Norwich Western Link

Environmental Statement Chapter 5: Approach to EIA Appendix 5.1: Environmental Impact Assessment Scoping Report 2020 Part 1 of 3

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Contents

1 Introduction

1.1.1 The purpose of this report is to ensure that the subsequent ES is focused on the key impacts likely to give rise to significant adverse effects upon the environment, and to obtain agreement on the approach and scope of the assessments for each factor. This report also identifies those elements that are not considered necessary to assess further. This approach is in line with the general aim to undertake proportionate EIA, as advocated by industry best practice. Whilst this report seeks to establish the overall framework for the EIA in relation to the environmental factors and associated effects, the exact scope of the EIA will be influenced by the scoping opinion received, the on-going design evolution of the Scheme, and through on-going baseline data collection (field surveys). It is proposed that the following environmental factors, as listed under Article 3(1) of EU Directive 2014/52/EU, are included in the scope of the EIA:

- Population and Human Health;
- Biodiversity;
- Land, soil, water, air and climate; and
- Material assets, cultural heritage and the landscape

1.1.2 The factor-specific elements scoped in and out of further assessment are outlined in chapters 5 to 18 and are summarised in chapter 4.

1.1.3 We have included a summary of key information shown in this document in an accessible format. However, some users may not be able to access all technical details. If you require this document in a more accessible format please contact norwichwesternlink@norfolk.gov.uk.

Norfolk County Council

NORWICH WESTERN LINK

Environmental Impact Assessment Scoping Report

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Environmental Impact Assessment Scoping Report

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CONTENTS

APPENDICES

APPENDIX A

PROJECT LOCATION PLAN

APPENDIX B-1

SCHEME CONSTRAINTS PLAN

APPENDIX B-2

WATER ENVIRONMENTAL CONSTRAINTS PLAN

APPENDIX C

PROJECT LAYOUT PLAN

APPENDIX D-1

AIR QUALITY - ADDITIONAL INFORMATION

APPENDIX D-2

AIR QUALITY - SCOPING STUDY AREAS

APPENDIX D-3

AIR QUALITY - BASELINE CONDITIONS

APPENDIX D-4

AIR QUALITY - DESIGNATED SITES

APPENDIX E

MA&D LEGISLATION AND GUIDANCE

APPENDIX F

TRANSPORT ASSESSMENT SCOPING STATEMENT

APPENDIX G

PROPOSED STRUCTURE OF THE ENVIRONMENTAL STATEMENT

Table 1 – Abbreviations Used

Abbreviation	Description
AOD	Above Ordnance Datum
ADMS	Advanced Dispersion Modelling System
APIS	Air Pollution Information System
AQMA	Air Quality Management Area
ARG UK	Amphibian and Reptile Groups of the United Kingdom
ATI	Ancient Tree Inventory
AADT	Annual Average Daily Traffic
ARN	Appraised Road Network
AONB	Area of Outstanding Natural Beauty
ALARP	As low as reasonably practicable
BNL	Basic Noise Level
BAP	Biodiversity Action Plan
BNG	Biodiversity net gain
BGS	British Geological Survey
BS	British Standard
BSI	British Standards Institute
BTO	British Trust for Ornithology
BES	BRS Environmental & Sustainability Standard
BRE	Building Research Establishment
CRTN	Calculation of Road Traffic Noise
CIEEM	Chartered Institute of Ecology and Environmental Management
CAD	Computer Aided Design
CDW	Construction and demolition waste
CDM	Construction Design and Management
CEMP	Construction Environmental Management Plan
CIRIA	Construction Industry Research and Information Association
CDE	Construction, Demolition and Excavation
CDE	Construction, Demolition and Excavation
CL:AIRE	Contaminated Land: Applications in Real Environments
COMAH	Control of Major Accident Hazards

