herpetological Journal 10 (4), 143-155, Oldham, R. S, Keeble, J. Swan, M. J. S. and Jeffcote, M. (2000)
- Ecology of the European Otter. Conserving Natura 2000, Series No. 10, English Nature
- The Water Vole Mitigation Handbook (The Mammal Society Guidance Series) Mammal Society Mitigation Guidance Series)
- Bird census techniques (2nd ed.), BIBBY, C.J. et al

8.3 Study area

8.3.1 Due to the variability of species, the distance in which the Proposed Scheme could affect said species can be different. The study areas used for specific ecological surveys therefore differs dependant on the survey. The study area for specific surveys can be found in Table 8.1.

Table 8.1: Study areas for each ecological receptor

Receptor	Study Area, distances from the Proposed Scheme (including areas not surveyed)
International and nationally designated sites (including Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Wetlands of International Importance (Ramsar Sites), National Nature Reserves (NNRs) and Sites of Special Scientific Interest (SSSIs).	2km
SACs designated for bats.	30km
Statutory sites designated for birds.	10km
Locally designated conservation sites (including Local Nature Reserves (LNRs), Local Wildlife Sites (LWSs) and RSPB reserves).	2km
Phase 1 habitat survey.	100m
Habitat Suitability Index (HSI) for great crested newts (GCN) <i>Triturus cristatus</i> .	500m
Water vole <i>Arvicola amphibius</i> , otter <i>Lutra lutra</i> and wintering birds.	500m
Aquatic invertebrates from within wetland sites that could be directly impacted by the Proposed Scheme.	50m
Other potential ecological assessments (including badger <i>Meles meles</i> , reptiles, breeding birds) and for trees and buildings that may support roosting bats.	50m

8.4 Assumptions and limitations

- 8.4.1 It should be noted that the absence of records or field signs of certain protected or rare species from the Phase 1 survey does not preclude their presence on a site. There is always the risk of protected or rare species not being identified, either owing to the timing of the survey or the scarcity of the species over the Proposed Scheme.
- 8.4.2 Field surveys in 2017 were confined to locations where landowner permission had been obtained. Surveys are planned to continue in 2018 with access sought to areas not previously surveyed.
- 8.4.3 During the bat activity surveys in 2017, 1 transect route (transect 1) could not be completed due to access not being granted to the land. This is considered to be a limitation to the results of the survey as no information on bat foraging and commuting was obtained for this area. Surveys for transect 1 in 2018 are ongoing.
- 8.4.4 Terrestrial invertebrate surveys were undertaken between June and September 2017. These surveys would not pick up species which are active in spring (March to May) such as many of the mining bees *Andrena sp.* Given the number and diversity of invertebrate species likely to be present on any site, it is unlikely that a complete species list even for the target taxa

would be produced from the sampling procedure. Therefore, terrestrial invertebrate surveys are ongoing in 2018.

8.4.5 In 2017 the breeding bird survey consisted of a single suite of surveys completed in July. This is a limitation as although the breeding season runs March to September inclusive, surveys undertaken later in the breeding season would miss birds that have single broods and birds that nest early on in the season. Breeding bird surveys were completed in June 2018.

8.4.6 Ecological surveys are ongoing. An updated assessment will be included within the Environmental Statement (ES) after ecological surveys for the following species are completed in 2018:

- Breeding birds
- Bat activity
- Bat emergence
- Invertebrates

8.5 Baseline

8.5.1 A number of nationally and locally designated sites occur within the study area, which are presented in Table 8.2.

Table 8.2: Summary of existing nature conservation designated sites

Designated Site	Distance from Proposed Scheme
The Broads SAC	1.17km south-west (from A47 at Brundall)
Broadland SPA	1.17km south-west (from A47 at Brundall)
Broadland Ramsar	1.17km south-west (from A47 at Brundall)
Breydon Waters Ramsar	6.78km south-east (from Acle on the A47)
Breydon Waters SPA	6.78km south-east (from Acle on the A47)
Decoy Carr, Acle SSSI	0.6km south (from Acle on the A47)
Paston Great Barn SAC (designated for bat populations)	Located within 30km of the Proposed Scheme
Lingwood Community Woodland	0.07km south (from A47 at Lingwood)
Church & Drive Plantations County Wildlife Site (CWS)	0.14km north (from A47 at North Burlingham)
Woodbastwick Road Roadside Nature Reserve (RNR)	0.29km north (from A47 at Blofield)
Belt Plantation CWS	0.56km north (from A47 at North Burlingham)
Howe's Meadow CWS	0.99km north (from A47 at Blofield)
Acle Road RNR	1-1km north (from Acle on the A47)
Birch Grove and Dawling's Wood CWS	1.39km north-east (from A47 at Blofield)
Damgate Wood CWS	1.42km south (from Acle on the A47)
Highnoon Farm Braydeston CWS	1.60km north (from A47 on High Noon Lane)
Land adjacent to Witton Lane CWS	1.65km north (from A47 at Yarmouth)
Walsham Wood CWS	1.90km north (from A47 at Pedham)
Long Lane RNR	2km south-west (from Lingwood on the A47)

8.5.2 An Extended Phase 1 habitat survey and a desktop study were undertaken by 2 suitably qualified ecologists in April 2016. This was updated during secondary surveys undertaken throughout 2017, to assess the ecological importance of the habitats over the study area and determine the requirement for Phase 2 surveys, as summarised in Table 8.3. The Phase 1 and Phase 2 data were collected using the Dominant, Abundant, Frequent, Occasional and Rare (DAFOR) scale.

Table 8.3: Summary of the habitats found on site during the Extended Phase 1 habitat survey and the species that may be supported on site that required further survey in 2017

Survey Type	Date Undertaken	Habitats Found	Potential Species	Further Species Survey Date
Extended Phase 1 Habitat Survey	Mar-16	Arable	Bats Breeding birds Overwintering birds GCN Badgers Reptiles Otters Polecat GCN Hedgehog Breeding birds Bats	2017
		Semi-improved grassland		
		Improved grassland		
		Including semi-natural and plantation broadleaved woodland		
		Mixed plantation woodland		
		Coniferous plantation		
		Scrub		
		Dry ditches		
		Tall ruderal		
		Standing water		
		Allotments		
		Hedgerows		
		Scattered trees		
		Church yard and cemeteries		
Ephemeral / short perennial				

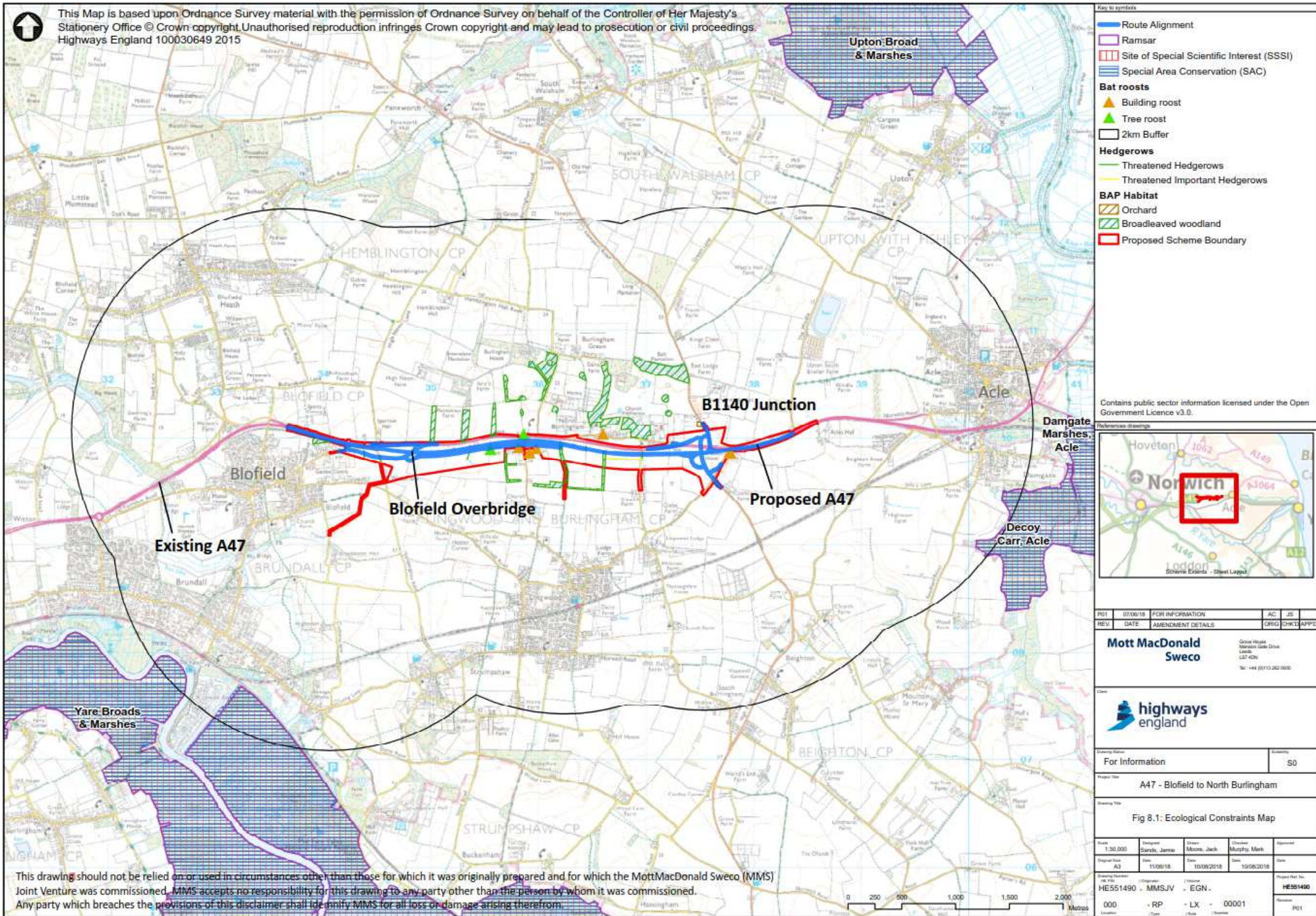
8.5.3 Six Priority Habitats listed on Section 41 of the National Environment and Rural Communities (NERC) Act (2006) are recorded within the study area. These are: arable field margin, eutrophic standing water, hedgerows, lowland mixed deciduous woodland, traditional orchards and pond habitats. Only hedgerows, lowland mixed deciduous woodland and traditional orchards have been shown on the Ecological Constraints Map in Figure 8.1 for the purposes of clarity.

8.5.4 Figure 8.1 of this report shows an ecological constraints map of the Proposed Scheme detailing the ecological data that has previously been collected for the Proposed Scheme.

8.5.5 Surveys planned for 2018 are currently ongoing for bats, breeding birds and terrestrial invertebrates, ultimately to inform production of the ES.



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- Key to symbols
- Route Alignment
 - Ramsar
 - Site of Special Scientific Interest (SSSI)
 - Special Area Conservation (SAC)
 - Bat roosts**
 - Building roost
 - Tree roost
 - 2km Buffer
 - Hedgerows**
 - Threatened Hedgerows
 - Threatened Important Hedgerows
 - BAP Habitat**
 - Orchard
 - Broadleaved woodland
 - Proposed Scheme Boundary

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REV	DATE	FOR INFORMATION	AC	JS
		AMENDMENT DETAILS	DRG	CHKD APPR

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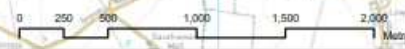
Drawing Title	Quantity
For Information	S0

Project Title: A47 - Blofield to North Burlingham

Fig 8.1: Ecological Constraints Map

Scale	1:30,000	Designed	Sands, James	Drawn	Moores, Jack	Checked	Murphy, Mark	Reviewed	
Original Date	AD	Date	11/09/18	Date	10/09/2018	Date	10/06/2018	Date	
Drawing Number	HE551490 - MMSJV	Organization	EGN	Project Ref. No.	HE551490				
Location	000	Type	- RP	Scheme	- LX	Sheet	- 00001	Revision	001

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Bats

Tree survey

- 8.5.6 A total of 93 trees were found to have moderate to high bat roost potential and these were climbed and inspected for hibernation roosts in January 2017. None of the trees were identified as having hibernation roosts. Twenty trees were also climbed and inspected for summer roosts in May 2017. No summer roosts were identified during surveys.

Dusk emergence / dawn return to roost survey

- 8.5.7 A minimum of 1 bat emergence or 1 return to roost survey was completed for the trees and buildings identified as having moderate or high suitability for roosting bats following bat roost potential appraisals undertaken in January and February 2017.
- 8.5.8 Bat roosts were found in 4 buildings and 2 trees within the 50m buffer of the Proposed Scheme: The Lindens; Oaklands; Poplar Farm; The White House; and Trees 5 and 67.
- 8.5.9 Two additional surveys are required for buildings and trees classified as having high suitability to support roosting bats, or those where a roost has been confirmed. One additional survey is required for buildings and trees classified as moderate suitability to support roosting bats. These are to be completed in 2018.
- 8.5.10 Emergence surveys planned for April, May and June 2018 are currently ongoing in order to provide a full year's worth of data and to understand how bats are utilising the habitats over the Proposed Scheme for foraging, and commuting between roost and foraging locations.
- 8.5.11 In addition, a full daytime assessment is to be undertaken on one additional building within the Zone of Influence (ZOI) of the Proposed Scheme in 2018.

Bat activity survey

- 8.5.12 Bat activity was generally considered to be low during walked transect surveys in 2017, with the most bat activity identified on land surrounding St Andrews Church and St Peters Church ruins in North Burlingham.
- 8.5.13 Static detector surveys undertaken in 2017 identified the highest number of bat passes in October behind farm buildings to the north of the A47 and the west of South Walsham Road. The corner of Lingwood Lane and the A47 had the highest recorded number of noctule *Nyctalus noctula* passes in August and September.

- 8.5.14 Bat activity transect surveys planned for April, May and June 2018 are currently ongoing in order to provide a full year's worth of data and to understand how bats are utilising the habitats over the Proposed Scheme for foraging and commuting between roost locations.

Great crested newt

- 8.5.15 HSI assessments were carried out in 2016 on all identified water bodies within the ZOI. There were 66 water bodies in total; 27 were scoped out using professional judgement and HSI assessment scores, as they were either dry or entirely unsuitable. Ponds that were assigned HSI ratings of below average, average, good or excellent were subject to environmental DNA (eDNA) surveys to confirm presence or likely absence of GCN.
- 8.5.16 Of the 39 ponds considered for eDNA survey there were 4 positive results, 2 ponds are false positive likely due to sediment, 3 indeterminate and the remaining ponds are negative. In 2017, 1 pond was re-tested for GCN eDNA following an indeterminate result in 2016, and 2 additional ponds were tested for GCN eDNA in 2017.
- 8.5.17 Population size class surveys (manual) techniques were then undertaken on all ponds which tested positive as well as a garden pond, which was identified after the eDNA surveys had been carried out, however, no GCN were found in this pond. Therefore, GCN are no longer considered at this pond as part of this assessment.

Breeding birds

- 8.5.18 A single breeding bird survey visit was undertaken in July 2017, where breeding activity was difficult to determine due to the timing of the survey visit at the later stages of the breeding bird season. Three further breeding bird surveys were undertaken from March-June 2018 to cover the early part of the breeding season that was missed in 2017. The findings are detailed below.
- 8.5.19 A total of 73 species were recorded within the site boundary during the suite of surveys in 2017-2018, of which:
- 7 species are listed on Wildlife and Countryside Act (1981) Schedule 1
 - 15 species are listed on NERC S41
 - 15 were Birds of Conservation Concern (BoCC Red List species)
 - 13 were Birds of Conservation Concern (BoCC Amber List species)
 - 8 are listed as LBAP species

- 8.5.20 Of the 73 species, 22 were confirmed as breeding. This was concluded through the identification on recently fledged young, adults visiting nests and adults carrying food.
- 8.5.21 20 species were considered probable breeders on the site. This was concluded through pairs observed in suitable breeding habitat, birds permanently on territories, agitated behaviour, nest building and courtship displays.
- 8.5.22 12 species were considered as possibly breeding on site. This was concluded by birds either being observed in suitable breeding habitat or singing males present in suitable habitat. The other 19 species of birds recorded were classed as non-breeders.

Autumn passage bird surveys

- 8.5.23 A total of 13 notable bird species were recorded during surveys undertaken in September 2017. Nine bird species recorded are classed as migrant or resident birds and 4 are classed as passage or winter visitors. This does not meet any importance thresholds as the assemblage consists of fewer than 25 species over the entire Proposed Scheme. The following notable species and assemblages were recorded:
- 2 species listed in the Norfolk Biodiversity Action Plan (BAP): song thrush *Turdus philomelos* and skylark *Alauda arvensis*.
 - 6 species listed on the BoCC (2009) Red List: linnet *Linaria cannabina*, lapwing *Vanellus vanellus*, skylark, song thrush and herring gull *Larus argentatus*.
 - 7 species listed on the BoCC (2009) Amber List: pink-footed goose *Anser brachyrhynchus*, black headed gull *Chroicocephalus ridibundus*, common gull *Larus canus*, mute swan *Cygnus olor* and kestrel *Falco tinnunculus*.
 - 5 species which are SPA qualifying species: linnet, herring gull, lapwing, skylark and song thrush.
- 8.5.24 Further passage surveys have been undertaken in April 2018 as part of the breeding bird survey (which is currently ongoing) to record spring passage migration. This ensures that impacts to SPA qualifying species are assessed appropriately, and this would be discussed within the ES.

Overwintering birds

- 8.5.25 Two Schedule 1 species: fieldfare *Turdus pilaris* and redwing *Turdus iliacus* were observed on land within the study area during surveys undertaken in December 2017 and February 2018.

-
- 8.5.26 Potential impacts on overwintering and breeding birds would be considered as part of the Habitat Regulation Assessment (HRA) as well as in the Biodiversity Chapter of the ES.

Badgers

- 8.5.27 A badger survey was undertaken in April 2018 in order to gather a full data set for the Proposed Scheme. No badger setts or signs of badger activity were found within the 50m ZOI of the Proposed Scheme. Therefore, no further recommendations are made with regard to badgers.

Reptiles

- 8.5.28 No reptiles were noted during the 2017 survey and therefore no further recommendations are made with regard to reptiles within the ZOI of the Proposed Scheme.

Otters

- 8.5.29 Surveys previously undertaken in February 2017 by Highways England noted there was no suitable habitat present to support otter. Running water and pond habitats have been re-evaluated following the selection of the Proposed Scheme, and no field signs of otters were noted; suitability is considered to be low for this species.
- 8.5.30 Pre-construction surveys are recommended for otter a maximum of 12 months before construction works are due to commence.

Water voles

- 8.5.31 Surveys previously undertaken in February 2017 by Highways England found within the ZOI of the Proposed Scheme to have limited habitat to support water vole, and no field signs were noted. As with surveys previously undertaken by Highways England, the habitats within the ZOI of the Proposed Scheme were found to have limited habitat to support water vole and no field signs were recorded.
- 8.5.32 Pre-construction surveys should be undertaken for water vole a maximum of 12 months prior to the commencement of construction of the Proposed Scheme as a precaution.

Aquatic invertebrates

- 8.5.33 Results from the aquatic invertebrate survey undertaken in June 2017 via sweep netting show that waterbodies are of poor water quality due to pollution from farming activities. There were no notable species recorded, the site is currently of low value for aquatic invertebrates.
- 8.5.34 No recommendations are made with regard to aquatic invertebrates within the 50m ZOI of the Proposed Scheme.

Terrestrial invertebrates

- 8.5.35 Results from a walkover survey in June 2017 assessed the majority of the Proposed Scheme as arable farmland of limited potential to support a rich and diverse invertebrate fauna with few habitat features of value such as tussocks, banks or bare patches which would support nesting, over-wintering or basking invertebrates, and poor vegetation structure. Field margins had some flowering plants to support pollinator species but in general these had low diversity and few features such as tussocks, banks or bare patches which would support nesting, over-wintering or basking terrestrial invertebrates.
- 8.5.36 Of the 170 invertebrate species identified, 104 are associated with open habitats and the remainder are associated with tree (20) or wetland (15) habitats. Open habitat associations comprise tall sward and scrub (89 species) and short sward and bare ground (14 species). Woodland associations comprise arboreal (9 species), decaying wood (7 species), shaded woodland floor (5 species) and wet woodland (1 species). Wetland habitat associations comprise marshland (8 species), peatland (4 species), wet woodland (1 species) and running water (1 species).
- 8.5.37 Further surveys for terrestrial invertebrates planned from April to June 2018 are currently ongoing in order to collect a full data set.