CWS	County Wildlife Site
DOS	Degree Of Saturation
DTC	Demonstration Test Catchment
DNA	Deoxyribonucleic acid
DEFRA	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges
DCO	Development Consent Order
DPD	Development Plan Document
DM	Do minimum
DS	Do something
DAFOR	Dominant, Abundant, Frequent, Occasional, Rare
ELG	Ecology Liaison Group
EFT	Emissions Factors Toolkit
EA	Environment Agency
EAR	Environmental Assessment Report
EHO	Environmental Health Officer
EIA	Environmental Impact Assessment
EPA	Environmental Protection Act 1990
ES	Environmental Statement
EC	European Commission
EU	European Union
FRAP	Flood Risk Activity Permit
FRA	Flood Risk Assessment
GCSE	General Certificate of Secondary Education
GIS	Geographical Information Systems
GNDP	Greater Norwich Development Partnership
GNLP	Greater Norwich Local Plan
GHG	Greenhouse Gas
GPP	Guidance for Pollution Prevention
HSI	Habitat Suitability Index
HPI	Habitats of Principal Importance
HRA	Habitats Regulation Assessment

HAZID	Hazard Identification
HASWA	Health and Safety at Work etc. Act 1974
HSE	Health and Safety Executive
HDV	Heavy Duty Vehicle
HGV	Heavy Goods Vehicle
HE	Highways England
HEWRAT	Highways England Water Risk Assessment Tool
HEDBA	Historic Environment Desk Based Assessment
HER	Historic Environment Record
ID	Identifier
IROPI	Imperative reasons of overriding public interest
ICCI	In-combination Climate Change Impact
IEMA	Institute of Environmental Management and Assessment
IDB	Internal Drainage Board
ISO	International Organization for Standardization
JNCC	Joint Nature Conservation Committee
KSI	Killed and Seriously Injured
LVIA	Landscape and Visual Impact Assessment
LLFA	Lead Local Flood Authority
LGV	Light Goods Vehicle
LINSIG	LinSi Traffic Modelling Software
LAQM	Local Air Quality Management
LA	Local Authority
LCA	Local Character Area
LLG	Local Liaison Group
LNR	Local Nature Reserve
LPA	Local Planning Authority
LOAEL	Lowest Observed Adverse Effect Level
MAH	Major Accident Hazard
MAD	Major accidents and disasters
MRN	Major Road Network
MA	Master of Arts

NGR	National Grid Reference
NHLE	National Heritage List for England
NNR	National Nature Reserve
NN	National Networks
NOMIS	National Online Manpower Information System
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NPSNN	National Policy Statement for National Networks
NRHE	National Record of the Historic Environment
NRFA	National River Flow Archive
NTEM	National Trip End Model
NVC	National Vegetation Classification
NVQ	National Vocational Qualification
NRW	Natural Resources Wales
NVZ	Nitrate Vulnerable Zone
NIA	Noise Important Area
NPSE	Noise Policy Statement for England (published March 2010)
NMU	Non-Motorised User
INNS	Non-native invasive species
NAIP	Norfolk Access Improvement Plan
NNUH	Norfolk and Norwich University Hospital
NBIS	Norfolk Biodiversity Information Service
NDR	Northern Distributor Road
NATS	Norwich Area Transportation Strategy
NRP	Norwich Retail Park
NWL	Norwich Western Link
ONS	Office for National Statistics
OSR	Options Selection Report
OS	Ordnance Survey
OBC	Outline Business Case
NOX	Oxides of Nitrogen
PPV	Parts per volume

PPE	Personal Protective Equipment
PPG	Planning Practice Guidance
PCM	Pollution Climate Mapping
PBRA	Preliminary Bat Roost Assessment
PHE	Public Health England
PROW	Public Right of Way
PAS	Publicly Available Specification
RFC	Ratio of Flow to Capacity
RLB	Red line boundary
RCP	Representative Concentration Pathway
RAMS	Risk Assessments and Method Statements
RBD	River Basin District
RBMP	River Basin Management Plan
RHS	River Habitat Survey
RWRS	River Wensum Restoration Strategy
RNR	Roadside Nature Reserve
RAF	Royal Air Force
RSPB	Royal Society for the Protection of Birds
SSD	Safe, Sustainable Development
SOAEL	Significant Observed Adverse Effect Level
SSSI	Site of Special Scientific Interest
SPZ	Source Protection Zone
SAC	Special Area of Conservation
SPA	Special Protection Area
SPI	Species of Principal Importance
SOBC	Strategic Outline Business Case
SRN	Strategic Road Network
SPD	Supplementary Planning Document
SUDS	Sustainable drainage systems
STS	Sustainable Transport Strategy
TG	Technical guidance
UEA	The University of East Anglia

TRRL	Transport and Road Research Laboratory
TA	Transport Assessment
TPO	Tree protection order
UXO	Unexploded Ordnance
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organization
VTA	Visual Tree Assessment
WCH	Walking, Cycling and Horse Riding
WCHAR	Walking, Cycling and Horse Riding Assessment and Review
WFD	Water Framework Directive (Directive 2000/60/EC)
WSP	Williams Sale Partnership
ZTV	Zone of Theoretical Visibility
ZVI	Zone of Visual Influence

1. INTRODUCTION

1.1. BACKGROUND

1.1.1. WSP has been instructed by Norfolk County Council (hereafter referred to as the 'Applicant') to produce an Environmental Impact Assessment Scoping Report (hereafter referred to as the 'Scoping Report') to be submitted to the Local Planning Authority (Norfolk County Council) to determine the scope of the Environmental Statement (ES) for the proposed Norwich Western Link road, which is a highway scheme linking the A1270 Broadland Northway from its junction with the A1067 Fakenham Road to the A47 trunk road near Honingham (hereafter referred to as the 'Scheme'). The Scheme location is shown in **Appendix A** of this Scoping Report.

1.1.2. The Scheme will include:

- Dualling the A1067 Fakenham Road westwards from its existing junction with the A1270 to a new roundabout located approximately 400m to the north west;
- Construction of the new roundabout; and
- Constructing a dual carriageway link from the new roundabout to a new junction with the A47 near Honingham (A47 to be re-aligned and dualled as part of a Highways England scheme).

1.1.3. The area of land with the potential to be directly affected by the Scheme (approx. 125 ha) is referred to as the 'Site' and is defined by the site extents boundary shown in Appendix C. The Site includes the footprint of the new highway and associated structures, as well as the areas required for enabling works during the construction phase. Enabling works are likely to include the construction of temporary access roads and the formation of construction compounds (exact locations are to be confirmed).

1.1.4. The Scheme includes the crossing of the River Wensum and its flood plain by means of a viaduct and will also cross a number of minor roads by means of overpass or underpass bridges. The Scheme will include ancillary works such as provision for non-motorised users, necessary realignment of the local road network and the provision of environmental mitigation measures.

1.1.5. The purpose of this Scoping Report is to establish the scope of the Environmental Statement (ES) that will be prepared in accordance with the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (hereafter referred to as the 'EIA Regulations 2017') and will accompany the Applicant's planning application. For the purpose of this report, the scope for assessment within the environmental factors will focus primarily on the preliminary design as of April 2020.

1.1.6. Construction of the Scheme is anticipated to commence in 2023 and be completed in 2025.

1.2. DEFINITION OF AN EIA

1.2.1. The term 'Environmental Impact Assessment' ('EIA') describes a procedure that must be followed for certain types of project before it can be given 'consent'. The procedure is a means of drawing together, in a systematic way, an assessment of a project's likely significant environmental effects. This helps to ensure that the importance of the predicted effects and the scope for avoiding, preventing, reducing or, if possible, offsetting them are properly understood by the public and the authority granting consent (the 'determining authority') before it makes its decision.

1.3. REQUIREMENT FOR EIA

1.3.1. The EIA Regulations 2017 require that, before consent is granted for certain types of development, an EIA must be undertaken. The EIA Regulations 2017 set out the types of development which must be subject to an EIA (referred to as Schedule 1 development) and other developments, which may require assessments depending on their location and / or if they have the potential to give rise to significant environmental effects (referred to as Schedule 2 development).