Hedgerows

- 8.5.38 Two important hedgerows were recorded within the survey area. A further 2 hedgerows were found to be species-rich but assessed as being under 30 years old and therefore not considered important hedgerows. The remaining hedgerows were species poor and not considered important hedgerows, being largely hawthorn-dominated.
- 8.5.39 No further surveys are recommended for hedgerows.

Fungi

- 8.5.40 The survey corridor has been assessed as of “low” value during a fungi survey undertaken in October 2017 as only abundant and widespread fungi species were recorded. No protected or notable fungi were recorded during the survey. It is considered that there is no suitable habitat for the protected species sandy *stiltball* *Battarraea phalloides* within the ZOI. The current soil conditions are considered to be poor for supporting fungi due to extensive nitrogen deposition through sources such as fertiliser spray drift and poor air quality through emissions from long-term vehicle usage of the existing A47 and surrounding farm land. Therefore, it is considered unlikely that the soil in the ZOI of the Proposed Scheme would support fungi in the future.
- 8.5.41 No recommendations for further survey are made with regard to fungi within the 50m ZOI.

Other species

- 8.5.42 Surveys will be undertaken in 2018 following UKBAP mammal guidance for species such as hedgehog *Erinaceus europaeus* and brown hare *Lepus europaeus* within the ZOI of the Proposed Scheme, pending consultation with relevant stakeholders.

Invasive non-native species

- 8.5.43 There were no invasive species noted during the survey undertaken in 2017. Any invasive species found during surveys for other ecological receptors in 2018 would be recorded.

Valuation of ecological receptors

- 8.5.44 A summary of the valuation of ecological receptors relevant to the Proposed Scheme is provided in

8.5.45 Table 8.4: Summary of valuation of ecological receptors.

Table 8.4: Summary of valuation of ecological receptors

Ecological receptor	Valuation
The Broads SAC	International
Broadland SPA / Ramsar	International
Breydon Waters SPA/Ramsar	International
Decoy Carr, Acle SSSI	National
Paston Great Barn SAC	International
Lingwood Community Woodland	Local
Church & Drive Plantations CWS, Belt Plantation CWS, Howe's Meadow CWS, Birch Grove and Dawling's Wood CWS, Damgate Wood CWS, Highnoon Farm Braydeston CWS, Land adjacent to Witton Lane CWS, Walsham Wood CWS	County / Unitary Authority Area
Woodbastwick Road RNR, Acle Road RNR, Long Lane RNR	County / Unitary Authority Area of the Norfolk District
NERC Act (2006) Section 41 Priority habitats – Broadleaved woodland, important and species-rich hedgerows, standing water and traditional orchards adjacent to Development Consent Order (DCO) Boundary of the Proposed Scheme.	National
Scrub - within and adjacent to the DCO boundary of the Proposed Scheme.	Negligible
Scattered trees – within and adjacent to the DCO boundary of the Proposed Scheme.	Local
Grasslands (semi-improved and improved) – within and adjacent to the DCO boundary of the Proposed Scheme.	Negligible
Tall ruderal – within and adjacent to the DCO boundary of the Proposed Scheme.	Negligible
Hedgerows – Species poor within and adjacent to the DCO boundary of the Proposed Scheme.	Local
Plantation woodland – mixed plantation woodland.	Negligible
LBAP Allotments – within and adjacent to the DCO boundary of the Proposed Scheme.	Local
Dry Ditches - within and adjacent to the DCO boundary of the Proposed Scheme.	Negligible
Buildings – church yards and cemeteries.	Local
Buildings – within and adjacent to the DCO boundary of the Proposed Scheme.	Negligible
Terrestrial Invertebrates – within and adjacent to the DCO boundary of the Proposed Scheme.	Local
Aquatic Invertebrates – within and adjacent to the DCO boundary of the Proposed Scheme.	Negligible
Birds – within and adjacent to the DCO boundary of the Proposed Scheme.	Local
Birds – Broadlands SPA; Breydon Waters SPA.	International
Bats – Paston Great Barn SAC.	International
Bats – within and adjacent to the DCO boundary of the Proposed Scheme.	Local
Badgers – within and adjacent to the DCO boundary of the Proposed Scheme.	Negligible (although subject to legal constraints)
Fungi – within and adjacent to the DCO boundary of the Proposed Scheme.	Negligible

Ecological receptor	Valuation
Great Crested Newt – >500m outside the DCO boundary of the Proposed Scheme.	Negligible
Otters – within and adjacent to the DCO boundary of the Proposed Scheme.	Local
Water voles – within and adjacent to the DCO boundary of the Proposed Scheme.	Negligible
Reptiles – within and adjacent to the DCO boundary of the Proposed Scheme.	Negligible
Notable species (hedgehogs and brown hare) – within and adjacent to DCO boundary of the Proposed Scheme.	Local

8.6 Consultation

8.6.1 Consultation will be undertaken with Highways England and Natural England to discuss the findings of the Habitats Regulations Assessment report that is to be undertaken in 2018. This consultation would discuss the impact to ecological receptors included in the Biodiversity Chapter of the ES. Consultation would be undertaken with the local or county ecologist in relation to impacts on Lingwood Woodland.

8.7 Design interventions

8.7.1 A number of measures are recommended to guide the design process and identify mitigation requirements. These measures are not an exhaustive list and a review of additional measures are to be undertaken following completion of the survey work to inform the design. These will be reported in the ES.

- Considerate design, such as the use of drainage infrastructure that is designed to avoid trapping amphibians, and the design of balancing ponds to minimise risks to wildlife during the operational phase, as maintenance operations have potential to cause harm to animals that colonise the ponds.
- Minimising illumination where possible and ensuring that any lighting that is necessary is directed and localised to prevent detrimental effects to habitat quality and function.
- Sensitive working methods to be implemented during construction works, such as working under protected species mitigation licences for example for bats. Other species not protected directly, but considered priority species, would require works to be undertaken in accordance with non-licensed mitigation strategies.

8.8 Potential mitigation measures

Bats

- 8.8.1 Specific bat mitigation would likely be required to some extent; this may include (as specified under a derogation licence where appropriate):
- Creating, restoring or improving roosts (i.e. bat boxes, bat bricks in new or existing bridges).
 - Creating, restoring or improving habitats including foraging areas and flight corridors.
 - Minimising loss of valuable semi-natural habitats and maintaining habitat connectivity where possible. Where habitat loss is inevitable, replacement habitats would be provided, providing habitat connectivity where possible, for example, using bat hops where roads sever known bat flight paths.

Breeding birds

- 8.8.2 Mitigation for breeding birds is likely to include scheduling any vegetation removal works to take place outside the breeding bird season (which spans from March to August inclusive). There is scope for providing compensatory habitat to replace and enhance that which would be lost, including arable field margins, hedgerows, trees and skylark plots.

Over-wintering birds

- 8.8.3 Mitigation for wintering birds is likely to include retention of important habitats where possible such as favoured, open arable habitats, and the creation of lost habitats such as replacing woodland and hedgerows.

Otter

- 8.8.4 Specific mitigation may be needed and would include but not limited to:
- Restoring or improving habitats to compensate for those that would be lost
 - Use of viaducts or underpasses to allow otters to cross barriers (i.e. the A47)
 - Installing mammal ledges on new bridges and culverts
 - Constructing artificial holts to replace those that would be damaged or removed (none found to date)
 - Pollution prevention and sediment control measures to ensure a continued food source
 - Covering trenches at night (or providing escape ramps)
 - No night working (or appropriate lighting restrictions)

8.9 Potential impacts

8.9.1 No direct impacts are anticipated on any statutory designated sites.

8.9.2 No direct impacts are anticipated on any CWSs or RNRs. However, Lingwood Community Woodland would be directly impacted by land-take (the land-take size is still to be confirmed) but may be mitigated by:

- habitat replacement
- habitat improvement
- pollution prevention
- improving connectivity of habitat

8.9.3 There are 4 buildings identified within the Site that support bat roosts and could be potentially disturbed as a result of the proposed alignment of the A47 and associated construction works:

- Poplar Farm
- Oaklands
- The Lindandes
- The White House

8.9.4 A European Protected Species licence from Natural England may be required. St Andrews Church, where a roost was previously confirmed in 2017, has been scoped out of further assessment as it is no longer within the study area of the Proposed Scheme.

8.9.5 Following consideration of the possible mitigation measures outlined in Section 8.8 above, there is the potential for the following effects during construction and operation.

Construction

8.9.6 The construction impacts of the Proposed Scheme on ecological receptors after implementation of the mitigation measures outlined in Section 8.8 and are described as follows:

- Loss or damage to natural habitats, including hedgerows and Lingwood woodland (see Section 8.5.3)
- Temporary impact of natural habitats through construction of site compounds and access tracks
- Fragmentation of habitat links
- Risk of killing, injury and disturbance of protected and notable species during construction works from plant and machinery. Disturbance could affect the breeding success of these protected and notable species
- Loss of bat foraging habitat with loss of arable land/ light disturbance

- Potential loss of connectivity due to road being wider and some species finding it more dangerous to cross (e.g. birds, hedgehogs)

Operation

8.9.7 The impacts of the operational Proposed Scheme on ecological receptors after mitigation in Section 8.8 and are described as follows:

- Loss of bat foraging habitat with loss of arable land / light disturbance
- Potential loss of connectivity due to road being wider and some species finding it more dangerous to cross (birds, hedgehogs)

8.9.8 The Proposed Scheme would result in small, localised losses of habitats and potentially some severance of connecting habitats (hedgerows, tree lines) on the verges where the greater losses would be experienced. This may impact more mobile species such as bats and birds. However, as no areas are expected to have a net loss of the habitat at any point on the Proposed Scheme, long-term impacts on most species are not expected.

8.10 Chapter summary

- 8.10.1 This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon ecological receptors. There are valuable habitats and species present of nature conservation importance which could be impacted by the Proposed Scheme. The ongoing ecological surveys would help identify mitigation measures to reduce the magnitude of impacts through sensitive design and construction methodologies, with a view to safeguard the conservation status of populations through both the construction and operational phases.
- 8.10.2 Mitigation in the form of pollution prevention, Ecological Clerk of Works presence during vegetation clearance and retained and enhanced habitat is recommended to reduce such impacts to levels not considered to be significant. Specific mitigation measures for protected species would be finalised within the Biodiversity Chapter of the ES following the proposed protected species surveys.
- 8.10.3 A number of measures have been recommended initially to guide the design process and identify mitigation requirements. However, these measures are not an exhaustive list and are likely to require a review and additional measures following completion of the survey and design work.

9 Geology and Soils

9.1 Introduction

9.1.1 This chapter presents the preliminary findings of the geology and soils assessment. This comprises a review of the existing environment and identification of potential impacts of the Proposed Scheme upon surrounding land. The chapter also outlines proposed design measures to help mitigate these potential impacts and relevant consultation.

9.2 Guidance and best practice

9.2.1 The main legislative framework for geology and soils chapter (including contaminated land, agricultural viability, farm severance and soils as a national resource) includes the following guidance, standards and best practice:

- The Contaminated Land (England) (Amendment) Regulations 2012
- The Environmental Damage (Prevention and Remediation) (England) Regulations 2015
- The Environmental Permitting (England and Wales) Regulations 2016
- The Environmental Permitting (England and Wales) (Amendment) Regulations 2018
- The Environmental Protection Act 1990 (as amended by the Environment Act 1995)
- The Water Resources Act 1991 (England and Wales) (Amendment) Regulations 2009
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
- Design Manual for Roads and Bridges (DMRB) Volume 11 Section 2 Part 5 Assessment and Management of Environmental Effects, Chapter 2 (Highways Agency, 2008)
- Code of Practice for the Sustainable Use of Soils on Construction Sites, Defra 2009
- Contaminated Land Risk Assessment – A Guide to Good Practice C552 (CIRIA, 2001)
- CLR 11: Model procedures for the management of land contamination. Environment Agency / Defra, 2004
- Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. Environment Agency, 2001
- DMRB Volume 11, Section 3, Part 6 (Land Use) (DMRB 2001)

9.3 Study area

- 9.3.1 The following study areas were used for the Proposed Scheme, based on professional judgement and the distance over which potential impacts could occur in relation to geology and ground conditions:
- 2km buffer either side of the proposed road alignment was used to identify any designated sites of geological interest
 - 300m buffer either side of the proposed road alignment was used to identify bedrock, superficial deposits and soils types, and to identify any potentially contaminated land in the vicinity
- 9.3.2 DMRB guidance does not provide a set definition of the study area for assessing the effects on Agriculture and Farm Viability. Therefore, the study area has been based on professional judgement and includes all farms, farm access routes, important agricultural infrastructure and agricultural land within the Site.

9.4 Assumptions and limitations

- 9.4.1 With regards to land quality and contaminated land, it should be noted that there are uncertainties and data limitations concerning geochemical makeup, and the characteristics of surface water and groundwater etc.

9.5 Baseline

Determining baseline conditions

- 9.5.1 A desk-top review of available geological, soils, historical Ordnance Survey and agricultural maps along with previously published reports and ground investigations were reviewed along with previous site walkover information. This includes evaluation of information from the Highways Agency Geotechnical Data Management System (HADGMS) and an envirocheck desk study report (Landmark Information group, 2017).
- 9.5.2 A site walkover survey was undertaken in February 2017 to determine the accuracy of desk study information, and also to identify any sites worthy of further investigation.

Designated sites

- 9.5.3 There are no designated sites, for example Sites of Special Scientific Interest or Geological Conservation Review Sites, within the study area that are designated for their geological or geomorphological importance.

Artificial ground

- 9.5.4 The term Artificial Ground describes Made Ground, Worked Ground (areas where the ground has been cut away – quarries, road cuttings, sand and gravel pits), infilled ground and disturbed ground. Artificial Ground is likely to exist in the vicinity of the former sand pits around chainages (ch) ch1+450 and ch1+700, in close proximity to the route. The composition of the material within the former pits is unknown and may present potential sources of soil and groundwater contamination (Landmark Information group, 2017).

Superficial deposits

- 9.5.5 The anticipated superficial geology underlying the site is comprised of glacial deposits consisting of Lowestoft Formation – Diamicton, Happisburgh Glacigenic Formation-Sand, Happisburgh Glacigenic Formation – Diamicton (British Geological Survey (BGS), 2017).

Bedrock geology

- 9.5.6 The superficial deposits are underlain by the Crag Group bedrock throughout the Site. In the western extents, this is underlain by the 'Upper Chalk Group' at. In the east, the Crag Group is underlain by the Ormesby Clay which in turn is underlain by the 'Upper Chalk Group' (BGS), 2017).

Soil conditions

- 9.5.7 The European Soils Bureau (UK Soil Observatory, 2017) indicates that the soils comprise glacial till deposits (diamicton) with a loamy and peaty texture. The Cranfield Soil and Agrifood Institute (2017) online map indicates the soils in the study area to be 'soilscape 6' (freely draining slightly acid loamy soils). Natural England's (2017) agricultural classification map shows the surrounding farmland is classified as either Grade 1 (Excellent) or Grade 2 (Very Good).

Mineral resource

- 9.5.8 There are no active mines or quarries within the study area. A review of historical maps has shown the presence of disused sand pits and gravel quarries (BGS, 2017).

Agricultural viability

- 9.5.9 Land to the north and south of the A47 within the Site is predominantly agricultural and much of this is used for arable production; particularly areas to the south and east of the existing A47 carriageway. Smaller parcels of land are believed to be used as permanent pasture, parkland and woodland which indicate little agricultural viability.
- 9.5.10 The quality of the agricultural land is yet to be determined as no detailed Agricultural Land Classification (ALC) surveys have been conducted to date. There have been 5 ALC investigations into sites surrounding the Site, which can be used as a proxy to inform the baseline. The reports and maps of these surveys have been published by Natural England and the results are outlined below:
- Yarmouth Road, Blofield (February 1996): situated 1,400m west of the western boundary of the Site, a total area of 42.9ha of agricultural land was surveyed with Grades 2, 3a, 3b and 4 agricultural land observed (Natural England, 2016a).
 - Acle (January 1992): situated 175m north of the current A47 carriageway, a total area of 17.4ha of agricultural land was surveyed with Grade 2 agricultural land observed (Natural England, 2016b).
 - Lingwood (January 1992): situated 950m south of the current A47 carriageway, a total area of 10ha of agricultural land was surveyed with Grade 2 agricultural land observed (Natural England, 2016b).
 - Witton Roundabout (April 1992): situated 2500m west of the western extent of the Site, a total area of 2.2ha of agricultural land was surveyed with Grade 2 and 3a agricultural land observed (Natural England, 2016c).
 - Witton Lodge (April 1992): situated 2,500m west of the western extent of the Site north of Witton Roundabout, a total area of 2.8ha of agricultural land was surveyed with Grade 2 and 3a agricultural land observed (Natural England, 2016d).
- 9.5.11 In combination, these investigations indicate that the Proposed Scheme is most likely to encounter Grades 2 and 3a agricultural land within the study area. This information can be cross referenced with Natural England's (2010) 1:250,000 ALC map for the eastern region, which although not of sufficient detail to be suitable for scheme specific assessments, can be used as guidance. This Map, indicates that Grade 2 land is present locally.
- 9.5.12 Grades 2 and 3a agricultural land is classified as 'best and most versatile' (BMV) land by Defra standards and is considered a national resource. The exact area of land-take is yet to be determined, however, the potential for loss of BMV land indicates the potential for significant impacts.

Farm severance

- 9.5.13 Privately owned parcels of agricultural land (small fields to large multi-field farm estates) are located within the study area. Access tracks to these fields are also present, and are predominately located off side roads.

Contamination and contaminated land

- 9.5.14 The assessment of contaminated land-takes account of the ‘source-pathway receptor’ (S-P-R) approach which seeks to establish the potential for a link between a source of contamination and a receptor which may constitute a risk.

Potential contamination sources

- 9.5.15 Potential contamination sources, S1 to S14, have been identified from a review of historical maps and other sources of information and are presented in the first column of Table 9.1. These are split into on-site and off-site potential contamination sources.

Potential contamination transport pathways

- 9.5.16 Potential migration pathways, P1 to P6, have been identified. They are presented in the third column of Table 9.1 and linked to potential receptors

Potential receptors

- 9.5.17 Potential receptors, R1 to R6, have been identified and are presented in the second column of Table 9.1. This table describes the expected S-P-R linkages which form the initial conceptual site model.

Table 9.1: Summary of the potential S-P-R linkages within the study area

Source	Receptor	Pathway	Comments
On-site S1 Agricultural Land – potentially pesticides, fertilisers and slurry applied to the land within the site. S2 Agricultural Land - potential fuel spillages from agricultural machinery. S3 Existing A47 - vehicle fuels, oils, brake fluid.	R1: Groundwater	P1: Horizontal and vertical migration of leachate through potentially permeable soils and geological formations	Principal and Secondary aquifers underlie the route. The risk to groundwater is considered to be moderate / low.
	R2: Surface water bodies	P1: Horizontal and vertical migration of leachate through potentially permeable soils and geological formations	There are multiple surface water features, ponds, watercourses on and in proximity to the Site. Due to the distance of potential receptors the risk to surface water is considered moderate.