1.3.2. The Scheme does not fall under any of the types of development set out in Schedule 1 of the EIA Regulations. The Scheme falls under *Schedule 2 of the EIA Regulations, 10(f) 'Construction of roads*', and exceeds the threshold of being greater than 1 ha in area. The Applicant is of the view that the Scheme qualifies as EIA development and as a result, the Applicant will submit an ES to accompany the planning application. WSP have been commissioned by the Applicant, to draft and prepare this Scoping Report which includes liaison with WSP's in house design and highways team and to ensure all environmental factors ranging from, but not limited to, ecology, noise, air and waste are informed of the design to help support the Scoping Report.

1.4. PURPOSE OF THE REPORT

1.4.1. The purpose of this report is to ensure that the subsequent ES is focused on the key impacts likely to give rise to significant adverse effects upon the environment, and to obtain agreement on the approach and scope of the assessments for each factor. This report also identifies those elements that are not considered necessary to assess further. This approach is in line with the general aim to undertake proportionate EIA, as advocated by industry best practice[1].

Whilst this report seeks to establish the overall framework for the EIA in relation to the environmental factors and associated effects, the exact scope of the EIA will be influenced by the scoping opinion received, the on-going design evolution of the Scheme, and through on-going baseline data collection (field surveys).**Table 1-1** below sets out what information the EIA Regulations 2017 state that a request for a scoping opinion must include and where this information can be found in this report.

[1] IEMA (2017). Delivering proportionate EIA. Available at: https://www.iema.net/policy/ia/proportionate-eia-guidance-2017.pdf

Table 1-1 - Information Required to Accompany a Request for a Scoping Opinion

Information Required	Location within this Scoping Report
A plan sufficient to identify the land	Appendix A: Site Location
A description of the nature and purpose of the development, including its location and technical capacity	Chapters 2 – 4
An explanation of the likely significant effects of the development on the environment	Chapters 5 – 18
Such other information or representations as the person making the request may wish to provide or make	Chapters 5 – 18

1.5. EIA SCOPING REPORT STRUCTURE

1.5.1. This EIA Scoping Report comprises of the following:

- **Chapter 2** provides an outline description of the Scheme and its key design components and the construction activities which would be involved in its implementation;
- **Chapter 3** provides an overview of the overall EIA approach for the Scheme, the consultation undertaken on the scope of the EIA prior to the submission of the EIA Scoping Report, and the proposed approach for the alternatives considered as part of the design development of the Scheme;
- **Chapter 4** summarises the proposed environmental factors, or elements thereof, to be scoped out of the EIA; and
- **Chapters 5 – 19** provides a description of the baseline conditions (existing and future) within the applicable study area for each environmental assessment factor; summarises the work undertaken to date in terms of consultation, desk based studies and/or site surveys; outlines the potential impacts and the recommended design; mitigation and enhancement measures and presents the proposed methodologies for the assessment of potential residual effects, including cumulative, to be applied during the EIA.

1.5.2. The environmental factor chapters included in this EIA Scoping Report are as follows:

- Chapter 5: Air Quality;
- Chapter 6: Noise and Vibration;
- Chapter 7: Cultural Heritage;
- Chapter 8: Landscape and Visual effects;
- Chapter 9: Biodiversity;
- Chapter 10: Road Drainage and the Water Environment/Groundwater;
- Chapter 11: Geology and Soils;
- Chapter 12: Material Assets and Waste;
- Chapter 13: Climate;
- Chapter 14: Population and Health;
- Chapter 15: Arboriculture;
- Chapter 16: Major Accidents and Disasters;
- Chapter 17: Traffic and Transport; and
- Chapter 18: Cumulative effects.

2. THE SCHEME

2.1. NEED FOR THE SCHEME

2.1.1. Since before Broadland Northway fully opened in spring 2018, there has been sustained local pressure for provision of the Norwich Western Link (NWL) to connect the A47 to the A1067, to ease traffic problems in the local area and enhance strategic connectivity.

2.1.2. Together with the A47 dualling between North Tuddenham and Easton, due to commence in early 2022, the Norwich Western Link would complete a dual carriageway orbital route around Norwich. This would reduce the need for traffic to enter the city and alleviate local transport issues to the west of Norwich.

2.1.3. Prior to the production of this report, other assessments have been completed to inform the selection of the preferred highway alignment for the Scheme. This has been detailed within an Option Selection Report (OSR)[2] and Strategic Outline Business Case (SOBC)[3], both produced in 2019. To inform those reports, various environmental studies were completed in order to identify the likely environmental effects on a number of alternatives route options for the Scheme. An Outline Business Case (OBC) is to be developed alongside the ES for the Scheme.

2.2. PROJECT OBJECTIVES

2.2.1. A number of high level and specific objectives have been identified for the Scheme. Detailed below are the specific objectives of the Scheme, as identified by Norfolk County Council[4]:

- Improve connectivity and journey times on key routes in Greater Norwich;
- Reduce the impacts of traffic on people and places within the western area of Greater Norwich;
- Encourage and support walking, cycling and public transport use;
- Improve safety on and near the road network, especially for pedestrians and cyclists;
- Protect the natural and built environment, including the integrity of the River Wensum Special Area of Conservation; and
- Improve accessibility to key sites in Greater Norwich

[2] WSP on behalf of Norwich County Council (2019). Norwich Western Link, Options Selection Report. Available at: https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/norwich/norwich-western-link/timeline

[3] WSP on behalf of Norwich County Council (2019). Norwich Western Link, Strategic Outline Business Case. Available at: https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/norwich/norwich-western-link/timeline

[4] Norfolk County Council (2020). About the Norwich Western Link. Available at: https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/norwich/norwich-western-link/about-the-norwich-western-link

2.3. PROJECT LOCATION

2.3.1. The Scheme is located to the north-west of Norwich, running from the A47 at its junction with Wood Lane and Berrys Lane (southern end), to the A1067 Fakenham Road and its junction with the A1270 Broadland Northway (northern end). Refer to Appendix A – Project Location Plan and Appendix C – Project Layout Plan.

2.3.2. The highway alignment for the Scheme crosses the River Wensum (a Special Area of Conservation and Site of Special Scientific Interest), and its flood plain by means of a viaduct, located towards the northern end of the Scheme. The highway alignment passes through a combination of agricultural/arable fields and existing woodlands before connecting into the A47 (to be dualled and re-aligned as a result of a Highways England scheme).

2.3.3. The nearest settlements to the scheme are Weston Longville (approximately 0.19km west), Ringland (approximately 0.68km east), Weston Green (0.28km west), Honingham (0.34km west) and Easton (3.4km east). The Scheme also crosses and interacts with several small side roads, including Ringland Lane, Weston Road, Breck Road and The Broadway.

2.3.4. The Scheme is located largely within Flood Zone 1, however parts of the Scheme are located within Flood Zone 3, within the floodplain of the River Wensum. The Scheme also crosses another section of Flood Zone 3 at a watercourse to the South of Foxburrow Plantation (refer to Appendix B).

2.4. PROJECT DESCRIPTION

2.4.1. The Scheme consists of the construction of a 3.8 mile long road connecting the A1067/A1270 junction and the A47. The junctions with the two existing roads are to be roundabout junctions, reducing congestion at these junctions. There are interactions with other side roads, which are detailed below.

2.4.2. As part of the scheme the following structures are proposed:

- Viaduct crossing the River Wensum and floodplain (approx. 667m long)– this will be a divided structure carrying each carriageway independently. The design shows that piled piers will be required within the floodplain;
- Wildlife crossings, including a bat underpass and badger underpass;
- Bridges at the interaction with the existing highways Ringland Lane, Weston Road and Breck Road;
- Two green bridge crossings over the highway alignment for wildlife and pedestrian access are currently proposed, however further survey work is required to identify if further mitigation will be required;
- Culvert crossing the River Tud tributary;
- The scheme will be elevated on embankments at various locations along the highway alignment. The topography of the surrounding area results in sections of the scheme being located on embankments and others in cuttings (refer to Appendix C).