Source	Receptor	Pathway	Comments
<p>S4 Potentially Infilled Land (Water). S5 Extractive Industries Activity from 1950 – 1980. S6 Existing Ponds (Possibly drainage ponds) at chainages.</p> <p>Offsite S7 BGS Recorded Mineral Site. S8 Potentially Infilled Land (Water). S9 Potentially Infilled Land (Non – Water). S10 Quarrying of Sand and Clay, Operation of Sand and Gravel Pits. S11 Water Abstraction. S12 Discharge consents including drainage water, treated effluent and agricultural run-off. S13 Sand Pits - Backfilled with a material of unknown provenance. S14 Garages located 70m and 150m from the site at chainages 900m and 3100m</p>	<p>R3: Subsurface structures</p>	<p>P1: Horizontal and vertical migration of leachate through potentially permeable soils and geological formations</p> <p>P2: Migration of contaminants along engineered preferential pathways, e.g. underground services, pipes, tunnels and drainage pathways both surface and culverted</p> <p>P6: Vertical and lateral migration of volatile vapours and ground gases</p>	<p>Risk to buried concrete is considered to be low.</p>
	<p>R4: Flora and fauna</p>	<p>P1: Horizontal and vertical migration of leachate through potentially permeable soils and geological formations</p> <p>P2: Migration of contaminants along engineered preferential pathways, e.g. Underground services, pipes, tunnels and drainage pathways both surface and culverted</p> <p>P3: Surface runoff along roads, pavements, cutting faces etc</p> <p>P4: Root uptake</p> <p>P5: Human uptake pathways</p> <p>P6: Vertical and lateral migration of volatile vapours and ground gases</p>	<p>The risk to flora and fauna is considered to be low.</p>
	<p>R5: Construction and maintenance workers</p>	<p>P5: Human uptake pathways</p> <p>P6: Vertical and lateral migration of volatile vapours and ground gases</p>	<p>It is standard practice for all members of the construction and maintenance teams to wear suitable Personal Protective Equipment (PPE). The risk is considered to be low.</p>
	<p>R6: Road users</p>	<p>P5: Human uptake pathways</p> <p>P6: Vertical and lateral migration of volatile vapours and ground gases</p>	<p>Following development, end users are unlikely to come into contact with the soils at site. The risks to the road users is considered to be very low.</p>

9.5.18 Soil and groundwater sampling and chemical analysis will be completed as part of the proposed ground investigation. The results will be assessed in line with good practice guidance to produce a revised conceptual site model. The initial S-P-R linkages would be updated based on the data obtained, and a remediation options appraisal are then to be completed if appropriate. This identifies the requirement for any remediation / mitigation works to mitigate any potential risks identified by the process.

9.6 Consultation

- 9.6.1 The proposed works are not considered to warrant specific consultation in respect of land quality issues i.e. potential sterilisation of mineral reserves and contaminated land risks. The former is unlikely to be a material consideration owing to the depth of rockhead, and the alignment does not impinge upon significant expanses of surface sand and gravel deposits. The latter can be addressed as part of routine investigation and assessment procedures which do not require a specific permit.
- 9.6.2 Confidential questionnaires are to be issued to landowners and tenant farmers in relation to their agricultural land and farm status. Discussion with the local Planning and Economic Development Officers and key stakeholders (landowners and property agents) will also take place.

9.7 Design interventions

- 9.7.1 The most applicable mitigation for Agricultural Viability, and Farm Severance is through effective design.
- 9.7.2 The first principle is to ensure that the footprint of the Proposed Scheme is reduced as much as practicable, without adversely affecting the design. This minimises the total area of agricultural land affected. It also minimises the number of incidents of farm access and irrigation severance.
- 9.7.3 No further design interventions are proposed at this stage of the design pending review based on the ground investigation data. The outcomes of which will be reported in the Environmental Statement (ES).

9.8 Potential mitigation measures

- 9.8.1 The construction phase would be carried out in accordance with a Construction Environmental Management Plan (CEMP).
- 9.8.2 The CEMP would include a Soil Management Plan, incorporating guidance provided by the Code of Practice for the Sustainable Use of Soils on Construction Sites, to ensure the use of best practice measures for soil handling.
- 9.8.3 The CEMP would contain a Materials Management Plan / Soil Resource Plan which would outline areas of soil to be protected from earthworks and construction activities; the areas and types of topsoil and subsoil to be stripped, haul routes, stockpile locations; the methods for stripping, stockpiling, respreading and ameliorating landscape soils, and a cut and fill balance to ensure as much material as possible is re-used in the Proposed

Scheme. An earthworks specification would also be produced, which would provide geotechnical and chemical acceptability criteria to which site-won and imported materials should comply before being used during construction.

- 9.8.4 Dust from construction activities would be suppressed using best practice methods such as the use of netting, wheel washing facilities and road sweeping vehicles to prevent the spread of potentially contaminated windblown material.
- 9.8.5 Mobilisation of contaminants, either from existing sources or from spillages during works, would be mitigated by the implementation of best practice measures set out in the CEMP. Hazardous substances such as any excavated contaminated land, fuels, chemicals, waste and construction materials would be stored, handled, transported and disposed of in accordance with the CEMP. This should also outline emergency procedures to respond to potential accidental spillages and leaks. To mitigate short-term (acute) risks appropriate construction methods would be adopted to minimize exposure to potentially harmful substances, and suitable Personal Protective Equipment employed.
- 9.8.6 Where open excavations are anticipated in any areas of potential contaminated ground, excavations should be lined in order to inhibit water percolation and subsequent leachate generation. Where piling or penetrative ground improvement is required through potentially contaminated ground, the works should be carried out in accordance with published Environment Agency guidance, and a foundation works risk assessment may need to be undertaken.
- 9.8.7 Clean drilling methods are specified for drilling cable percussive boreholes which form part of the ground investigation in consideration of the of the aquifers beneath the Proposed Scheme.

9.9 Potential impacts

Construction

- 9.9.1 The Proposed Scheme would result in impacts on agricultural land and farm businesses during construction, due to potential severance, loss of access and disruption to drainage and irrigation, together with impacts resulting from the reduction in farm size and / or manageability and / or income because of temporary land-take or severance.

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- 9.9.2 There may also be deterioration and compaction of adjacent existing soil resource, due to storage and handling or due to vehicle movements during construction and loading in proximity to the new road construction.
- 9.9.3 Contamination of site soils could occur during construction, relating to potential spills and leakages from plant and processes. Existing soil or groundwater contaminants may be mobilised by construction activities (e.g. improperly stored contaminated soils, mobilisation of free product etc.). Pollution of water courses, ponds or groundwater could also result from spills and leakages or mobilisation of existing areas of contamination.
- 9.9.4 Construction activities could create dust, which combined with ground preparation and earthworks, soil handling and vehicle movements could disturb or spread existing contaminated soils.

Operation

- 9.9.5 In general, geology and soils impacts from road schemes primarily tend to be limited to the construction phase. The newly constructed hardstanding cover has the potential to lead to increased surface water runoff during operation. Uncontrolled runoff onto adjacent agricultural land may give rise to erosion of soil. Potential contamination may arise from fuel spills associated with the use of the new road.
- 9.9.6 The Proposed Scheme would result in permanent impacts on agricultural land including soils as a national resource as well as farming businesses because of land-take and the severance and loss of access, disruption to drainage, irrigation and impacts resulting from reductions in farm size and / or manageability and / or income because of land-take, severance or loss of buildings.

9.10 Chapter summary

- 9.10.1 This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon geology and soils. Without appropriate design interventions and mitigation measures, impacts are likely during the construction phase due to the nature of the works from the Proposed Scheme. Loss of Grade 1 and Grade 2 agricultural land, soil compaction adjacent to the new road corridor and contamination of site soils have been identified as potential impacts.
- 9.10.2 Further work will be undertaken to develop design interventions to limit or reduce impacts and promote opportunities for the environment within the study area wherever possible. Design development and potential mitigation

will be reported in the ES as well as further detailing of baseline conditions and likely changes during both construction and operation for all identified receptors.

10 Materials

10.1 Introduction

10.1.1 This chapter presents the preliminary findings of the materials impact assessment. This comprises a review of the existing environment and identification of the potential impacts of the Proposed Scheme from the use of material resources and generation of waste. The chapter also outlines proposed design measures to help mitigate potential impacts and relevant consultation.

10.2 Guidance and best practice

- 10.2.1 The following legislation, standards and best practice guidelines are considered relevant to the Proposed Scheme which regulate the management of materials and waste:
- EU Waste Framework Directive 2008/98/EC, sets the basic concepts and definitions in relation to waste management, providing an overarching framework (waste hierarchy) for waste management and requirement to prioritise waste prevention.
 - Waste (England and Wales) Regulations 2011 (as amended 2012)
 - Environmental Protection Act 1990, Part II, Section 34
 - Hazardous Waste (England and Wales) Regulations 2005 (as amended, 2016)
 - Environment Permitting (England and Wales) Regulations 2010 (as amended 2011 and 2012)
 - Environment Agency (EA) (Standard Rules SR2015 No39: use of waste in a deposit for recovery operation)
 - CL:AIRE Definition of Waste: Development Industry Code of Practice Version 2, 2011
 - Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites, 2009
 - Defra Guidance on applying the Waste Hierarchy, 2011
 - Legislation setting out the requirement for Site Waste Management Plans (SWMP) was released in December 2013, however the use of a SWMP is regarded as best practice and adopted by Highways England. The SWMP aims to determine the waste types and amounts to be produced during design and construction and to identify appropriate waste management controls.)

10.3 Study area

- 10.3.1 The assessment establishes 2 geographically different study areas, which are used to examine the use of primary / secondary / recycled / manufactured materials; and the generation and management of waste.
- 10.3.2 The first study area includes land within the Proposed Scheme boundary (referred to hereafter as ‘the Site’) where the proposed design footprint, site clearance, drainage, earthworks and construction are proposed.
- 10.3.3 The second study area considers the location of appropriate waste management facilities which could accept arisings or waste generated by the Proposed Scheme, as well as the location of feasible sources of construction materials.

10.4 Assumptions and limitations

- 10.4.1 At the time of writing, detailed information or estimates on the quantity of materials and generation of waste arisings from the Proposed Scheme are not available. Therefore, this section will be applicable to the Environmental Statement (ES) and are noted here as an indication of the anticipated assumptions and limitations.
- 10.4.2 The potential impacts associated with material use and the production, movement, transport, processing and disposal of waste is assessed based on estimates of the type and quantity of materials at the preliminary design stage. Estimates of material volumes are not yet available. These volumes may also change at the detailed design stage.
- 10.4.3 Estimates on the volumes of inert, non-hazardous and hazardous waste from earthwork activities are to be based on ground investigation results and the anticipated ratio of made ground and natural soils to be excavated. For this report, this data is not yet available and is to be reported in the ES.
- 10.4.4 A net import of earthwork material is expected, however, the re-use of any site-won material would be undertaken, where appropriate. Site-won material which is geotechnically or chemically (due to the presence of soil contaminants at unacceptable concentrations) unsuitable for re-use would require disposal or treatment prior to any re-use off-site.
- 10.4.5 For materials and removal of waste, these are classed according to whether they are likely to be sourced, re-used / recycled or disposed of on a regional (i.e. within 120 km), national or international level. These assumptions depend on the type of material / waste, availability of regional facilities, suppliers and manufacturers. Specific suppliers are not selected at this

preliminary design stage and assumptions are based on typical procurement options used for similar highway schemes.

10.5 Baseline

- 10.5.1 There are no current estimates on material resource use and waste generation during the site remediation / preparation, demolition and construction phases. These shall be developed as the design is progressed and reported in the ES accordingly.
- 10.5.2 The earthworks of the mainline in the Proposed Scheme partially encroaches on an area identified by Norfolk County Council as a safeguarded mineral resource. The potential impact on this safeguarded mineral resource as a result of the Proposed Scheme would be assessed in the ES.
- 10.5.3 Information on the geology (including potential for peat resources) is addressed in Chapter 9 (Geology & Soils). The potential impact on peat resources due to the Proposed Scheme will be assessed in the ES.
- 10.5.4 Where waste generated by the Proposed Scheme cannot be re-used either on or off-site, direct impacts may result from the demand on the capacity of waste management facilities and impacts associated with transport. The location and capacity of waste management facilities and landfills in the study area are considered to assess the impact of the Proposed Scheme.
- 10.5.5 Commercial construction and demolition waste is identified as by far the most significant source of inert waste in Norfolk and there is the need for additional inert waste recycling infrastructure within the region.
- 10.5.6 Details of current waste management facilities in the region are summarised in Table 10.1.
- 10.5.7 There are a number of regional sand and gravel quarries, including secondary and recycled aggregate resources within Norfolk. The regional, national or international sourcing of other construction materials would be presented in the ES.

Table 10.1: Licenced Waste Management Facilities

Site name	Site address	Type of waste accepted	Approximate distance from the Proposed Scheme
Postwick Waste Site	Griffin Lane, Saint Andrew, NR7 0SL	A06: Landfill taking other wastes (Non-hazardous and hazardous)	6km
Spixworth Quarry	Grange Farm, Buxton Road, Spixworth, NR10 3PR	L05: Inert Landfill	13km
Easton Inert Landfill Site	Easton Lodge Farm, Dereham Road, Costessey, NR9 5EQ	A05: Landfill taking Non-Biodegradable Wastes (Non-hazardous)	20km
Attlebridge Landfill Site	Reepham Road, Attlebridge, NR9 5TD	A01: Co-Disposal Landfill Site (Non-hazardous and hazardous waste) A06: Landfill taking other wastes (Non-hazardous and hazardous)	20km

10.6 Consultation

10.6.1 No specific consultation has been undertaken to date regarding materials and waste.

10.7 Design interventions

10.7.1 The principles of value engineering have been adopted by the Design Team to optimise the alignment and reduce costs, where appropriate. This would directly decrease the impacts from the use of materials. Further opportunities to reduce may also be achieved at the detailed design stage and will be reported in the ES.

10.8 Potential mitigation measures

10.8.1 For this report, specific quantities of materials and waste are not available and will be reported in the ES. Potential opportunities to re-use surplus material from other sections of the A47 where improvements are planned (or any other local projects concurrent to the construction phase) would mitigate the impacts from the use of material.

10.8.2 In accordance with the waste hierarchy, consideration would also be given to the re-use of waste generated on-site before waste is transported off-site for re-use or disposal.

10.8.3 A combination of the SWMP (including a MMP) and the appointed Contractor's Construction Environmental Management Plan (CEMP) would

ensure that adverse impacts associated with materials use, waste generation and required transport are managed.

10.8.4 Mitigation measures in the SWMP and CEMP may include (but not limited to):

- implementation of the waste hierarchy and avoiding generation of waste through design
- use of site-won or recycled materials as opposed to sourcing new materials
- where surplus materials cannot be re-used on-site, seek opportunities for re-use off-site, including other A47 schemes or other projects off-site (e.g. quarry restoration scheme)
- use of material logistics planning to manage procurement, storage and use of materials and minimise damage, over ordering and wastage
- encourage local and responsible resourcing of materials (e.g. through adoption of BES 6001) and efficiencies by minimal ordering of materials
- waste to be appropriately segregated and stored / stockpiled on-site by waste type, to ensure waste remains in a suitable condition to be re-used
- where waste must be taken to a recycling / disposal site, ensure these sites hold the appropriate permits

10.9 Potential impacts

Construction

10.9.1 There is the potential for significant adverse impacts during construction due to the anticipated use of materials and generation of waste typical for a road infrastructure scheme of this size. Construction of the Proposed Scheme would involve the production, procurement, transport and use of material resources and the production of waste streams which have the potential to generate significant environmental effects, as summarised in Table 10.2.

Table 10.2: Summary of materials and waste that have the potential to generate significant environmental effects

Activity	Material use	Waste arisings
Site remediation / preparatory / earthworks	<ul style="list-style-type: none"> Bulk materials for earthwork Timber (e.g. for temporary use for shuttering) 	<ul style="list-style-type: none"> Surplus / unsuitable topsoil or subsoil arising from earthworks Invasive plant species (e.g. Japanese knotweed) and injurious weeds Hazardous or contaminated soils encountered on-site Vegetation and other above ground materials produced by site clearance (e.g. litter, fly tipped waste)
Demolition	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Demolition waste from removal of surge chamber, footways and culvert modifications
Construction	<ul style="list-style-type: none"> Road sub-base and surface materials Concrete, steel and other structural materials Pre-cast and prefabricated products (e.g. kerbs, gullies, barriers, manholes, drainage) Signage, lighting columns and markings Timber (e.g. for temporary use for shuttering) Topsoil 	<ul style="list-style-type: none"> Surplus, damaged and 'cut-off' construction materials

Operation

10.9.2 Environmental impacts from the use of materials and generation of waste are unlikely during the operation of the Proposed Scheme since there would be minimal requirements for materials, besides infrequent maintenance activities.

10.10 Chapter summary

10.10.1 This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts due to use of materials and the generation of waste. There is the potential for adverse impacts during construction due to the anticipated use of materials and generation of waste typical for a road infrastructure scheme of this size. Operational impacts are considered to be unlikely.

10.10.2 Further work will be undertaken to develop design interventions to limit or reduce adverse impacts and promote opportunities for the environment in the study area, wherever possible. Any design development and potential mitigation will be reported in the ES as well as further detailing of baseline conditions and material volumes.

11 Noise and Vibration

11.1 Introduction

11.1.1 This chapter presents the preliminary findings of the noise and vibration assessment. This comprises a review of the existing environment and identification of the potential impacts of the Proposed Scheme in the context of noise and vibration. The chapter also outlines proposed design measures to help mitigate potential noise and vibration impacts.

11.2 Guidance and best practice

11.2.1 The following legislation, standards and best practice guidelines are considered to be relevant to the Proposed Scheme:

- The National Planning Policy Framework 2018
- The Noise Policy Statement for England 2010
- Planning Practice Guidance (noise) 2014
- The Designated National Networks National Policy Statement , 2015
- The Land Compensation Act 1973 Part 1
- The Noise Insulation Regulations 1975 (amended 1988)
- Sections 60 and 61 of The Control of Pollution Act 1974
- British Standard (BS) 5228-1:2009+A1:2014, Code of practice for noise and vibration control on construction and open sites – Part 1: Noise
- BS5228-2:2009+A1:2014, Code of construction practice for noise and vibration control on construction and open sites - Part 2: Vibration
- Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 7, Noise and Vibration, (HD213/11 – Revision 1) 2011
- Calculation of Road Traffic Noise (CRTN) 1988
- Guidelines for Noise Impact Assessment, Institute of Environmental Management & Assessment, 2014
- World Health Organization (WHO), Night Noise Guidelines for Europe 2009

11.3 Study area

11.3.1 The study area for operational noise is defined in accordance with DMRB Volume 11, Section 3, Part 7 and predominantly involves:

- calculation of the noise levels at up to 600m from the new carriageway edge
- consideration of any other affected routes (where there is a change of 1dB in the short-term or 3dB in the long-term)

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- 11.3.2 As is typical for construction activity, noise is calculated at distances up to 300m and vibration at distances up to 100m from the Proposed Scheme footprint depending on the noise and vibration characteristics of the plant used.
- 11.3.3 The impact of construction traffic on the local network is also considered.

11.4 Assumptions and limitation

- 11.4.1 This chapter is based on a desk-top study and is qualitative. However, it is also informed by noise measurements undertaken in March 2017 and the Defra Noise map, a product of the strategic noise mapping exercise undertaken by Defra in 2012 to meet the requirements of the Environmental Noise Directive (Directive 2002/49/EC) and the Environmental Noise (England) Regulations 2006 (as amended).
- 11.4.2 The variable nature of construction noise is such that it is difficult to accurately predict the noise impacts at given receptors over the period of the construction phase until plant details become available.

11.5 Baseline

- 11.5.1 The study area is predominantly rural, with sensitive receptors principally concentrated in the villages of Blofield, Lingwood and North Burlingham. Sensitive receptors include dwellings, schools, nursing homes and churches in addition to other community facilities. There are residential properties which are close to the Proposed Scheme boundary, hereafter referred to as 'the Site'. Blofield and North Burlingham are the most densely populated areas as well as dispersed properties and isolated farmsteads.
- 11.5.2 No designated ecological sites (Sites of Special Scientific Interest (SSSI), Special Protection Area (SPA), Special Area of Conservation (SAC)), Area of Outstanding Natural Beauty, National Parks or Scheduled Monuments are located in the operational noise study area. Several public rights of way are located in the study area, mainly in Blofield and north Burlingham.
- 11.5.3 The predominant noise source in the area is the A47 and this would continue to be the case with the Proposed Scheme. Modelled noise data (DEFRA, 2012) shows that where there is a direct line of sight to the A47, the index used to characterise night-time noise L_{night} , is typically above 55dB at distances below 60m from the existing road. An L_{night} of 55dB is the WHO recommended (WHO, 2009) Interim Target (IT) Level for night-time noise where the Night Noise Guideline value of 40dB cannot be achieved in the short-term and where policy makers choose to adopt a step-wise approach

to reduce night-time noise. All other receptors are likely to be exposed to noise levels below the IT level.

11.5.4 A noise survey was carried out in March 2017 including 3 24hr measurements in Burlingham and Blofield and a further 5 sets of 3hr duration measurements on footways near the existing A47 carriageway. The survey measured the $L_{A10,18h}$ index that is used in the UK to characterise day-time road traffic noise. The survey showed that, in general:

- The existing A47 dominates the noise environment with the measurement locations close to the A47 experiencing noise levels of greater than 70dB $L_{A10,18h}$ (at the Public Rights of Way (PRoW) at The Windle and Acle Road).
- Measurement locations further away from the A47 experience lower noise levels of around 60 to 65dB $L_{A10,18h}$ (PRoW Lingwood Road – 100m from existing A47, PRoW off Main Rd North Burlingham – 115m from existing A47, Main Rd. North Burlingham – 40m from existing A47 and Wyngates, Blofield – 180m from existing A47) however the A47 was audible at these locations.
- At the other two measurement locations (PRoW Bullacebush Lane – 540m from existing A47 and at farm in Blofield – 540m from existing A47) the measured noise levels were around 50dB $L_{A10,18h}$ and noise from the A47 was not audible.