2.4.3. The extent of the Site (see Appendix C) allows for sufficient space to construct the Scheme. Some allowance for likely environmental mitigation and compensation areas has also been included within the Site boundary at this time. However additional land outside of the current Site boundary is likely to be required for off-site compensatory habitat creation as part of the Biodiversity Net Gain requirements and to mitigate effects on protected species. It is likely that these further 'offsite' areas will be included in the final Site boundary submitted as part of the planning application in order to

facilitate land acquisition where required and to provide confidence to the LPA that mitigation will be implemented. It is highly unlikely that the provision of Biodiversity Net Gain and compensatory habitats will affect the scope of the ES, as these issues are already fully addressed within the scope of the proposed ES. Upon confirmation of the final Site boundary for the Scheme we will look to formally agree with NCC the scope and content of the planning application.

2.4.4. Alterations to existing Non-motorised User (NMU) routes (PRoW and footpaths) will be required as part of the Scheme, which are to be developed and detailed within an NMU strategy. This will be produced and will support the ES.

2.4.5. The Scheme is generally to remain unlit, with the exception of a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions. The lighting design has been developed by Norfolk County Council.

2.4.6. During the construction phase, temporary haul routes will be required in order to facilitate the construction of the Scheme. On completion, a haul route being utilised for the construction of the viaduct is to be retained to allow for maintenance access to the viaduct piers as required. Maintenance tracks are also to be constructed, running parallel to the NWL alignment, for the maintenance of the highway, drainage basins and proposed structures. These are to be designed, where possible, to be dual purposed to allow for shared use as NMU routes. These tracks do not run along the full length of the Scheme alignment.

2.4.7. A landscaping design is to be developed and will be included within the planning application for the Scheme.

2.5. EMBEDDED ENVIRONMENTAL DESIGN MEASURES

2.5.1. Table 2-1 below, details the environmental design measures that will be embedded within the design of the Scheme. These measures are the Scheme design principles that are to be adopted to avoid and/or prevent adverse environmental effects.

Table 2-1 - Embedded Environmental Design Measures

Environmental Factor to which the Embedded Environmental Design Measure Relates	Embedded Environmental Design Measure and Associated Benefit
Biodiversity and Landscape	Wildlife crossings (including for Barbastelle bats and badgers) have been included within the design. These include underpasses, culverts and green bridges. Further wildlife crossings may be required following completion of relevant surveys. Further detail is included in section 9 below.
Biodiversity and Water	The design of the viaduct over the Wensum Valley will allow for the two carriageways to be separated, reducing the effects of shading on the River Wensum.
Biodiversity and Water	The design for the alignment of the viaduct will allow for the structure to cross the River Wensum at such an angle so as to limit the effects of shading on the River Wensum.

Environmental Factor to which the Embedded Environmental Design Measure Relates	Embedded Environmental Design Measure and Associated Benefit
Biodiversity and Water	Viaduct piers will be designed to be a minimum distance from the edge of watercourses (particularly the River Wensum) to avoid direct impacts on river flow and aquatic flora and fauna.
Biodiversity and Water	The design of culverted drains and minor watercourses will consider the requirements of aquatic and semi-aquatic species to travel safely through these structures.
Landscape and Noise	The highway alignment and associated earthworks will be designed so that the road is in cutting where possible to reduce visual impact as well as the effect of traffic noise on sensitive receptors.
Water	The viaduct design will be developed to accommodate a limited number of piers within the floodplain to reduce the loss of flood storage.
Water	Areas of floodplain compensation will be included within the design in order to compensate for flood storage lost through temporary and permanent works within the River Wensum floodplain.
Water	The drainage design will be developed so as not to exacerbate surface water run-off, increase the risk of surface water flooding events or increase the risk of pollution events associated with run-off.
Noise, Landscape and Biodiversity	Roadside barriers will be included in the design as required, notably along the viaduct to control salt spray, light and noise pollution from traffic.
Air Quality, Arboriculture, Water and Biodiversity	The highway alignment has been selected to avoid key features and ecological constraints where possible – such as ancient woodland, county wildlife sites and residential receptors.
Carbon and Landscape	The landscaping scheme will provide a means of carbon sequestration over the life of the Scheme, as well as integrate the Scheme with its setting.
Carbon	The design will include facilities and features for non-motorised users (e.g. walkers and cyclists) including shared use routes for maintenance of the Scheme and public use.