11.5.5 To set these numbers into context, the 'specified level' in the Noise Insulation Regulations, 1975 (amended 1988) is a $L_{10,18h}$ of 68dB façade level corresponding approximately to a free-field level (as reported for the noise survey) of approximately 65dB and is the level, subject to additional criteria, associated with grants in respect of the carrying out insulation work.

11.5.6 A Noise Important Areas (NIA) is defined as an area or noise 'hotspot', where the 1% of the population are located that are affected by the highest noise levels from major roads according to the results of the first round of strategic noise mapping (Defra, 2012). There are 4 such NIA within the study area (see Table 11.1) and it is particularly important to avoid increasing noise in these areas.

Table 11.1: Noise Important Areas

ID	Location
5206	Western end of the Site, north of Blofield
5207	Yarmouth Road, Blofield
5208	Lingwood Road
5209	The Windle

11.6 Consultation

- 11.6.1 Consultation has been undertaken in response to comments received in the scoping opinion from PINS and reported in the Environmental Statement (ES).
- 11.6.2 The scope and methodology is to be discussed with the local authority as the Proposed Scheme progresses and any requirements in a Construction Environmental Management Plan (CEMP) and Section 61 Certificate (Control of Pollution Act, 1974).

11.7 Design interventions

- 11.7.1 A low noise running surface is proposed within the design; this is estimated to reduce noise by ~3dB at typical highway speeds in comparison with conventional hot rolled asphalt.
- 11.7.2 The horizontal alignment of the Proposed Scheme would take some existing A47 traffic further from some residential receptors in the vicinity of North Burlingham, although, the noise benefit of this could be outweighed by changes in traffic volume and mix and by changes in traffic speed.

11.8 Potential mitigation measures

- 11.8.1 Potential noise impacts during construction would be mitigated through measures included within the CEMP, which would be prepared alongside the ES.
- 11.8.2 Acoustic barriers can be effective at reducing noise for receptors close to the source, during both construction and operation, and would be considered in the ES for sensitive receptors that may be affected by the Proposed Scheme.

11.9 Potential impacts

Construction

- 11.9.1 The main activities during the construction phase which would generate noise and vibration are:
- Excavation, compaction and foundations works
 - Construction of bridges, retaining structures, services, drainage and the new carriageway
 - Surfacing
 - Installation of noise barriers, signage, gantries and road markings

-
- 11.9.2 Vehicles accessing the site and compounds for the delivery of materials and equipment, carrying muck away, attendance of site personnel etc. would also generate noise.
- 11.9.3 Noise impacts due to the construction of the Proposed Scheme are expected to be perceptible at nearby sensitive receptors particularly frontline properties along the A47.
- 11.9.4 The proximity of some residential receptors to the existing A47, the understanding of the noise environment and the possibility that some phases of work would require night work, there is the potential for impacts to have significant impacts without careful management. Vibration impacts may also arise during any construction activities, such as piling and surfacing if vibratory rollers are used.

Operation

- 11.9.5 Operational impacts from noise and vibration could arise from changes in traffic composition and flow (volume and speed), new carriageways and re-alignment of existing carriageways. Road traffic may generate ground-borne or air borne impacts associated with vibration. All newly-constructed carriageways would comply with current specifications, therefore ground-borne vibration from the Proposed Scheme are unlikely to generate perceptible levels of vibration. Relatively high levels of noise are required to cause perceptible levels of airborne vibration and therefore noise induced vibration is only likely to occur at properties close to heavily trafficked road links.
- 11.9.6 While increases in traffic volume and speed tend to increase noise; in the absence of traffic data it is not possible to state if there would be any net beneficial or adverse impacts due to the Proposed Scheme. The alignment changes may also have a positive impact (when traffic is moved further from receptors) and when any potentially negative impacts are mitigated by the introduction of bunds or barriers.
- 11.9.7 Where changes in alignment are relatively small compared to the overall distance from a highway to a receptor, any changes in noise are likely to be correspondingly small.

11.10 Chapter summary

- 11.10.1 This chapter has identified potential noise and vibration impacts of the Proposed Scheme, both short-term impacts associated with construction activities and long-term impacts due to road traffic noise.

-
- 11.10.2 Sensitive receptors in proximity to the Proposed Scheme have been identified. Receptors that are close to the A47 are already exposed to relatively high noise levels due to road traffic.
- 11.10.3 Noise impacts due to the construction of the Proposed Scheme are likely to occur at nearby sensitive receptors; particularly at frontline properties along the A47 and would be controlled by a CEMP.
- 11.10.4 Any changes in road traffic noise due to the introduction of the new slip roads, changes in alignment, changes in traffic mix and speed, road surface and any barriers or bunds would be calculated and assessed in detail for the ES; and design interventions would be incorporated to avoid or reduce impacts where possible.

12 People and Communities - Travellers

12.1 Introduction

- 12.1.1 This chapter presents the preliminary findings of assessment relevant to Travellers, including non-motorised users (NMU), motorised travellers (MT), public transport and community severance.
- 12.1.2 People and Communities is a broad topic and therefore, for ease of assessment and review, People and Communities has been split into 2 chapters. Chapter 13 (People and Communities – Social) presents the assessment of the social elements of land-take, community facilities, development land and local economy.
- 12.1.3 This chapter comprises a review of the existing environment and identification of potential impacts of the Proposed Scheme. Potential impacts are discussed, considering relevant policy and legislation, relevant consultation.

12.2 Guidance and best practice

- 12.2.1 People and Communities is identified as a Design Manual for Roads and Bridges (DMRB) topic within Interim Advice Note (IAN) 125/15 ('Environmental Assessment Update') (DMRB 2015) and IAN 125/09 ('Supplementary Guidance for users of DMRB Volume 11 on Environmental Assessment') (DMRB 2009).

12.3 Study area

- 12.3.1 DMRB guidance does not provide a set definition of the study area for assessing NMU, community severance and amenity. Therefore, the study area has been based on professional judgement based on the type and scale of the Proposed Scheme and the context of the surrounding area. MT driver stress and MT views from the road are specified in DMRB Volume 11 Section 2 Part 4 and DMRB Volume 11 Section 3 Parts 8 and 9. These study areas are considered more than sufficient in terms of identifying the impacts in full.
- 12.3.2 The study areas for this assessment are as follows and are shown in Figure 12.1:
- **NMU:** all NMU facilities including public rights of way (PRoW), permissive footpaths and bridleways, footways and long-distance walks

and cycle routes located within 600m of the land within the DCO site boundary (referred to hereafter as the 'Site').

- **Community severance:** includes the main centres of population and community facilities within 600m of the Site.
- **Amenity:** all NMU facilities including PRoW, permissive NMU routes, footways, long distance walks and cycle routes identified within 600m of the Site.
- **MTs driver stress:** comprises all roads and connecting roads within 600m of the Site.
- **MTs views from the road:** considers views from the proposed route alignment in operation only.

12.3.3 The study area for MT views from the road considers views from the Site.

12.4 Assumptions and limitations

12.4.1 This assessment relies on desk based studies, using publicly available information where available. This information includes strategic documents, Geographical Information Science software and previous assessments undertaken.

12.4.2 Traffic data has not been used to support the assessments for amenity and driver stress and therefore, the assessments are qualitative in nature. Traffic data and modelling will inform the assessment in the Environmental Statement (ES).

12.5 Baseline

12.5.1 The Site is within the Broadland district in the county of Norfolk.

Motorised travellers: driver stress

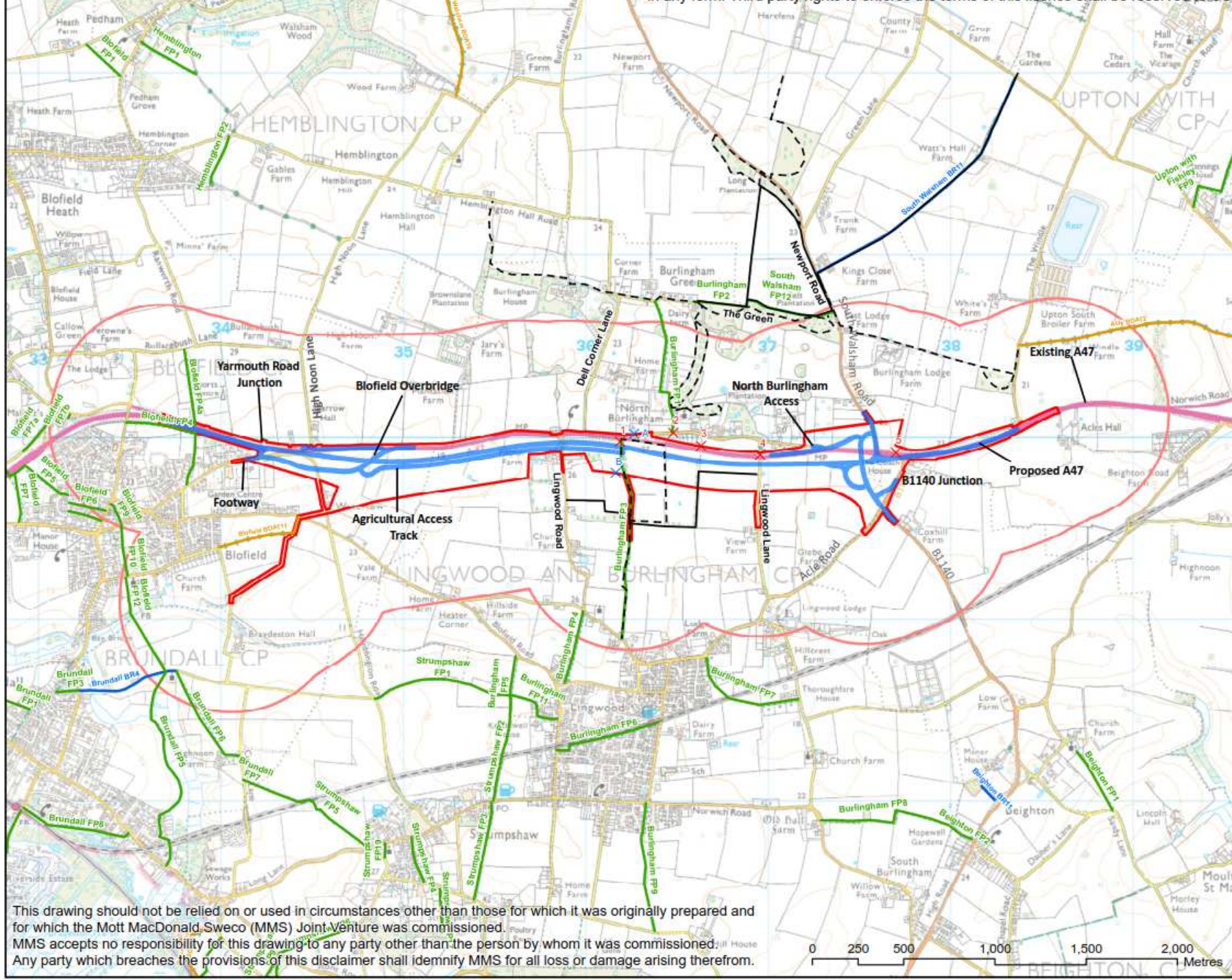
12.5.2 The section of A47 in the study area is a single carriageway road located between 2 sections of dual carriageway. This may be an existing cause of increased driver stress as the vehicles travelling along this route have to join one lane and reduce speed.

12.5.3 Traffic volumes on the A47 are heavy during the peak commuter periods and delays are experienced when joining the A47 at the west end of Blofield.

12.5.4 Driver stress on the A47 is considered to be high, particularly at junctions and during peak periods where high traffic volumes leads to queues and delays. Stress experienced by users of side roads is likely to be lower, while roads within villages are unlikely to cause noticeable levels of driver stress.



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- Key to symbols**
- ✕ Stage 2 NMU Surveys
 - ✕ Stage 3 NMU Surveys
 - Proposed Road Alignment
 - NMU Journey Length and Community Severance Study Area
 - Proposed Scheme Boundary
- Public Rights of Way**
- Bridleway
 - BOAT
 - Footpath
 - - - Burlingham Woodland Walks Footpath
 - Burlingham Woodland Walks Bridleway

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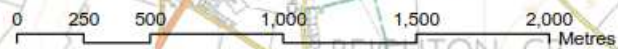
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Project Title: A47 Blofield to North Burlingham

Drawing Title: Figure 12.1 - People and Communities: Travellers Study Area

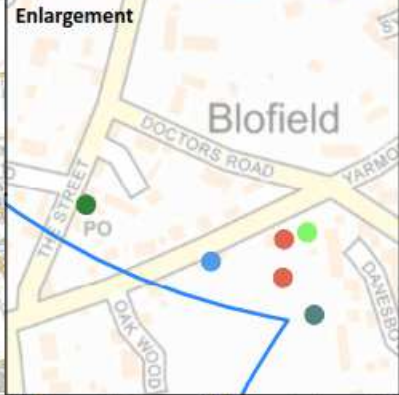
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Original Date	2nd	Date	11/08/18	Date	08/08/2018	Date	08/08/2018	Date		
Drawing Number	HE551490 - MMSJV - EGN -	Volume		Page		Project Ref. No.	HE551490			
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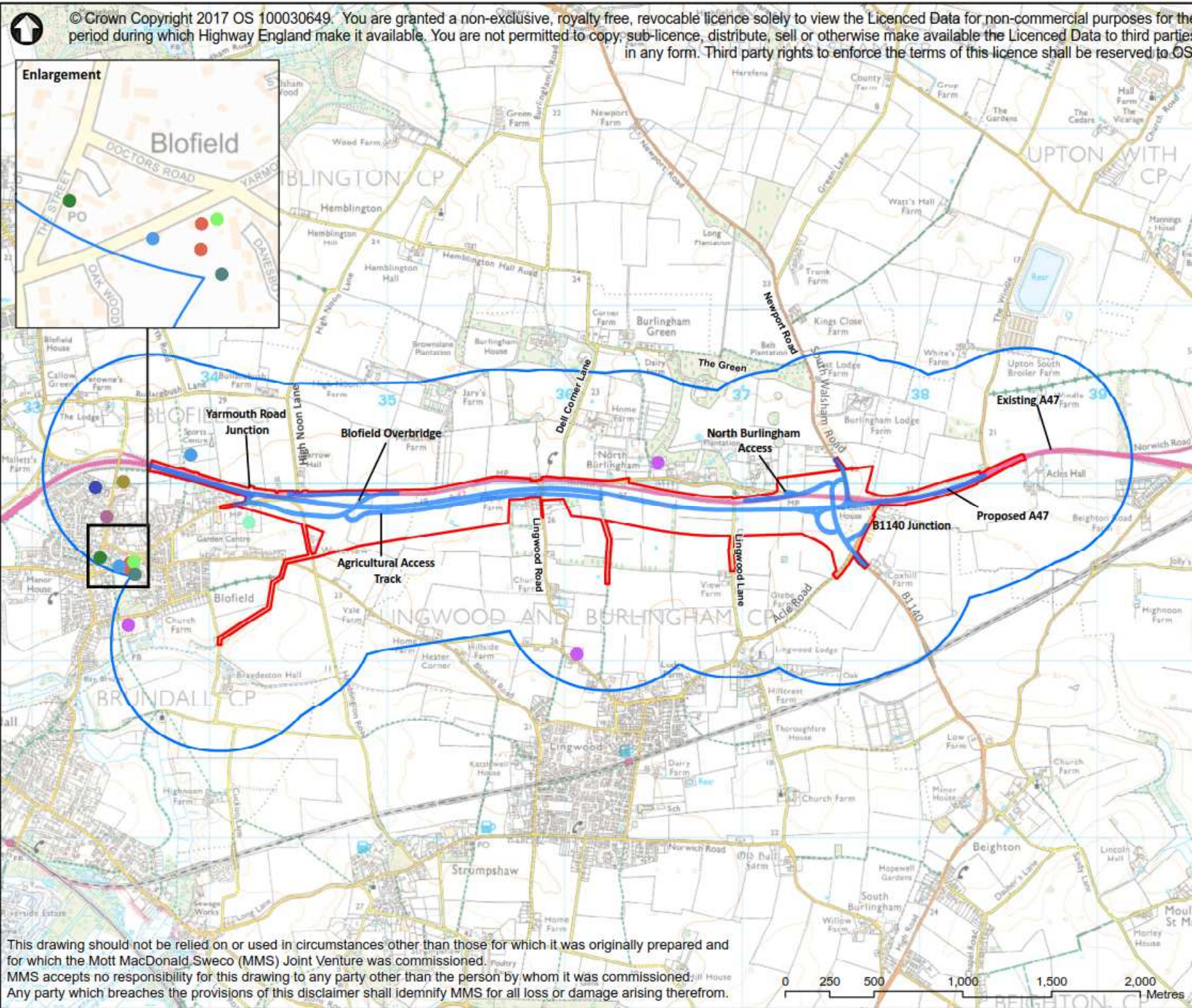




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- Key to symbols
- Allotments
 - Church
 - Commercial
 - Football Facility
 - Health Care Services
 - Local Government Service
 - Post Office
 - Preparatory / First / Primary / Infant / Junior / Middle School
 - Public / Village Hall / Other Community Facility
 - Racquet Sports Facility
 - Proposed Design
 - Proposed Scheme Boundary
 - NMI Journey Length and Community Severance Study Area



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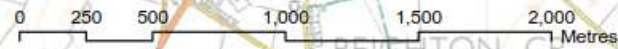
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Project Title: A47 Blofield to North Burlingham

Drawing Title: Figure 12.2 - Community Facilities

Scale	1:20,000	Designed	Bards, Jamie	Drawn	Morris, Jack	Checked	Murphy, Mark	Approved	Jones, Bryn
Original Issue	A4	Date	11/09/16	Date	09/08/2016	Date	09/08/2016	Date	
Drawing Number	HE551490 - MMSJV	Client	EGN	Project Ref. No.	HE551490				
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Views from the road

- 12.5.5 The typical view from the road within the extent of the study area is that of open fields, gently rolling hills or plateau landform, church towers and woodlands. The existing A47 corridor is partially delineated by mature trees and hedgerows, but also includes large sections of the route without notable vegetation cover. As the existing A47 is typically slightly elevated above its surroundings views from the road look out across the surrounding landscape where gaps in highway vegetation occur. Overall, views from the road are considered to be intermittent.

Non-motorised users and community severance

- 12.5.6 The NMU routes within the study area are identified in Figure 12.1. One PRoW, Burlingham FP3, has been identified in the study area as being affected by the Proposed Scheme. Burlingham FP3 runs north to south between A47 and Church Road.
- 12.5.7 A section of permissive footpath, which forms part of the Burlingham Woodland Walks would also be affected by the Proposed Scheme. This footpath runs in an easterly direction from Burlingham FP3, close to the southern frontage of the A47 in North Burlingham, before heading south and then west to form a connection back to Burlingham FP3. A permissive bridleway lies to the south of the A47 and provides a connection between Lingwood Road, Burlingham FP3 and Lingwood Lane, although this would not be directly affected by the Proposed Scheme.
- 12.5.8 Limited NMU surveys were undertaken on Tuesday 14 and Wednesday 15 February 2017 for approximately 3 hours, with those in the morning taking place between 8am and 11am and those in the afternoon between 3pm and 6pm. The surveys took place at two locations on Burlingham FP3 as indicated with a blue 'X' in Figure 12.1.
- 12.5.9 The surveys recorded low usage of Burlingham FP3 during both survey periods. Three dog walkers were the only observed users during the morning survey period, with 2 users travelling south towards Lingwood and 1 user travelling west towards Lingwood Road. During the afternoon survey period only 3 dog walkers were observed all travelling south towards Lingwood. Although no users were observed crossing the A47 from North Burlingham during the surveys, it was considered likely that some cross the A47.
- 12.5.10 When consulted, Norfolk County Council explained that the existing A47 in this area acts as a barrier for NMU due to the high traffic volumes which it

currently carries and there are currently no formal NMU crossing points along the length of the Site. Norfolk County Council (NCC) expressed the view that the low usage of Burlingham FP3 recorded in the limited NMU surveys undertaken to date may reflect the severance effect of the A47.

- 12.5.11 The presence of a number of potential informal crossing points on the A47 were identified during a site visit, undertaken on 15 November 2017 during both daytime and night-time hours, to observe background conditions and examine usage of the NMU infrastructure. These informal crossing points, indicated with a red 'X' in Figure 12.1, provide access to Burlingham FP3 and the permissive footpath and bridleway linked to Burlingham FP3. As Burlingham FP3 and both the permissive footpath and bridleway form part of the Burlingham Woodland Walks, a network of local leisure routes, additional, more extensive, NMU surveys were undertaken between 7am and 7pm for the period 26 May to 3 June, inclusive, to cover both the weekday and weekend periods to provide further information on existing usage of the network and in particular crossing movements of the existing A47. NMU surveys were also undertaken over the same periods at the junction of Main Road with Burlingham FP1 and at the junctions of the A47 with the B1140 and South Walsham Road. With the exception of the occasional shower on Saturday 2 June, weather on each of the survey days was dry and bright.
- 12.5.12 The surveys recorded very low usage of Burlingham FP3 and the connecting permissive footpath on all weekdays and at weekends and very few crossing movements of the A47 were observed. A maximum two-way flow over the 12hr survey period of less than 5 users was recorded using both routes on a weekday with only 3 users crossing the A47. A similar situation was observed during the Saturday survey periods whereas during the Sunday survey periods, a maximum two-way flow of 10 users was recorded using Burlingham FP3, the majority of which crossed the A47. All of the recorded users were either lone pedestrians or dog walkers.
- 12.5.13 No users were observed crossing the A47 between the field access and the permissive footpath on any of the survey days.
- 12.5.14 A maximum two-way flow over the 12hr survey period of 6 users was recorded using the permissive bridleway on each survey day and these users were either lone pedestrians or dog walkers.
- 12.5.15 A maximum two-way flow over the 12hr survey period of 5 users was recorded crossing the A47 between Lingwood Lane and the short length of road leading to the centre of North Burlingham. On the weekdays, these

users were either lone pedestrians or cyclists whereas during the weekends, only pedestrians crossed the A47.

- 12.5.16 The surveys recorded high usage of Burlingham FP1, which runs north to south from Main Road to the north of North Burlingham, on weekdays and at weekends, especially on a Sunday. A maximum two-way flow over the 12hr survey period of around 70 users was observed on a weekday whereas the maximum flow on a Sunday was around 90 users. Only around 20 users were observed using the route on a Saturday. Based on the results for the various count points it can be deduced that very few or indeed none of the users of Burlingham FP1 continued on Main Road in either direction to access and cross the A47. This is not a surprising result given that one of the recommended starting points for accessing the Burlingham Woodland Walks is the St Andrew and St Peter's Church car park located just off Main Road in North Burlingham and the vast majority of the walking routes lie to the north of North Burlingham.
- 12.5.17 Very few NMU movements were recorded at the junctions of the A47 with the B1140 and South Walsham Road on each of the survey days. The only crossing movements of the A47 to access the side roads were undertaken by cyclists with a maximum two-way flow over the 12hr period of 9 users and this was observed on a Saturday.
- 12.5.18 Yarmouth Road is used as a route between Blofield and the villages of Strumpshaw and Lingwood. It is unlikely to be used by NMU and use by vulnerable people is very low.
- 12.5.19 High Noon Lane has two routes to the A47 and would be used by local residential and commercial receptors to access the A47. Due to the lack of footway and the close proximity to the A47 it is likely to have low usage by NMU.
- 12.5.20 Lingwood Road is a single-track road which acts as an arterial route between the A47 and the village of Lingwood. There are no footways along this road but it links to Burlingham FP3.
- 12.5.21 Lingwood Lane is a single-track road which also acts as an arterial route between the A47 and the village of Lingwood. There are no footways along this road but a permissive bridleway which forms part of the Burlingham Woodland Walks links to this road.
- 12.5.22 Dell Corner Lane is a single-track road and is most likely used for access to local residential receptors north of the A47.
- 12.5.23 Main Road is a single carriageway road allowing vehicles access to residential, community and commercial properties in North Burlingham and

to exit back onto the A47 in both directions. There is a footway partially along this road.

- 12.5.24 South Walsham Road is a single carriageway road. There are no footways along this road, however traffic levels are observed to be low. A bridleway (South Walsham BR11) and a footpath (South Walsham FP12) link to South Walsham Road along with a permissive footpath which forms part of the Burlingham Woodland Walks.
- 12.5.25 Acle Road is a single carriageway road and like Lingwood Road, acts as an arterial route from the A47 to Lingwood. There are no footways or adjoining PRoW.
- 12.5.26 The receptors and their sensitivity are summarised in Table 12.1.

Table 12.1: Sensitivity of NMU routes to changes in journey length

Receptor	Sensitivity
Burlingham FP3	Medium
Permissive footpath to south of A47 at North Burlingham.	Medium
Permissive bridleway between Lingwood Road, Burlingham FP3 and Lingwood Lane at North Burlingham.	Medium
Yarmouth Road	Medium
High Noon Lane	Medium
Lingwood Road	Medium
Lingwood Lane	Medium
Dell Corner Lane	Low
Main Road	High
South Walsham Road (B1140)	Medium
Acle Road	Low

- 12.5.27 Figure 12.2 shows the locations of the main centres of population in the study area, namely the village of Blofield and the smaller village of North Burlingham, together with the locations of the community facilities. As can be seen, the majority of the community facilities lie in and around Blofield village to the west and south of the Site so the existing A47 does not result in community severance in relation to these facilities. However, there is no formal crossing point of the A47 for NMU to the east of Blofield and no existing NMU infrastructure is provided along the A47 route in the direction of North Burlingham until the footway on the northern frontage commencing close to the Lingwood Road junction. The existing A47 therefore acts as a barrier for NMU and results in a degree of severance between the communities of Blofield and North Burlingham. In addition, St Andrew and St Peter's Church at North Burlingham and St Peter's Church at Lingwood lie to the north and south of the existing A47, respectively. Again, the existing

A47 acts as a barrier for NMU wishing to cross to access these facilities, especially during the peak hours when traffic volumes are high and there are no formal crossing points to overcome the severance effect.

Amenity

- 12.5.28 Both NMU routes and the local side roads within the study area are considered in the baseline of this report and the ES.
- 12.5.29 Burlingham FP3 is a PRoW with access from the A47 to the north, Lingwood Lane to the east, Lingwood Road to the west and Church Road to the south. Except for where Burlingham FP3 meets the A47, users are isolated from traffic. Previous survey results identified dog walkers as the sole users of the Burlingham FP3, however these surveys were limited in time and further surveys are proposed and will be reported in the ES. It is likely that most users are from Lingwood since they were observed travelling south towards the settlement, however it may be the case that some users may cross the A47 from North Burlingham even though none were observed doing this during the NMU surveys undertaken to date. The majority of the route is lined with trees and / or hedgerows with occasional wide views over the neighbouring fields.
- 12.5.30 The permissive footpath lying to the south of the A47 at North Burlingham, which forms part of the Burlingham Woodland Walks network, connects to Burlingham FP3 at two locations. Except for the stretch running parallel to the A47, users of the footpath are isolated from traffic as the route predominantly lies between hedgerows and forms a circuit around a field.
- 12.5.31 The permissive bridleway lying to the south of the A47 provides a connection between Lingwood Road, Burlingham FP3 and Lingwood Lane. Users of the permissive bridleway are isolated from traffic and the route predominantly lies between hedgerows.
- 12.5.32 Yarmouth Road is a single carriageway road which joins onto the A47 north-east of Blofield. It is used as a route for vehicles travelling towards or leaving Blofield and onto the A47 and observation confirms that it is busy with vehicle travellers. There is a single footway along this route, but this is discontinued approximately 175m south-west of the Yarmouth Road / A47 junction. Verges are generally well kept and views are closed due to the presence of high hedgerows and trees.
- 12.5.33 High Noon Lane is a single-track road which acts as an access road for residential properties and commercial premises lying to the north of A47. The road has two junctions with the A47 and for a short distance, approximately 250m, runs parallel to the A47. There are no footways on

High Noon Lane and site observation suggests that traffic is limited, however traffic noise can be heard from the A47. There is a line of trees between High Noon Lane and the A47 partially blocking views, but there are wide views across the surrounding landscape.

- 12.5.34 Lingwood Road is a single-track road which acts as an arterial route between the A47 and the village of Lingwood. There are few views of the A47 for both NMU and MT and traffic cannot be heard by users. Users' views are partially closed due to the road being lined by hedgerows, grass verges and trees with some wide views of the surrounding fields. There are no footways along this road.
- 12.5.35 Lingwood Lane is a single-track road which also acts as an arterial route between the A47 and the village of Lingwood. There are distant views of the A47 for both NMU and MT and traffic cannot be heard by users. Users' views of the surrounding fields are partially interrupted by trees and hedgerows lining the road. There are no footways along this road.
- 12.5.36 Dell Corner Lane is a single-track road which provides access to local residential receptors north of the A47. There are no footways and the road is partially lined with hedgerows and trees blocking some of the views of surrounding arable fields.
- 12.5.37 Main Road is a busy single carriageway road allowing vehicles access to residential, community and commercial properties in North Burlingham and to exit back onto the A47 in both directions via at grade junctions. A footway runs partially along the eastbound side of Main Road and continues along the A47, west of North Burlingham. Main Road offers intermittent views of the A47 blocked by buildings and tree lines. Traffic from the A47 can be heard from the road.
- 12.5.38 South Walsham Road (B1140) is a single carriageway road with no footways and low traffic levels. Views are open to the east of neighbouring arable fields and intermittent to the west by vegetation. Views in the east are relatively open and of arable fields. Verges are maintained but heavily vegetated.
- 12.5.39 Acle Road is a single carriageway road and like Lingwood Road, acts as an arterial route from the A47 to Lingwood. There are no footways and views on both sides of the road are open to neighbouring arable fields and partially blocked by trees. The grass verges are well maintained.
- 12.5.40 The Windle is a single carriageway road connecting the A47 to residential receptors and a reservoir. There are no footways and site observation suggests that traffic volumes are low. Views are open to the western arable

fields and closed to the east, particularly around the reservoir site. Verges are maintained.

12.5.41 The sensitive receptors and their sensitivities are summarised in Table 12.2.

Table 12.2: Sensitivity of NMU routes to changes in amenity

Receptor	Sensitivity
Burlingham FP3	Medium
Permissive footpath to south of A47 at North Burlingham.	Medium
Permissive bridleway between Lingwood Road, Burlingham FP3 and Lingwood Lane at North Burlingham.	Medium
Yarmouth Road	Medium
High Noon Lane	Medium
Lingwood Road	Medium
Lingwood Lane	Medium
Dell Corner Lane	Medium
Main Road	Medium
South Walsham Road (B1140)	Medium
Acle Road	Medium
The Windle	Medium

12.6 Consultation

12.6.1 A meeting was held with the PRoW and Active Travel officers of Norfolk County Council (NCC) on 15 November 2017 to confirm current NMU provisions and activity in the study area of the Proposed Scheme and to obtain an understanding of any future plans to improve / expand the networks. NCC expressed the view that the existing A47 acts as a barrier for NMU due to the high traffic volumes it carries and the lack of formal crossing points. Burlingham FP3 would be severed by the Proposed Scheme and therefore, the provision of a safe facility for north to south crossing movements should be considered. In addition, a permissive footpath running parallel to the existing A47 and connecting to Burlingham FP3 would be affected by the Proposed Scheme.

12.6.2 NCC indicated that there was no significant equestrian activity in the vicinity of the Site.

12.7 Design interventions

12.7.1 The Proposed Scheme incorporates the provision of a new NMU route in the form of a combined footway / cycleway between Blofield and North Burlingham via the existing A47 and the proposed Blofield Overbridge. The

provision of the Blofield overbridge would ease the severance effect for NMU associated with the existing A47. The section of the permissive footpath, which runs parallel to the existing A47 at North Burlingham, lost to the Proposed Scheme, would be re-provided to the south of the proposed alignment of the A47. A new access track running parallel and to the south of the proposed A47 mainline alignment would provide a connection between Burlingham FP3 and the proposed Blofield Overbridge.

- 12.7.2 The existing junction at the eastern extent of North Burlingham connecting the Main Road to the existing A47 is a one-way single carriageway travelling out of North Burlingham. The Proposed Scheme introduces a new junction, North Burlingham Access, that provides vehicle access in both directions and reduces diversion time for vehicles travellers approaching North Burlingham from the east.

12.8 Potential mitigation measures

- 12.8.1 No specific mitigation measures are proposed at this stage.

- 12.8.2 During construction, the following best practice measures are anticipated to be of relevance for the Proposed Scheme:

- A Construction Environmental Management Plan (CEMP) is to be prepared by the appointed Contractor and implemented during the construction period. The CEMP would ensure that the construction of the Proposed Scheme is undertaken in as sensitive a manner as possible, with regards to people in the local community.
- A Traffic Management Plan (TMP) would be implemented during the construction phase of the Proposed Scheme. The TMP would ensure that access is maintained and disruption is minimised as far as possible wherever practicable, and would include measures to minimise severance by ensuring diversions for pedestrians are well signed, alternative access arrangements are made, and access to properties are retained.
- Impacts on NMU would be minimised through ensuring that all temporary diversions for users of NMU amenities around the work site are clearly signed, with alternative access arrangements maintained through the full construction period, as required.

12.9 Potential impacts

Construction

MT: Driver stress

- 12.9.1 With good practice and the implementation of a TMP, no significant impacts on MT driver stress are anticipated.

Views from the road

- 12.9.2 It is anticipated that the construction of the Proposed Scheme would be undertaken whilst retaining the existing A47 as the 'live' highway corridor for a large part of the construction period. Within this scenario, construction of the Proposed Scheme would be experienced as a change to the landscape to the south of the A47 whereby the change would be perceived as detrimental to the relative quality of the view from the road.
- 12.9.3 Where construction activity associates more directly with the existing A47 at either end of the Proposed Scheme or following a switch of traffic to the route of the Proposed Scheme the driver view would associate the influence of construction more directly within the highway corridor and less so as one of change to the view out from the road.
- 12.9.4 The Proposed Scheme would result in vehicle travellers experiencing views outside of the partial visual containment afforded by vegetation along the existing highway corridor once traffic is diverted onto the new A47 alignment. This would however be likely to associate with a limited duration of the overall construction phase, and would associate with an outlook influenced by temporary construction earthworks and other construction activity that would limit the potential for uninterrupted 'open' views from the road. Overall the nature of the outlook from the road during construction would therefore remain one characterised by 'intermittent' views.

NMU and community severance

- 12.9.5 The existing A47 acts as a barrier for NMU and results in a degree of severance for NMU wishing to travel between the communities of Blofield and North Burlingham in order to access the various community facilities. The existing A47 also acts as a barrier for NMU wishing to travel between Lingwood and North Burlingham using Burlingham FP3, Lingwood Road or Lingwood Lane.
- 12.9.6 The Proposed Scheme would impact on users of Burlingham FP3 and the permissive footpath forming part of the Burlingham Woodland Walks

network, since it would sever both routes. This would result in increased journey times and lengths and it would also increase the existing severance resulting in an adverse impact during the temporary construction period.

12.9.7 The Proposed Scheme would also impact on users of Lingwood Road and Lingwood Lane since it would sever both routes. This would result in increased journey times and lengths and it would also increase the existing severance resulting in an adverse impact during the temporary construction period.

12.9.8 The Proposed Scheme would have adverse impacts on users of the permissive bridleway, Yarmouth Road, High Noon Lane, Dell Corner Lane, Main Road, South Walsham Road and Acle Road during the temporary construction period.

Amenity

12.9.9 Amenity would likely be temporarily affected for users of Burlingham FP3, stretches of the permissive footpath and permissive bridleway forming part of the Burlingham Woodland Walks network and the local side roads during construction through the presence of construction plant, machinery, materials, construction compounds and construction lighting, whilst there is also potential for barriers and traffic flows to change.

12.9.10 In addition, construction activities may cause indirect impacts on NMU, due to noise, dust and the presence of construction plant, materials, compounds sites and machinery for a temporary period.

Operation

MT: Driver stress

12.9.11 Driver stress would be reduced as a result of the Proposed Scheme owing to the reduction in the number of side roads with access to the carriageway and the provision of a new, grade separated junction with Acle Road and South Walsham Road. The upgrading of the road to a dual carriageway would provide greater overtaking opportunities and remove the need for vehicles travelling along this route to join one lane and reduce speed. Although the severance of some of the side roads would lead to a concentration of traffic on those side roads which would maintain access to the A47, the proposed grade separated arrangement at the B1140 junction would reduce driver stress both for vehicles wishing to join the A47 and those wishing to cross the A47.

Views from the road

- 12.9.12 At year 1 of operation, prior to the establishment of Proposed Scheme mitigation planting, there would be 'open' views from the road to the south of the Proposed Scheme. The view to the north of the Proposed Scheme would be more limited by the potential screening influence of vegetation along the route of the existing A47 corridor. The nature of view at year 1 of operation would however remain comparable to that of the baseline, comprising views across open fields, gently rolling hills or plateau landform, church towers and woodlands.
- 12.9.13 By year 15 of operation the establishment of Proposed Scheme roadside vegetation would broadly redefine the existing situation in terms of establishing 'intermittent' views from the road.

NMU and community severance

- 12.9.14 The Proposed Scheme incorporates the provision of a new NMU route between Blofield and North Burlingham via the existing A47 and the proposed Blofield overbridge. As a result, there would be a negligible increase in journey time and length and crossing of the A47 would be made easier and safer by the introduction of the overbridge resulting in an overall beneficial effect in terms of removing the severance for NMU travelling between the 2 communities and associated facilities.
- 12.9.15 The Proposed Scheme would impact upon users of Burlingham FP3 since it would sever the route between Lingwood and North Burlingham and its connection to the existing A47. Users of FP3 bound for North Burlingham, albeit low in number based on the results of the NMU surveys, would be required to divert to the proposed access track which would run parallel to the new A47 mainline alignment before accessing North Burlingham via the new NMU route and the proposed Blofield overbridge. This would result in an increase in journey time and length for NMU wishing to travel between Lingwood and North Burlingham thereby increasing the existing severance.
- 12.9.16 The Proposed Scheme would also impact on users of Lingwood Road and Lingwood Lane since it would sever both routes. This would result in increased journey times and lengths and an increase the existing severance.
- 12.9.17 The section of permissive footpath lost to the Proposed Scheme would be re-provided to the south of the new alignment of the A47.

- 12.9.18 The B1140 compact grade separated arrangement to be provided as part of the Proposed Scheme would allow cyclists to avoid crossing the A47 at grade, which is likely to have a beneficial impact.

Amenity

- 12.9.19 The Proposed Scheme would impact on amenity for users of Burlingham FP3 since the new alignment of the A47 would sever the route. Amenity would be degraded and may put off users of the route. The Proposed Scheme would have an adverse impact on amenity for users of the permissive footpath and local side roads.

12.10 Chapter summary

- 12.10.1 During construction, views from the road would be subject to the detracting influence of construction operations including earthworks and construction vehicles, but would otherwise retain intermittent views of the wider area. During operation, views from the road would initially be relatively open, but would revert to intermittent views comparable to the existing situation following the establishment of Proposed Scheme roadside vegetation.
- 12.10.2 During operation, driver stress would be reduced as a result of the Proposed Scheme owing to the reduction in the number of side roads with access to the carriageway and the provision of a new, compact grade separated junction with Acle Road and South Walsham Road. The upgrading of the road to a dual carriageway would provide greater overtaking opportunities and remove the need for vehicles travelling along this route to join one lane and reduce speed. Although severance of many of the side roads would lead to a concentration of traffic on those side roads which would maintain access to the A47, the proposed grade separated arrangement at the A47/B1140 Acle Road / South Walsham Road junction would reduce driver stress both for vehicles wishing to join the A47 and those wishing to cross the A47.
- 12.10.3 The Proposed Scheme would result in an overall beneficial effect for NMU travelling between Blofield and North Burlingham since crossing of the A47 would be made easier and safer by the introduction of the Blofield Overbridge. However, it would have an adverse impact upon users of Burlingham FP3 travelling between Lingwood and North Burlingham since it would sever the route and its connection to the existing A47 increasing the existing severance. The Proposed Scheme would also have a beneficial effect on cyclists crossing the A47 to and from the 2 side roads at the B1140 junction.