3. APPROACH TO EIA

3.1. INTRODUCTION

3.1.1. This chapter sets out the overall approach that will be taken to the EIA for the project.

3.1.2. The ES will contain the information specified in Schedule 4 of the EIA Regulations. The approach to the assessment has been informed by current best practice guidance, including the principles detailed within the Design Manual for Roads and Bridges (DMRB), which are followed throughout this report.

3.1.3. A detailed overview of the guidance and methodology adopted for each environmental factor is provided within the respective environmental factor chapters of this report.

3.1.4. The environmental factors listed within Article 3(1) of EU Directive 2014/52/EU are listed below.

- Population and Human Health
- Biodiversity
- Land
- Soil
- Water
- Air
- Climate
- Material Assets
- Cultural Heritage
- Landscape

3.2. CONSULTATION

3.2.1. Technical consultation is a proactive engagement with the relevant organisations and stakeholders to establish the following:

- A sufficient baseline to inform assessment for the EIA;
- Agree suitable methodology for baseline data collection (where appropriate);
- Identify local objectives related to environmental factors;
- Identify likely significant effects relating to the construction and operations phases of the Scheme;
- Determining the most appropriate assessment methodology; and
- Inform Scheme design.

3.2.2. As part of the EIA process, consultation will be undertaken with a range of statutory and non-statutory consultees. It is anticipated at this stage that consultees will include, but not limited to (further detail is included in the chapters below):

- Norfolk County Council;
- Broadland and South Norfolk District Council;
- Breckland District Council;
- Environment Agency;
- Norfolk Rivers Drainage Board;
- Natural England; and
- Historic England.

Consultation will be conducted with various officers, including but not limited to, Environmental Health Officers and historic environment, landscape and ecology specialists.

3.2.3. The Public Participation Directive 2003/35/EC, as part of the EIA Regulations, provides opportunities for the public to be involved in the consenting process for certain activities, through access to information, justice and consultation on key documents.

3.2.4. Specific detail of any consultation conducted to date is included within section 5-19 below. A public consultation is proposed to be held in Spring 2021 with public and statutory consultees in advance of submission of the planning application.

3.3. GENERAL ASSUMPTIONS AND LIMITATIONS

3.3.1. The following general assumptions and limitations apply to this Scoping Report:

- This report has been produced in line with the known design details at the time of writing, in accordance with the Scheme layout plan (Appendix C);
- The Scheme design may be subject to change due to survey information from ongoing environmental surveys, any changes will be provided within the ES.
- Where applicable, this report has been produced following the Design Manual for Roads and Bridges (DMRB) guidance.
- This report has been produced in line with commentary and opinions of stakeholders that have been consulted with at the time of writing.
- No primary modelling has been completed for the production of the Climate chapter (Chapter 13). All data used within this report is based on data available from UKCP18.

3.4. DEFINING THE STUDY AREA

3.4.1. Environmental factor specific study areas have been adopted within each of the chapters below (Sections 5 to 19), in accordance with relevant legislation, guidance (such as DMRB) and in consultation with relevant stakeholders. These areas are often specific to elements of each environmental factors.

3.5. ESTABLISHING BASELINE CONDITIONS

3.5.1. Environmental effects as a result of the project will be described in the ES in relation to the extent of changes to the existing baseline environment as a result of the construction and/or operation of the project. The baseline environment will comprise of the existing environmental characteristics and conditions, based upon desk-top studies and field surveys undertaken and information available at the time of the assessment.