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- 12.10.4 The Proposed Scheme would impact on users of Lingwood Road and Lingwood Lane since it would sever both routes. This would result in increased journey times and lengths and an increase in the existing severance.
 - 12.10.5 The Proposed Scheme would likely temporarily affect users of Burlingham FP3, the permissive footpath and the local side roads during construction.
 - 12.10.6 Further work will be undertaken to develop design interventions to limit or reduce impacts and promote opportunities for the environment within the study area wherever possible. Design development and potential mitigation will be reported in the ES as well as further detailing of baseline conditions and likely changes during both construction and operation for all identified receptors.

13 People and Communities - Social

13.1 Introduction

- 13.1.1 This chapter sets out the baseline and assesses the preliminary impacts on People and Communities – Social arising from the A47 Blofield to North Burlingham Proposed Scheme.
- 13.1.2 People and Communities is a broad topic and therefore, for ease of assessment and review, People and Communities has been split into 2 chapters. Chapter 12 (People and Communities – Travellers) presents the assessment of the Proposed Scheme on the ‘travellers’ element (pedestrians, cyclists, equestrians, community severance and vehicle travellers).
- 13.1.3 This chapter presents assessment of the social elements of people, communities, the local economy and outlines proposed design measures to help mitigate potential impacts and relevant consultation.

13.2 Guidance and best practice

- 13.2.1 The People and Communities chapter is a Design Manual for Road and Bridges (DMRB) topic within Interim Advice Note (IAN) 125/15 (‘Environmental Assessment Update’) (DMRB 2015) and IAN 125/09 (‘Supplementary Guidance for users of DMRB Volume 11 on Environmental Assessment’) (DMRB 2009).
- 13.2.2 The assessment has been undertaken in accordance with the relevant sections of DMRB Volume 11, Section 3, Part 6 (Land Use) (DMRB 2001) and Part 8 (Pedestrians, Cyclists, Equestrians & Community Effects) (DMRB 1993) which provide guidance on the sub-topics for People and Communities – Social:
- Private property and land-take
 - Community land and community facilities
 - Community severance
 - Development land
 - Human health
- 13.2.3 There is currently no DMRB guidance on the assessment of local and wider economic impacts. Potential Local Economy impacts, including economic development impacts as a result of the Proposed Scheme, have been considered using a process based on the HM Treasury Green book principles (HM Treasury 2013). Local Economy is a sub-topic considered in this chapter in addition to those detailed in the DMRB guidance.

13.2.4 The sub-topics form the foundation to the structure of this chapter. Due to each sub-topic having different requirements (such as different specialist inputs, study areas, and assumptions and limitations), the headings in this chapter are sub-divided and grouped, where relevant, to benefit the reader.

13.3 Study area

13.3.1 The land within the proposed site boundary is herein referred to as ‘the Site’. Study areas for this chapter are defined in Table 13.1.

13.3.2 The area within 250m of the Site is referred to as the local impact area (LIA) and is the primary study area for this topic. This LIA is used to assess: demolition of private property and associated land-take; impacts on community land and community facilities; community severance; impacts on development land.

13.3.3 The assessment of impacts on the Local Economy will focus on the wider impact assessment (WIA) which in this case will be the of district of Broadland.

13.3.4 The study area for human health is defined by the impacts being experienced. Impacts associated with people and communities are assessed within the LIA and WIA. Health impacts associated with noise and air quality are assessed within the study area set out in the Air Quality and Noise and Vibration chapters.

13.3.5 As the Proposed Scheme is 1 of 6 along the A47, the cumulative effects may be felt more widely than both the LIA and WIA and as such, the County of Norfolk is also considered.

Table 13.1: People and Communities – Social study areas per sub-topic

Sub topic	Study area	Referred to as
Private property and associated land-take	The Site	
Community land and community facilities Businesses Community severance Development land	250m from the Site	LIA
Local economy, human health	District of Broadland	WIA

13.4 Assumptions and limitations

13.4.1 To prevent double-counting of impacts, those impacts relating to other environmental topics (such as noise and air quality) are not considered in detail as part of the assessment.

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- 13.4.2 The LIA is based on a 250m boundary from the Site, and not on distances via particular modes (such as walk times), by particular routes, or taking into account man-made and natural barriers (such as major roads, railway lines or water courses).
- 13.4.3 Potential impacts on human health are considered as part of the topics which are themselves determinants of health – namely Noise, Air Quality, and, where relevant, within the People and Communities – Social chapter.
- 13.4.4 Data used to define the baseline social and community conditions has been compiled from existing published sources. Assessments are based on the most recent data available for the LIA and WIA. The currency of data varies from dataset to dataset depending on how frequently information is collected. Dates for each dataset are noted in the baseline section where available.
- 13.4.5 The Construction Strategy for the Proposed Scheme has not yet been developed; the extent of required construction works and the location of construction compounds is not known at this stage. The assessment is based on the most up to date design which does not distinguish between permanent and temporary or construction and operational boundaries. Therefore, the exact extent of temporary and permanent land-take cannot be confirmed at this stage. A definite figure will be available as the design progresses.

13.5 Baseline

Private property and land-take

- 13.5.1 Residential properties in the study area includes; the eastern extents of Blofield, the smaller grouping of residential properties at North Burlingham and a wider, dispersed pattern of individual properties and farmsteads throughout.
- 13.5.2 At the junction of the A47 and the smaller Yarmouth Road there are a number of further residential properties (all within 15m of the road). There are also a number of properties within 20m of the junction between Lingwood Road and the A47. Between the A47 and Main Road (within 25m of the current route) there are also several properties. At the junction of the A47 and the B1140 there is a single large detached house.
- 13.5.3 There is a collection of warehouse buildings near to the route between the A47 and Main Road within 20m of the Site, some of which are occupied by retail businesses, including Furniture by Design and BHB Beads.

13.5.4 There are also the following businesses identified near the route:

- Blofield fish and chop shop, North Street
- Butterflies coffee shop, Yarmouth Road,
- Macron store, Plantation Park, Plantation Road
- Progress House meeting rooms, Plantation Park, Plantation Road
- Blofield pick your own, Yarmouth Road
- Atlantic Affordable Car Centre, Sparrow Hall Lane
- Norwich Camping and Leisure, Yarmouth Road
- Garden Lodge (holiday cottages), North Burlingham
- Burlingham Furniture Rental, North Burlingham
- Furniture by Design, North Burlingham

Community land and community facilities, and community severance

13.5.5 Within the LIA there are the following community facilities:

- Blofield Community Allotments
- St Andrew's church, North Burlingham
- Norwich United football club, Plantation Park
- Blofield primary school, North Street, Blofield
- Blofield Medical Centre, Plantation Road, Blofield

13.5.6 Figure 12.2, a map of the community facilities, is provided in Chapter 12 (People and Communities – Travellers).

13.5.7 The existing A47 route runs east to west through the Site and is a barrier for NMU travelling north to south between North Burlingham and Lingwood.

13.5.8 There are currently no bridges or underpasses crossing over the A47 on this section of the road. Community severance assesses the impacts on both community facilities and private businesses.

Development land

13.5.9 The Broadland District Council Joint Core Strategy which was adopted in 2011 and runs to 2026 states that Blofield should accommodate for 50 new houses as a minimum (Broadland District Council (2016) Site Allocations Development Plan Document (DPD)).

13.5.10 Two areas of development land have been identified within the LIA. Land at Wyngates, Blofield (approximately 4.5 hectares) has been allocated for housing (64 dwellings with open space). Land to the south of Yarmouth Road, and North of Lingwood Road, Blofield (approximately 2.5 hectares)

has been allocated for 75 dwellings, open space, and a community facility (Broadland District Council Site Allocations DPD).

- 13.5.11 There are also a number of development sites in the WIA with planning permission for residential dwellings and further sites that are in the process of seeking planning approvals.

Local economy

- 13.5.12 The district of Broadland had a population of 124,646 in the 2011 Census. It has an aging population. There is a slightly lower than average share of children aged under 16 (17% compared to 19% nationally), and a larger than average share of people aged over 65 (22% compared to 16% nationally). The wider county of Norfolk also has similar demographics to Broadland.

- 13.5.13 Broadland is an area of relative affluence and high employment. Table 13.2 presents the working age population that are economically active and the proportion that are in employment. It shows there are proportionally more economically active people in Broadland and Norfolk than in England (83% and 80%) compared to 78% across England and Wales. It also shows that employment is higher in Broadland at 81% and in Norfolk at 77%, compared to 74% across England and Wales. Unemployment is lower at 3% in Broadland, and 4% in Norfolk, compared with 5% across England and Wales.

Table 13.2: Employment and unemployment (Apr 2016 – Mar 2017)

	Broadland	Broadland (those aged 16-64)	Norfolk	Norfolk	England and Wales
Economically active	63,400	83%	441,800	80%	78%
In employment	61,800	81%	424,100	77%	74%
Unemployed	1,800	3%	17,700	4%	5%

Source: ONS annual population survey

- 13.5.14 The English indices of multiple deprivation 2015 (DCLG 2015) provides a comparative assessment of the level of deprivation between neighbourhoods in England, ranking lower super output areas (LSOA) by level of deprivation. All of the LSOA in the Broadland district are within the 50% least deprived in England. Five of the LSOA in the district are within the 10% least deprived.

Human health

- 13.5.15 Table 13.3 provides an overview of the health of the population in the WIA. This is provided at district level from Office of National Statistics (ONS)

Census data and Public Health England (PHE) data. Consideration has been given to conditions and impairments that may be exacerbated by the Proposed Scheme due to an increase in air pollution or removal of public open space.

- 13.5.16 The estimated prevalence of Chronic Obstructive Pulmonary Disease (COPD) in Broadland is in line with the national average. The under 75 mortality rate due to cardiovascular causes is lower than the national average and physical activity rates are higher than average. However, the proportion of obese children (Year 6) is higher than the national average.

Table 13.3: Human health baseline indicators

	Broadland	Broadland (those aged 16-64)	Norfolk	Norfolk	England and Wales
People with a long-term health problem or disability (ONS 2011 Census)	23,330	19%	172,431	20%	18%
Estimated prevalence of COPD (all ages) (PHE 2017)	3,822	3%	26,751	3%	3%
Percentage of physically active adults (PHE 2017)	-	72%	-	67%	66%
Obese children (Year 6) (PHE 2017)	-	20%	-	18%	14%
Under 75 mortality rate from Cardiovascular diseases (PHE 2017)	48.9 per 100,000	-	62.5 per 100,000	-	73.5 per 100,000

Source: ONS (2011) National Census; Public Health England (2017) Public Health Profile

- 13.5.17 There is a single health facility –the Blofield Medical Centre located just within the LIA. Several Public Right of Way (PRoW) providing access to green space for NMU within the LIA. These are identified in Chapter 12 (People and Communities – Travellers).

13.6 Consultation

- 13.6.1 No topic-specific consultation is required as part of the People and Communities – Social assessment. However, wherever inputs from the wider Proposed Scheme public consultation are relevant to the assessment, these will be incorporated.

13.7 Design interventions

- 13.7.1 The most applicable mitigation for private property and land-take, community land and community facilities, and development land is through effective design.

13.7.2 The first principle is to ensure that the footprint of the Proposed Scheme is reduced as much as practicable, without adversely affecting the design. This minimises the total area of private property, community land, and development land affected. It also minimises: residential properties and businesses directly affected; and the number of community facilities directly affected.

13.8 Potential mitigation measures

13.8.1 Prior to construction, a Construction Environmental Management Plan (CEMP) will be prepared by the appointed contractor and implemented during construction. This will ensure construction is undertaken in as sensitive a manner as possible with regards to People and Community receptors. The CEMP should incorporate:

- A Community Relations Strategy, managing communication with both the general public and local businesses prior to and during all construction works
- The Considerate Construction Scheme, informing local residents, businesses and other sections of the community about the Proposed Scheme
- A Traffic Management Plan (TMP), to manage all temporary diversions

13.8.2 During the construction and operational phases there is likely to be land-take from the Blofield community allotments, and access is likely to be impeded to some local businesses along the route. Highways England should work with the owners / operators to ensure that they are appropriately compensated for any permanent or temporary loss of use. Safe and accessible alternative routes provided to the businesses should be provided where required.

13.9 Potential impacts

Private property and land-take

13.9.1 No demolition of private property is planned as part of the Proposed Scheme.

13.9.2 Permanent land-take would be required along the length of the new alignment. The majority of which is agricultural land.

13.9.3 Temporary land-take would be required for construction activities such as, the construction compound. Indicative locations are considered for:

- a main compound - the Proposed Scheme west of the proposed Blofield Overbridge and south of the proposed A47 carriageway

- satellite compound - the Proposed Scheme east of the proposed B1140 Overbridge and south of the proposed A47 carriageway

13.9.4 There will be no demolition of private property during the operation phase. No further land-take is anticipated.

Community land and community facilities

13.9.5 The Blofield community allotments are adjacent to the Proposed Scheme. It is likely that a small area of land-take would be required from the access point to the community allotments. Access to this facility is likely to be affected during construction. Alternative access to the allotments will be provided.

13.9.6 No additional impacts on community land and facilities are anticipated during the operational stage.

Community severance

13.9.7 There will be severance during both the construction and operational phases due to the introduction of physical barriers to existing travel routes. Severance related to a change in journey length or increased traffic is assessed in the Chapter 12 (People and Communities – Travellers).

13.9.8 During construction, it is possible that access to the businesses within the study area may be impacted. Access will be maintained for all businesses and community facilities during both the construction and operational phases.

13.9.9 The proposed new Blofield Overbridge will include NMU facilities and provide a safer route between Blofield and North Burlingham and their associated community facilities and businesses.

13.9.10 Lingwood Lane and Lingwood Road will be closed during construction and operation which would affect access between Lingwood and North Burlingham. The Proposed Scheme is anticipated to improve connectivity between North Burlingham and Lingwood for vehicle travellers and therefore businesses.

Development land

13.9.11 No impacts on development land are anticipated during the construction phase.

13.9.12 There are a number of development sites in the LIA and WIA which are likely to benefit from improved accessibility once the new road is

operational. The road will improve access to the area and traffic flow, creating a more favourable environment for new development on the sites. There is therefore likely to be a beneficial effect on the development sites in the LIA and WIA. The benefits are likely to be greater when viewed cumulatively alongside other schemes being undertaken on the A47.

Local economy

- 13.9.13 The Proposed Scheme will require a construction workforce to deliver it. At present, a Construction Strategy for the Proposed Scheme is not available and there is no information on whether workers will be new or existing employees of the designated contractor (who is yet to be appointed), the skill levels likely to be required for delivery, and whether those workers can and will be drawn from the LIA or WIA.
- 13.9.14 For the duration of the construction phase, there will be construction workers on-site. This has potential beneficial impacts on the local economy as a result of these workers using local hospitality and catering establishments.
- 13.9.15 Direct operational employment is not expected to be created as a result of the Proposed Scheme. However, there will be increased indirect employment opportunities related to reduced congestion and improved journey times.

Human health

- 13.9.16 The Proposed Scheme has been identified in the All Travellers Chapter to sever the Burlingham FP3 and the permissive footpath forming part of the Burlingham Woodland Walks network. As the footpath currently provides access to green space and an environment for physical exercise for NMUs, any changes made to access have the potential to impact the health of NMUs who use it.
- 13.9.17 Access to green space is particularly important to children. When children are able to play in an outdoor environment they tend to be more active which supports physical health and positive mental health and wellbeing. However, no public green space likely to be used frequently by children, such as parks, would be lost due to the Proposed Scheme.
- 13.9.18 No additional effects on human health are anticipated during the operational stage.

13.10 Chapter summary

- 13.10.1 This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts associated with People and Communities – Social. Impacts are likely during the construction phase as result of land-take and community severance, human health impacts associated with severance of NMU routes and temporary employment generation. During the operational phase, there are likely to be impacts on community severance, development land and the economy.
- 13.10.2 Further work will be undertaken to develop design interventions to limit or reduce adverse impacts and promote opportunities for the environment in the study area wherever possible. Any design development and potential mitigation will be reported in the Environmental Statement as well as further detailing of baseline conditions and likely changes during both construction and operation for all identified receptors.

14 Road Drainage and the Water Environment

14.1 Introduction

14.1.1 This chapter considers the existing environmental baseline information with respect to road drainage and the water environment, together with water abstractions. The chapter describes the potential impacts that are anticipated from preliminary assessments in relation to the Proposed Scheme, and outlines proposed design and other measures to help mitigate these potential impacts.

14.2 Guidance and best practice

14.2.1 The following legislation, standards and best practice guidelines are relevant to the Proposed Scheme:

- National Planning Policy Framework and its associated Technical Guidance (2018)
- Highways Act (1980)
- Highways (Environmental Impact Assessment) Regulations 2007 (EIA Highways Regulations 2007)
- Highways England's Design Manual for Roads and Bridges (DMRB) Section 2: General Principles of Environmental Assessment (Highways England, 2008)
- Highways England's Design Manual for Roads and Bridges (DMRB) Volume 11, Part 10 (HD 45/09) Road Drainage and Water Environment (Highways England, 2009)
- Directive 1991/676/EEC, more commonly known as the Nitrates Directive (1991)
- Directive 2000/60/EC, more commonly known as the Water Framework Directive (2000)
- Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
- The Groundwater (Water Framework Directive) (England) Direction 2016
- The Environment Agency's approach to groundwater protection (Environment Agency, 2017a)
- Flood and Water Management Act (2010)
- Land Drainage Act 1991 and 1994
- The Environment Act (1995)
- The Water Act (2014)

- The Environmental Permitting (England and Wales) Regulations (2010) which replaces the Water Resources Act (1991) as the key legislation for water pollution in the UK
- Environment Agency's environmental permitting guidance (Environment Agency, 2018c)
- Best practice guidelines and procedures for pollution prevention and water management in construction as set out in the Construction Industry Research and Information Association (CIRIA) guidelines; CIRIA C532 (2002), CIRIA C648 (2006) and CIRIA C741 (2015).
- The Greater Norwich Development Partnership (2014) Joint Core Strategy for Broadland, Norwich and South Norfolk
- The Norfolk County Council Local Flood Risk Management Strategy (Norfolk County Council, 2015)
- The Greater Norwich Area Strategic Flood Risk Assessment (JBA Consulting, 2017)
- The Broadland Local Plan (2015-2026)

14.3 Study area

- 14.3.1 The land within the Proposed Scheme boundary is hereafter referred to as 'the Site'. The study area comprises a 1km buffer around the Site.
- 14.3.2 The study area may be extended to include downstream water environment features beyond 1km if they are deemed to be at risk from either the construction or operation phases. The full extent of the study area would be confirmed as part of the Environmental Statement (ES) when further design details are available.

14.4 Assumptions and limitations

- 14.4.1 This report has been prepared using publicly available information, with reference to previous reports carried out and Highways England's Drainage Data Management System (HADDMS). The assessment presented is based on a desk-based study and a site walkover carried out in April 2018. Considering the nature of the Proposed Scheme, it is not considered that the data limitations introduce any significant uncertainties with respect to surface water, groundwater, and flood risk. Further site visits will be carried out as part of the ES.
- 14.4.2 Construction methods are currently unknown and so the assumption has been made that construction would follow current best practice and guidelines.

14.5 Baseline

Local environment

- 14.5.1 The main water features within the study area are the catchments of 2 Water Framework Directive (WFD) surface water bodies (Witton Run and The Bure). However, the Site itself does not cross these water bodies. There are 7 smaller drainage channels and 15 isolated ponds within the study. Run-off from the existing A47 drains to soakaways at the eastern and western extents of the Site, at approximately chainages (ch) ch0 to ch950 and ch3+500 to ch5+150 respectively. Run-off in the centre of the Site is to drains / grips. According to HADDMS, the current highway run-off discharges are unattenuated and there are no known pollution control devices.
- 14.5.2 The whole of the Site and majority of the wider study area are located in Flood Zone 1 which is associated with a low risk of flooding from rivers. A small proportion of the study area to the south of Blofield is within Flood Zone 2 and Flood Zone 3b. This section of Flood Zone 3b is associated with Run Dike (Witton Run WFD water body), a tributary of the River Yare.
- 14.5.3 Based on the British Geological Survey Online Geology Map (British Geological Survey, 2017), the study area is underlain by the Norwich Crag deposits, overlain by a number of superficial deposits, including the Lowestoft Formation Diamicton, Happisburgh Glacigenic Formation Diamicton and Happisburgh Glacigenic Formation Sand. The Breydon Formation Peat underlies Run Dike and its tributaries.
- 14.5.4 According to the Environment Agency's online maps (Environment Agency, 2018b), the Norwich Crag is classified as a Principal aquifer, and therefore has high storage capacity due to high intergranular and / or fracture permeability. It may support water supply and / or river base flow on a strategic scale. The Happisburgh Glacigenic Formation Sand is classified by the Environment Agency as a Secondary A aquifer. It may support water supplies and base flow at a local scale. The Lowestoft Formation Diamicton, which underlies a majority of the study area, is classified as a Secondary (Undifferentiated) aquifer. It is therefore likely to have variable permeability i.e. may be water bearing or non-productive in different locations.

Designated sites

- 14.5.5 There are no Ramsar sites, Special Areas of Conservation (SAC), Sites of Special Scientific Interest (SSSI), Special Protection Areas (SPA), Local Nature Reserves or National Nature Reserves (NNR) within the study area.

- 14.5.6 The Broads SAC (UK0013577) and Broadland SPA (UK9009253), a 5885ha fenland site, are located wholly outside the study area over 2km north and south of the existing A47 carriageway.
- 14.5.7 There are potential groundwater links between the Proposed Scheme and the Broads SAC and the Witton Run and The Bure WFD water bodies.
- 14.5.8 Groundwater dependent Lowland Fens, part of Natural England's Priority Habitat Inventory, are present within 1km to the south-west of the areas that may be required for the Proposed Scheme drainage. These are located adjacent to Run Dike between Brundall and Highnoon Farm (Defra, 2017).

Sensitive receptors

- 14.5.9 The Anglian River Basin Management Plan (Environment Agency, 2018) provides information on 3 WFD water bodies within the study area that have the potential to be impacted upon:
- The Witton Run (water body reference: GB105034051310), runs in a generally southerly direction in the south west corner of the study area and is a tributary of the Yare (Wensum to tidal) (water body reference: GB105034051370).
 - The eastern half of the study area is within the catchment of the Bure (Horstead Mill to St Benet's Abbey) (water body reference: GB105034050931) although the water body itself is located outside the study area.
 - The Broadland Rivers Chalk and Crag groundwater body (water body reference: GB40501G40300), covers all groundwater within the study area.
- 14.5.10 The Witton Run water body is classified as a Heavily Modified Water Body with 'Moderate' ecological potential and 'Good' chemical quality. The ecological potential is limited by physico-chemical elements (dissolved oxygen) and supporting surface water elements (linked to agricultural land management, abstractions and diffuse phosphate pollution) not achieving 'Good' potential. The overall water body status is classified as 'Moderate' and is not expected to improve as it would be disproportionately expensive to achieve.
- 14.5.11 The Bure (Horstead Mill to St Benet's Abbey) water body is classified as a Heavily Modified Water Body with 'Moderate' ecological potential and 'Good' chemical quality. The ecological potential is limited by physico-chemical quality elements (dissolved oxygen and temperature) and other surface water elements (mitigation measures) not achieving 'Good' potential. The water body has an overall objective to achieve 'Good' potential by 2027.

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- 14.5.12 In addition to the above WFD waterbodies, 7 ordinary watercourses have been identified within the study area comprising drainage channels or ditches. Furthermore, a total of 15 unnamed isolated ponds were identified within the study area from mapping and the site walkover.
- 14.5.13 The Broadland Rivers Chalk and Crag groundwater body has 'Poor' Chemical and Quantitative status (2016 cycle 2). The quantitative status is limited by the Groundwater Dependent Terrestrial Ecosystems test which scored poorly due to agricultural abstractions lowering the natural flow and levels of the groundwater. The objective is to achieve 'Good' quantitative status by 2021. The chemical status is limited by diffuse groundwater pollution. The Chemical Drinking Water Protected Area criteria also scored poorly although data is reportedly suspect. Objectives are to achieve 'Good' chemical status by 2027 by natural recovery. The water body is linked to the areas protected under the Nitrates Directive and Drinking Water Protected Areas highlighted above (Environment Agency, 2018a).
- 14.5.14 According to the Environment Agency's online maps (Environment Agency, 2018), groundwater underlying the Site primarily has a 'Medium-High' groundwater vulnerability.
- 14.5.15 There are 10 private groundwater abstraction points from the Broadland Rivers Chalk and Crag groundwater body located within the study area. These are primarily for agricultural purposes. Additionally, the Site crosses Zone 3 (total catchment) of a source protection zone relating to public water supply abstractions in south-east Norwich, approximately 7km to the west of the Proposed Scheme (Environment Agency, 2018). There may be other unlicensed abstractions of less than 20m³/day within the study area. Unlicensed abstraction information would be obtained from the local council after consultation.
- 14.5.16 The sensitive water environment receptors are summarised in Table 14.1. They have been assessed according to the DMRB Volume 11, Section 3, Part 10 (HD 45 / 09, Highways Agency, 2009).

Table 14.1: Sensitive water environment receptors

Receptor	Location	Importance
Broadland Rivers Chalk and Crag groundwater body [GB40501G400300]. This includes groundwater abstractions and source protection zones as indirect receptors.	Underlies the Site and study area.	Very High
Witton Run [GB105034051310]	South-west corner of study area. Yare catchment covers western half of study area.	High
Bure (Horstead Mill to St Benet's Abbey) [GB105034050931]	North of study area. Bure catchment covers eastern half of study area.	High
Tributary to Witton Run	South of Blofield (ch0) to Hemblington Road (ch900)	High
Pond	636788 310013	High
Pond	635991 309327	High
Pond	634108 308943	High
Unnamed watercourse west of Blofield	North of Shack Lane	Low
Unnamed watercourse south of A47	Hemblington Road (ch900 to ch1+100)	Low
Unnamed watercourse south of A47	Lingwood Road (ch2+200 to ch2+400)	Low
Unnamed watercourse north of A47	ch4+350 to ch4+900	Low
Unnamed watercourse north of A47 and north of Blofield	South of Field Lane	Low
Unnamed watercourse north of A47 and north of Blofield	South of Bullacebush lane	Low
Pond	633129 310432	Low
Pond	633146 310943	Low
Pond	636755 310245	Low
Pond	636824 310114	Low
Pond	636848 310126	Low
Pond	636945 310154	Low
Pond	638620 311030	Low
Pond	636310 308740	Low
Pond	635761 309878	Low
Pond	635724 309868	Low
Pond	633646 308527	Low
Pond	633264 308779	Low
Pond	633713 309190	Low

Baseline surveys

14.5.17 A site walkover was carried out in April 2018. The walkover covered the extent of the Site with a focus on surface water features such as ponds and ditches.

14.5.18 No water quality or other surveys were carried out and it is assumed that the information available on the water environment within the Anglian River Basin Management Plan (Environment Agency, 2018) is representative of the general conditions at the study area. It is currently envisaged that water quality or other surveys would not be required to inform the ES.

14.6 Consultation

14.6.1 The Scoping Report (Highways England, 2018) was issued to the Planning Inspectorate in February 2018 to inform its Scoping Opinion. The following organisations responded to the Planning Inspectorate consultation in the Scoping Opinion:

- Environment Agency
- Norfolk County Council as Lead Local Flood Authority
- Anglian Water

14.6.2 Key points raised as part of the Scoping Opinion include the provision of sustainable drainage, with 'dry culverts' to allow for existing surface water flooding flow pathways, and designed for a 1 in 100 year event with both 20% and 40% rainfall intensity allowances for climate change. The ES is to include a flood risk assessment, considering all sources of flooding and providing at least one feasible solution for the disposal of water, a hydrogeological assessment to assess the potential impact of any changes to groundwater levels and flows on abstractions and surface water, and an assessment of the pollution impact of routine road runoff to surface water and groundwater.

14.6.3 Further meetings have been undertaken with the Environment Agency and Norfolk County Council, to further discuss comments made in the scoping opinion, and agree environmental considerations for the Proposed Scheme design and the ES.

14.6.4 Ongoing consultation will be carried out, when required, with the authorities identified above, and also Anglian Water Services and Broadland District Council during the statutory consultation period for the Proposed Scheme. This will be reported in the ES. No watercourses in the study area are within the Norfolk Rivers Internal Drainage Board area, and therefore no consultation with the internal drainage board is required.

14.7 Design interventions

14.7.1 The Proposed Scheme requires a new road drainage design, which is yet to be finalised, and it is assumed that only a small section of the existing A47 drainage would be utilised where it ties in.

- 14.7.2 The proposed drainage design will incorporate features to mitigate against the potential for an increase in flood risk, reduction in water quality within the water environment, or reduction of groundwater resource to abstractions or groundwater-dependent surface water features.
- 14.7.3 The proposed drainage design is summarised below and shown on Figure 1.2:
- Thirteen soakaways are planned along extent of the Proposed Scheme, comprising chambers and / or trenches. Seven are located along the mainline of the Proposed Scheme, five on the eastern side roads and one is located on the western side roads. Those located along the mainline are at the following chainages:
 - ch730 to ch840
 - ch890 to ch930
 - ch2+300 to ch2+310
 - ch2+530 to ch2+540
 - ch3+005 to ch3+040
 - ch3+550 to ch3+675
 - ch3+945 to ch4+070
 - The use of an infiltration basin (ch2+750) and an attenuation pond (ch1+100) with outfall to an existing ditch in the central section of the Site is dependent on the results of ground investigations.
- 14.7.4 The effect of an increase in impermeable area due to the proposed carriageway and side roads, could result in an increase in peak flow rate and volume which could, in turn, increase flood risk. Appropriate attenuation would be required in the drainage design to ensure there is no increase in surface water run-off peak flow rate or volume as compared to the existing condition, including a 20% allowance for climate change.
- 14.7.5 Mitigation may take the form of sustainable drainage systems (SuDS), where appropriate and subject to suitable ground conditions. Permanent SuDS features should be designed in accordance with relevant DMRB standards (Highways England, 2016a; 2016b) and the SuDS Manual (Construction Industry Research and Information Association, 2007). Any attenuation requirements would consider the potential effects of future climate change. SuDS has been considered in the drainage design using soakaways, infiltration basins and attenuation ponds outlined in Section 14.7.1.
- 14.7.6 The Proposed Scheme drainage includes a number of ‘interceptor drainage’ features where it could act as a potential overland flow barrier, to maintain connectivity of existing surface water flooding pathways. These interceptor drainage features are mostly located at natural low points along the length of the carriageway. The interceptor drainage would most likely take the form of

'dry culverts' and would be designed to convey a 1 in 100 year surface water flow event including an allowance for climate change.

- 14.7.7 Bypass interceptor drains may be used upstream of soakaways where required, to reduce the impact of routine run-off and accidental spillages on groundwater quality.
- 14.7.8 SuDS measures would be used, where appropriate, to mitigate the impact of routine run-off on the water quality of receiving surface watercourses.
- 14.7.9 The Proposed Scheme would require a pond, located at ch2+250, to be infilled. A site walkover in April 2018 identified this pond as likely a road drainage pond. This would require confirmation from the planned ground investigation.
- 14.7.10 The Proposed Scheme design includes a retaining wall at the western extent, and at bridge structures at ch1+200 and ch3+900. These may intercept permeable layers within the superficial deposits. At present, these structures are not considered to potentially impact on groundwater abstractions or groundwater dependent ecosystems.
- 14.7.11 Further design interventions may be required and identified during the design process and preparation of the ES when further details on the Proposed Scheme drainage are available.

14.8 Potential mitigation measures

- 14.8.1 During construction, best practice guidelines and procedures for pollution prevention and water management would be included as part of the overall Construction Environmental Management Plan (CEMP). The CEMP would incorporate best practice as set out in Construction Industry Research and Information Association (CIRIA) guideline documents notably CIRIA C532 (CIRIA, 2002), CIRIA C648 (CIRIA, 2006) and CIRIA C741 (CIRIA, 2015); the Environment Agency's Pollution Prevention Guidelines (EA, 2014); and the Environment Agency's approach to Groundwater Protection (Environment Agency, 2017a).
- 14.8.2 Where works lead to temporary changes in the surface water run-off regime by the alteration of ground elevations and overland flow pathways for example, by earthworks or proposed structures, a temporary surface water drainage strategy would be developed for the Site and incorporated into the CEMP to ensure that there would be no increase in run-off and flood risk during the construction phase. SuDS would be implemented where appropriate.

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- 14.8.3 The potential for impacts to occur because of contamination from accidental spillages would be minimised by the inclusion of emergency response procedures in the CEMP to handle any leakages or spillages of potentially contaminating substances. Spill kits would be located on sites near to watercourses and within the works compounds and staff would be trained in their use.
- 14.8.4 The potential for impacts to occur because of storage of materials would be minimised by locating compounds for the storage of construction materials or temporary stockpiling of excavated material away from surface watercourses and drains. Drums and barrels would be properly labelled and fitted with flow control taps and stored in a designated, bund-shielded safe area within the site compound.
- 14.8.5 Before any discharge of water is made from the site, appropriate settlement techniques would be used. All roads and hardstanding would be kept clean and tidy to prevent the build-up of pollutants, although the use of water sprays for reducing dust or washing construction areas would be carefully managed to avoid washing substantial quantities of silt and other materials into surface water receptors. Where appropriate, watercourses would be shielded by bunds to prevent contamination from surface water run-off.
- 14.8.6 Potential impacts upon groundwater during earthworks would be minimised by exposing subsoil for a minimum length of time after topsoil strip. Cut-off trenches, where necessary, would be excavated to prevent surface water run-off into watercourses. Cut-off trenches would discharge into sediment lagoons, with discharge to watercourses subject to prior consents, where appropriate, from regulatory bodies.
- 14.8.7 Piling works would be planned in accordance with the best practice guidance, as detailed in the Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention (Environment Agency, 2001). Piling operations would be subject to risk assessment and any potential to cause pollution to the aquifer would be covered by measures to be detailed in the piling method statements.
- 14.8.8 Further mitigation measures may be required and identified during the preparation of the ES when further details on the Proposed Scheme are available.

14.9 Potential impacts

Construction

14.9.1 The potential impacts of the Proposed Scheme during construction, without the mitigation practices described in section 14.8 in place, include the following:

- Damage to aquatic ecosystems, directly due to pollution of watercourses and indirectly due to pollution of the Broadland Rivers Chalk and Crag groundwater body. Pollution may arise from mobilised suspended solids during earthworks in saturated aquifer or uncovered excavations, heavy metal contamination and spillages of fuel, oil concrete or cement products.
- Increased risk of flooding due to changes in the extent of the floodplain or changed / new flood pathways due to temporary barriers created by construction works e.g. topsoil stockpiles.
- Temporary changes in the surface water run-off regime by the alteration of ground elevations and overland flow pathways, for example, by earthworks or proposed structures.
- Temporary effects on local structures, including property and infrastructure, due to subsidence arising from changes in groundwater level, for example due to dewatering or piling associated with structures at ch1+150 and ch3+900. Dewatering may impact on local abstractions, if occurring within the radius of influence.
- Foundations and piles associated with structures at ch1+150 and ch3+900 may provide potential pathways for contaminant migration and localised barriers to groundwater flow. This may also impact on the groundwater available for abstractions.

14.9.2 Other potential construction effects may be identified during the preparation of the ES when further details on the Proposed Scheme drainage are available.

Operation

14.9.3 The potential effects of the Proposed Scheme during the operation phase, without the design intervention and mitigation described in place, include:

- Loss of a surface water pond due to infill and road embankment construction at ch2+250.
- Potential increase in the rate of highway run-off and flood risk from an increase in impermeable area.
- Pollution of groundwater or surface water features associated with routine road run-off via proposed soakaways, the infiltration basin at ch2+750 and the surface water outfall at ch1+050.

- There is a risk of pollution to the Broadland Rivers Chalk and Crag groundwater body or surface water resulting from accidental spillages or pollution incidents. This risk is likely to rise with the potential increase in the volume of traffic and may affect receptors via proposed soakaways, the infiltration basin at ch2+750 and the surface water outfall at ch1+050.
- Permanent changes in the land drainage and surface water run-off regime and associated flood risk by the alteration of ground elevations and overland flow pathways, for example, by earthworks or proposed structures.
- Foundations and piles providing localised barriers to groundwater flow. This may impact on groundwater available for local abstractions.

14.9.4 Other potential operational effects may be identified during the preparation of the ES when further details on the Proposed Scheme drainage are available.

14.10 Chapter Summary

14.10.1 This chapter has summarised the current understanding of the baseline conditions, mitigation and likely anticipated impacts upon road drainage and water environment. The Proposed Scheme would potentially impact water receptors due to:

- Contamination of groundwater and surface water during construction and operation
- Changes to runoff, drainage and flood risk during construction and operation
- Reduction in groundwater resource to abstractions and groundwater dependent surface water features
- Pollution of groundwater and surface water during operation due to routine road runoff or accidental spillages

14.10.2 Mitigation in the form of a suitably designed drainage system incorporating SuDS, where appropriate alongside best practice construction methods is recommended to reduce such impacts to levels not considered to be significant. Specific mitigation measures for protected species would be finalised within the road drainage and water environment chapter of the ES.

14.10.3 Further work will be undertaken to develop design interventions to limit or reduce impacts and promote opportunities for the environment within the study area wherever possible. Design development and potential mitigation will be reported in the ES as well as further detailing of baseline conditions and likely changes during both construction and operation for all identified receptors.

15 Climate

15.1 Introduction

15.1.1 This chapter presents the preliminary findings of the Climate assessment. This comprises a review of the existing environment and identification of the potential impacts of the Proposed Scheme in the context of climate. The chapter also outlines proposed design measures to help mitigate potential impacts and relevant consultation.

15.2 Guidance and best practice

15.2.1 The Climate Change Act (2008) sets legally binding targets for reducing the UK's carbon emissions by 80% by 2050, relative to a 1990 baseline. The Environmental Impact Assessment (EIA) Directive (2014/52/EU) and subsequent updates to UK EIA regulations also now include a requirement to assess the impacts of projects on climate and their vulnerability to climate change.

15.2.2 To align with the requirements of the Infrastructure Planning EIA Regulations 2017, the National Networks National Policy Statement (NNNPS) 2014, and the recently updated Highways England Major Projects' Instructions, the chapter covers two separate aspects:

- Effects on Climate – i.e. potential impacts on climate from carbon emissions arising from the Proposed Scheme, including how the project may affect the ability of Government to meet its carbon reduction targets (in accordance with NNNPS paragraph 5.17).
- Vulnerability of the Proposed Scheme to climate change – i.e. the resilience of the Proposed Scheme to climate change impacts, including how the Proposed Scheme would take account of the projected impacts of climate change (in accordance with NNNPS paragraph 4.40 and the Infrastructure Planning EIA Regulations 2017).

15.2.3 For the purposes of this report, the term 'carbon' would be used as shorthand to refer to all relevant Greenhouse Gas (GHG) emissions.

15.2.4 The following guidance documents have also been used to inform the assessment:

- Climate Adaptation Risk Assessment Progress Update (Highways England, 2016)
- IEMA Environmental Impact Assessment guide to Climate Change Resilience and Adaptation (IEMA, 2015)
- IEMA's Guidance on Assessing the GHG Emissions and Evaluating their Significance (IEMA, 2017)

- Transport Analysis Guidance (TAG) Unit A3 Environmental Impact Appraisal (DfT, 2015) Chapter 4 Greenhouse Gases
- Publicly Available Specification (PAS) 2080:2016 Carbon Management in Infrastructure (British Standards Institution, 2016)

15.3 Study area

Effects on climate

- 15.3.1 The assessment of effects on climate considers the carbon emission potential of the Proposed Scheme for both construction and operation (for this assessment the operation would be considered for the design life of the Proposed Scheme).
- 15.3.2 In the subsequent Environmental Statement (ES), capital (embodied) carbon emissions associated with Proposed Scheme construction would encompass material supply, transport and manufacturing where practicable, as well as fuel associated with construction plant.
- 15.3.3 Operational carbon emissions associated with end-users of the Proposed Scheme (i.e. vehicle tailpipe emissions) would be assessed and reported in line with Design Manual for Roads and Bridges (DMRB) Volume 11 Section 3 Part 1 (HA 207/07).
- 15.3.4 Emissions associated with the end of life stage (i.e. decommissioning) would not be reported due to the uncertainty associated with the length of operation (use stage).

Vulnerability of the Proposed Scheme to climate change

- 15.3.5 For the purposes of the vulnerability assessment, the study area has been defined as:
- the area of temporary and completed works within the project boundary
 - affected receptors identified within other environmental factors scoped into the assessment (reported within the relevant topic text within the Cumulative Assessment, where applicable)
- 15.3.6 The vulnerability of the Proposed Scheme to climate change during both construction and operation would be considered, the latter of which is informed by the design life of the Proposed Scheme and the availability of UK Climate Projections.
- 15.3.7 For the purposes of assessing the climate baseline and future climate projections, regional historic data from the Met Office (2016) and the UK Climate Projections (2009) have been used.

15.4 Assumptions and limitations

- 15.4.1 Data pertaining to the climate baseline and future projections are based on available information from third parties, including the historical meteorological variables recorded by the Met Office and the UK Climate Projections (UKCP09) developed by the Met Office.
- 15.4.2 Uncertainty is inherently associated with climate change projections, as they are complex in nature and based upon various assumptions including future global emissions trajectories. The level of uncertainty associated with projections also varies between climate variables. For example, projections related to wind and extreme weather events are considered more uncertain than those pertaining to temperature and precipitation. Similarly, the degree of uncertainty associated with all climate change projections increases with time.

15.5 Baseline

Effects on climate

- 15.5.1 The carbon baseline has been taken as the current situation in which no proposed infrastructure is built, and considers existing travel and traffic patterns.
- 15.5.2 The availability of carbon baseline data specific to the study area is currently limited, therefore existing carbon emissions have been considered from a variety of sources (e.g. published local authority data) in the proximity of the Proposed Scheme.
- 15.5.3 Most recent figures, released in 2015, indicated total transport emissions for the wider Norfolk County area to be approximately 1,953,000 tonnes of CO₂ (Department for Business, Energy & Industrial Strategy, 2017a).
- 15.5.4 In 2015, 24% of UK greenhouse gas emissions originated from the transport sector with emissions of 120 MtCO₂e. The transport sector remains a key contributor to projected UK carbon emissions increases with road transport emissions projected to rise by 28 MtCO₂e (6%) over 2023-2027 (the fourth carbon budget period), relative to 2015 projections (Department for Business, Energy & Industrial Strategy, 2017b).

Vulnerability of the Proposed Scheme to climate change

- 15.5.5 A current climate baseline for the wider region has been compiled using Met Office (2016) regional climate data for the Eastern England region. High-

level climate observations for the region over a 30-year averaging period (1981-2010) are presented in Table 15.1.

Table 15.1: Historic climate baseline for Eastern England

Climate variables	Climate observations
Temperature	Mean daily minimum temperatures can range from 0°C to 2°C in winter, whilst summer daily maximum temperatures are in the region of 22°C.
Rainfall	Eastern England includes some of the driest areas in the country, with the majority of the region receiving less than 700mm of rainfall annually, distributed fairly evenly throughout the year. On average, the region experiences approximately 30 rain days during the winter months (December to February) and under 25 days during the summer period (June to August). Despite generally low levels of precipitation, the area has encountered a number of severe storms which can contribute significantly to total annual rainfall and may also result in the occurrence of hail.
Wind	Eastern England is one of the more sheltered parts of the UK, however the winter months are when the strongest winds are experienced. Wind direction is fairly consistent across the region; speeds are generally greater in coastal locations than inland, and gusts exceeding 167km/h have been recorded in East Anglia. The frequency of tornadoes is greatest in eastern England relative to other parts of the UK, nevertheless, the intensity of these events remains minor.
Sunshine	Average annual sunshine in the wider region ranges from approximately 1,450hrs over Lincolnshire and East Yorkshire, to over 1,600hrs in east Norfolk, Suffolk and Essex.
Air Frost	The average number of days with air frost ranges from less than 30 (coastal) to 55 (inland) per year.

Source: Met Office (2016) Regional Climate Data

Future projections

- 15.5.6 The UK Climate Projections (UKCP09) provide regional climate projection information, for which the Site is included within the East of England Administrative Region. The East of England region is predicted to experience changes in temperature, rainfall, and frequency of extreme weather events as a consequence of climate change. These changes are predicted to occur under all 3 carbon emissions scenarios (i.e. low, medium and high), which are incorporated into the climate change models prepared by the Met Office Hadley Centre. The general trend for the region is warmer, drier summers and warmer, wetter winters.
- 15.5.7 Under the high emissions scenario (50% probability) projection for the 2080s, estimated changes in climatic conditions are as outlined in Table 15.2.

Table 15.2: Future climate projection data for East of England (2080s; high emissions scenario)

Climate variables	Climate observations
Temperature	The average summer temperature is projected to increase by 4.5°C under the central estimate, which represents 'as likely as not' probability of change (50th percentile), and average winter temperature is estimated to increase by 3.7°C (50th percentile).
Rainfall	The average summer rainfall rate is projected to decrease by 27%, whereas the average winter rainfall rate is estimated to increase by 26% (in the 50 th percentile or central estimate for both).
Wind	Climate projections for wind are more uncertain than those for temperature and precipitation, due to inherent difficulty in modelling future wind conditions. However, overall an increase in extreme weather including wind is projected (Committee on Climate Change, 2017).

Source: UKCP09 UK Climate Projections

- 15.5.8 Climate projection data corresponding to the 2080s (2070-2099) under a high emissions scenario as per NNNPS guidance. That is, transport infrastructure with safety-critical elements and the design life of the asset is 60 years or greater, and therefore applicable to the Proposed Scheme.

15.6 Consultation

- 15.6.1 No external consultation has been undertaken for the assessment at this stage. This would be undertaken, where necessary, as part of the ES. Consultation with the Proposed Scheme design team and environmental specialists is currently ongoing and outcomes will be reported within the ES.

15.7 Design interventions

- 15.7.1 Under the current proposals, a 20% climate change allowance has been utilised for the drainage design for the Proposed Scheme. For the proposed attenuation pond, a 40% climate change allowance has been utilised.

15.8 Potential mitigation measures

Effects on climate

- 15.8.1 The Proposed Scheme seeks to minimise emissions as far as practicable in all cases in order to contribute to the UK's net reduction in carbon emissions. Mitigation of effects on climate (i.e. carbon emissions associated with the Proposed Scheme) would primarily take place throughout the design process in accordance with the principles of publicly available specification (PAS) 2080 (Carbon Management in Infrastructure). Details of any mitigation measures relevant to climate will be reported in the subsequent ES.

15.8.2 The duration of the construction works for the Proposed Scheme is anticipated to be approximately 16 months. As outlined in Chapters 5 and 10 (Air Quality and Materials), measures to be included in the Construction Environmental Management Plan (CEMP) would serve to limit emissions. This mitigation could include the following:

- reduction of raw material usage and recycling
- use of local suppliers
- ensuring vehicle engines and plant motors are switched off when not in use

15.8.3 Further assessment of the carbon emissions associated with the Proposed Scheme and potential mitigation measures will be reported in the ES.

Vulnerability of the Proposed Scheme to climate change

15.8.4 The Site may be subject to weather extremes during construction, although it is not anticipated that verifiable climate change would occur in the timeline between the time of design and ES, and the end of the construction period. Construction works are therefore not considered to be vulnerable to climate change, therefore no associated mitigation, other than what would be reasonable site practice at the time of design finalisation, is considered to be necessary.

15.8.5 Operational climate mitigation measures would be outlined within the ES.

15.9 Potential impacts

Effects on climate

15.9.1 An increase in carbon emissions is anticipated from activities associated with both the construction (capital carbon; e.g. pavement, earthworks and all associated materials) and operational (operational carbon; e.g. road lighting) phases of the Proposed Scheme.

15.9.2 There would also be an increase in carbon emissions associated with the use of the proposed infrastructure elements (end-user carbon; e.g. 'tailpipe' emissions from road traffic).

15.9.3 An appraisal of carbon emissions arising from the Proposed Scheme would be carried out and reported in the ES.

Vulnerability of the Proposed Scheme to climate change

15.9.4 Climate change is not expected to affect the Proposed Scheme during the construction phase and has been scoped out of the resilience assessment.

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- 15.9.5 Changes in climate as outlined in Table 15.2 are anticipated potential impacts over the design life of the Proposed Scheme. This has the potential to pose a risk to Proposed Scheme assets.

15.10 Chapter summary

- 15.10.1 The Proposed Scheme is anticipated to generate an increase in carbon emissions during both construction and operation. Changes in climate have the potential to impact Proposed Scheme assets and environmental receptors during operation. Predicted changes in climate have the potential to pose a risk to the Proposed Scheme.
- 15.10.2 Further work will be undertaken to develop design interventions to limit or reduce adverse impacts and promote opportunities for the environment in the study area wherever possible. Any design development and potential mitigation will be reported in the ES as well as further detailing of baseline conditions and climate emissions resilience.

16 Combined and cumulative impacts

16.1 Introduction

16.1.1 Combined and cumulative impacts result from multiple actions on receptors over time and are generally additive or interactive (synergistic) in nature. They can also be considered as impacts resulting from incremental changes caused by other past, present or reasonably foreseeable actions together with the project, identified as:

- Combined impacts from a single project (the interrelationship between different environmental factors)
- Cumulative impacts from different projects (with the project being assessed)

16.2 Legislation and guidance

16.2.1 The following legislation, standards and best practice guidelines are considered relevant to the Proposed Scheme with regard to combined and cumulative impacts and will be reported in the ES as such;

- The Town and Country Planning (Environmental Impact Assessment) Regulations 2017
- DMRB Volume 11, Section 2, Part 5 Assessment and Management of Environmental Effects
- The Planning Inspectorate Advice Note Seventeen: Cumulative Effects Assessment

16.3 Consultation

16.3.1 Consultation with Norfolk County Council as the Local Planning Authority will be undertaken in advance of the production of the ES to agree a list of proposed developments to be included within the cumulative impacts assessment.

16.4 Study area

Combined impacts

- 16.4.1 The study area for the assessment of combined impacts, for both construction and operation, are defined by the study areas identified within the relevant environment topic chapters of this PEIR.

Cumulative impacts

- 16.4.2 The search area for the identification of 'other developments' for inclusion in the assessment of cumulative impacts will reflect a 2km Zone of Influence (ZOI) around the boundary of the Proposed Scheme, for both construction and operation. This 2km ZOI is large enough to cover the proposed developments likely to contribute to cumulative impacts, whilst being proportionate to the scope and scale of the Proposed Scheme. DMRB Volume 11, Section 2, Part 5, details the study area for the assessment of cumulative impacts should be defined on a case-by-case basis reflecting the Proposed Scheme in question and the area over which impacts can reasonably be considered to have the potential to occur from both the Proposed Scheme and in combination with other developments. As such, a 2km search area is deemed appropriate for the Proposed Scheme.

16.5 Combined and cumulative impacts

- 16.5.1 The likely residual impacts and proposed mitigation for combined cross-discipline impacts and potential cumulative impacts from other developments will be identified and incorporated into the assessment of the ES.

16.6 Chapter summary

- 16.6.1 This chapter of the ES will bring together the principal findings of each topic chapters in order to identify and assess the combined and cumulative impacts of the Proposed Scheme in association with other existing or future developments within the study area.

17 Glossary

Acronym	Description
AADT	Annual Average Daily Traffic
ALC	Agricultural Land Classification
AOD	Above ordnance datum
AQMA	Air Quality Management Area
AQO	Air Quality Objectives
BAP	Biodiversity Action Plan
BGS	British Geological Survey
BMV	Best and Most Versatile Land
BoCC	Birds of Conservation Concern
BS	British Standard
c.	circa
CCI	Community Conservation Index
CEMP	Construction Environmental Mitigation Plan
CIRIA	Construction Industry Research and Information Association
CL:AIRE	Contaminated Land: Applications in Real Environments
CO ₂	Carbon Dioxide
CRTN	Calculation of Road Traffic Noise
CWS	County Wildlife Site
DAFOR	Scale: Dominant, Abundant, Frequent, Occasional, Rare
DCLG	<i>(former)</i> Department for Communities and Local Government
DCO	Development Consent Order
Defra	Department for the Environment, Food and Rural Affairs
dB	Decibel
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DMV	Deserted Medieval Village
EAR	Environmental Assessment Report
EclA	Ecological Impact Assessment
eDNA	Environmental DNA
EIA	Environmental Impact Assessment
ES	Environmental Statement
EU	European Union
GCN	Great Crested Newt
GHG	Greenhouse Gas
GI	Ground Investigation
GP	General Practitioner
GPA	Good Practice Advice
GVA	Gross Value Added
HADDMS	Highways England's Drainage Data Management System
HDV	Heavy Duty Vehicle
HAGDMS	HAGDMS – Highways Agency Geotechnical Data Management System
HER	Historic Environment Records
HGV	Heavy Goods Vehicle

Acronym	Description
HRA	Habitats Regulations Assessment
HSI	Habitat Suitability Index
IAN	Interim Advice Note
IT	Interim Target
km	kilometre
kph	Kilometres per hour
LED	Light Emitting Diode
LCA	Landscape Character Areas
LIA	Local Impact Area
LLFA	Lead Local Flood Authority
LNR	Local Nature Reserve
LSOA	Lower Super Output Areas
LUC	Land Use Consultants
LVIA	Landscape and Visual Impact Assessment
LWS	Local Wildlife Site
m	metre
MHCLG	<i>(former)</i> Ministry of Housing, Communities and Local Government
MMP	Materials Management Plan
MT	Motorised Travellers
MtCO _{2e}	Metric tons of carbon dioxide equivalent
NBIS	Norfolk Biodiversity Information Service
NCA	National Character Area
NERC	Natural Environment and Rural Communities
NHLE	National Heritage List for England
NIA	Noise Important Area
NMU	Non-Motorised User
NNR	National Nature Reserves
NNNPS	National Networks National Policy Statement
NO ₂	Nitrogen dioxide
NO _x	Nitrogen Oxides
NSIP	Nationally Significant Infrastructure Project
NVZ	Nitrate Vulnerable Zone
ONS	Office for National Statistic
OS	Ordnance Survey
PA	Planning Act
PAS	Publically Available Specification
PCM	Pollution Climate Mapping
PEI	Preliminary Environmental Information
PEIR	Preliminary Environmental Information Report
PINS	The Planning Inspectorate
PPE	Personal Protective Equipment
PRF	Preliminary Roost Feature
PRoW	Public Right of Way
RBMP	River Basin Management Plan
RNR	Roadside Nature Reserve
RSPB	Royal Society for the Protection of Birds

Acronym	Description
SAC	Special Area of Conservation
SEB	Statutory Environmental Bodies
SPA	Special Protected Area
SSSI	Site of Special Scientific Interest
SuDS	sustainable urban drainage systems
TAG	Transport Analysis Guidance
TEAM	Transparent Economic Assessment Model
TMP	Traffic Management Plan
µg/m ₃	Microgram per metre cubed
UK	United Kingdom
UKCP	United Kingdom Climate Projections
WFD	Water Framework Directive
WHO	World Health Organization
WIA	Wider Impact Area
ZOI	Zone of Influence

Term	Definition
Air quality limit value	A level fixed on the basis of scientific knowledge, with the aim of avoiding, preventing or reducing harmful effects on human health and/or the environment as a whole, to be attained within a given period.
Air Quality Management Area	An area identified by a local authority where the local air quality objectives not being achieved, or are not likely to be achieved within the relevant period. As required by Part IV of the Environment Act 1995.
Air quality objectives	Ambient concentration not to be exceeded, either without exception or with a permitted number of exceedances, within a specified timescale.
Air Quality Strategy	The Government's air quality policy document for England, Scotland, Wales and Northern Ireland.
Ambient concentration	Concentration of a pollutant in the surrounding area of environment.
Artefact	An item of archaeological interest.
Averaging period	A period of time over which a concentration is averaged when reporting air quality statistics. Commonly used averaging periods are 1-hour, 24-hour, 30-days and 365-days (annual). The averaging periods available for use is determined by the measurement technique employed for a given pollutant.
A-weighting	A standard filter applied to acoustic pressure fluctuations to compensate for the relatively low sensitivity of human ears to low and high frequencies.
Bronze Age	The period of human activity between 2,500 BC and 700 BC.
Continuous monitoring	The measurement of a pollutant concentration using an electronic instrumentation continuously over time. The time interval for each measurement is very short which allows rapid changes to be recorded. These measurements can be aggregated in to longer period averages of 1-hour, 8-hour etc.

Term	Definition
Cutting	The removal of soil or rock material to reduce the profile or elevation of the topography of a site.
Data capture rate	The quantity of actual data collected over a specified period as a percentage of the theoretical maximum available.
dB	A logarithmic scale that is used for sound pressure levels. Typically, a quiet night-time level in a bedroom is 30dB and 90dB is the level at the kerbside of a busy road.
Diffusion tube	Simple monitoring device for air pollutants that absorbs substances from the air by diffusion (e.g. nitrogen dioxide) into a liquid film coated onto the inside of a plastic tube.
Earthworks	The moving of soil or rock to reconfigure the topography of a site.
Embodied Carbon	The amount of carbon released from material extraction, transport, manufacturing and related activities. This may be calculated from cradle to (factory) gate, cradle to (installation) site or from cradle to grave (final point of disposal).
Exceedance	Infringement environmental protection standards by exceeding allowable limits or concentration levels.
Fieldwalking survey	Method of systematic non-intrusive survey involving walking across a plough field along transects to collect archaeological artefacts.
Footprint, the	The extents of the physical aspects proposed in the design. For road schemes this is usually the extent of the earthworks and drainage features.
Geophysical survey	Method of non-intrusive investigation involving the use of magnetometers to identify fluctuations in the earth's magnetic field which might indicate the presence of archaeological remains. Burnt remains and metals are best identified through this method of survey.
Heritage asset	An item of heritage interest, for example an historic building or an archaeological find.
Iron Age	The period of human activity between 700 BC and 43 AD
LA10,18h	The A-weighted sound level in dB that is exceeded 10% of the measurement period and is the standard index used within the UK to describe daytime traffic noise.
LAeq,T	The A-weighted steady sound level over time interval T that has the same mean square pressure as the time varying noise over the same time interval.
LiDAR	Light Detection and Ranging. A remote sensing operation using data taken from the air to identify changes in the landform.
Lnight	The equivalent continuous sound level which has the same A-weighted mean square pressure as the time varying noise between 23:00 and 07:00.
Made Ground	Ground created by infilling an area with material taken from elsewhere; typically, reworked soils, rubble, gravel, sand or former waste material e.g. ash.
Materials Management Plan (MMP)	The MMP documents how all of the materials to be excavated are to be dealt with.
Medieval	The period of human activity between 1066 AD and 1550 AD.
Mesolithic	Middle Stone Age. The period of human activity between 10,000 BC and 4,500 BC.

Term	Definition
Metal detector survey	Method of intrusive investigation involving the use of metal detectors to locate buried metal objects.
Modern	The period of human activity from 1900 to the present day.
National Mapping Programme (NMP)	A project funded by Historic England and local councils involving assessment and interpretation of aerial photographs and other remote sensing data, such as LiDAR.
Neolithic	New Stone Age. The period of human activity between 4,500 BC and 2,500 BC.
NERC S41	Section 41 of the Natural Environment and Rural Communities Act 2006.
Nitrogen oxides (NOx)	Nitrogen oxides is a term used to describe a mixture of nitric oxide (NO) and nitrogen dioxide (NO ₂), referred to collectively as NO _x . These are primarily formed from atmospheric and fuel nitrogen as a result of high temperature combustion. The most important sources in the UK are road traffic and power generation.
Palaeolithic	Old Stone Age. The period of human activity before around 10,000 BC.
PM10	Particulate Matter less than 10 microns, tiny solid or liquid particles of soot, dust, smoke, fumes, and aerosols. The size of the particles (10 microns or smaller, about 0.0004 inches or less) allows them to easily enter the air sacs in the lungs where they may be deposited, resulting in adverse health effects.
Post-medieval	The period of human activity between 1550 AD and 1900 AD.
Prehistoric	The period before the year 43 AD.
Proposed Scheme, the	The concept or design proposed i.e. the road layout and associated earthworks, drainage, structures, lighting, etc
Roman	The period of human activity between 43 AD and 410 AD.
Saxon	The period of human activity between 410 AD and 1066 AD.
Site, the	The Proposed Scheme boundary i.e. the existing geographic space the design is proposed to be located within.
Site Waste Management Plan (SWMP)	A plan which specifies how waste generated throughout the construction works would be managed and volumes estimated. This includes minimisation, storage, segregation, re-use and final disposal of wastes generated.
SRP	Soil Resource Plan; part of the Code of Practice for the Sustainable Use of Soils on Construction Sites used to protect soils and ensure adequate soil function (e.g. plant growth, water attenuation, biodiversity) during and after construction.
Super-elevated	Raised above ground.

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