3.6. ESTABLISHING FUTURE BASELINE CONDITIONS

3.6.1. The future baseline conditions against which the Scheme is to be assessed has been considered within each environmental factor chapter below, using a variety of different sources of information. This baseline will be used to assess the Scheme against and identify likely significant environmental effects.

3.7. APPROACH TO MITIGATION

3.7.1. Good practice dictates that the EIA process should influence the location and basic design of the development in question in order to limit adverse effects on receptors; such changes should be highlighted within the ES.

3.7.2. Environmental effects which cannot be avoided or mitigated through careful design will be assessed to determine their significance and where required suitable mitigation will be recommended for both the construction and operation of the Scheme. Any mitigation measures included within the ES will be selected using a hierarchical system, i.e. avoidance and prevention, reduction and remediation. An outline Construction Environmental Management Plan (CEMP) is to be produced and submitted with the planning application, this will identify the mitigation measures required during the construction phase.

3.8. ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

3.8.1. The assessment of likely significant effects will be based on a fixed scheme with the likely significant effects being set out in the ES. The assessment of likely significant effects will be undertaken within each environmental factor, in line with guidance within the relevant sections of DMRB.

3.8.2. The description of the Scheme within the ES will confirm the details of:

- the land use type and quantum;
- parameters of the Scheme including road length and width, layouts and positioning; and
- transport arrangements.

3.8.3. The assessment will consider the effects at the relevant stages of the Scheme development comprising the site preparation, construction and the operational stage. The definitions of these are presented below:

- Demolition and Construction: All works associated with the site preparation, demolition and construction phase of the development will be based on the details to be set out in the Scheme Chapter of the ES. The assessment of the likely significant effects will then be reported in each relevant Technical Chapter; and
- Operation stage: Once the development is completed and in use or occupied.

3.8.4. Both development stages may not be wholly applicable to the assessment process for all technical disciplines. Furthermore, effects emerging during the construction phase are likely to be temporary, yet there is the possibility that others may result in lasting changes.

3.8.5. Each technical discipline will consider and assess the effects in light of its geographical extent and its expected duration. The assessment of the effects will adopt the following criteria to determine whether or not the potential effects of the development are ‘significant’’. These significance criteria comprise the following, as detailed within Volume 11 of DMRB guidance:

- International, national and local standards;
- Relationship with legislation and planning policy;
- Magnitude of change compared to baseline conditions;
- Sensitivity of the receptor or receiving environment;
- Geographical extent;
- Likelihood of occurrence;
- Whether the effect is temporary or permanent;

- Whether the effect is short, medium, or long-term in duration; and
- Whether the effect is reversible or irreversible;

3.8.6. The following terms will be used in the ES, unless otherwise stated, to determine the significance of effects:

- Major beneficial or adverse effect - where the Scheme would cause a large improvement (or deterioration) to the existing environment;
- Moderate beneficial or adverse effect - where the Scheme would cause a noticeable improvement (or deterioration) to the existing environment;
- Minor beneficial or adverse effect - where the Scheme would cause a small improvement (or deterioration) to the existing environment; and
- Negligible - no discernible improvement or deterioration to the existing environment as a result of the Scheme.

3.8.7. The level of detail required for the ES will be dependent on the sensitivity of the receptor defined as a 'spatial area or feature subject to a change as a result of the development'. Receptors will be identified in the context of each of the technical disciplines and will be appropriately considered for both the potential significant effects on external and internal receptors (introduced as a result of the Scheme) where significant effects are anticipated.

3.8.8. The evaluation of receptor sensitivity will consider the nature of the receptor; the value of the receptor in a local, regional, national and international context; the proximity of the Scheme to the receptor; and their level of sensitivity classified as being of high, medium and low sensitivity based on a range of factors considering designations, value to the Site and surrounds and vulnerability to change.

3.8.9. At the ES stage, the assessment will consider In-combination Climate Change Impacts[5] as advised by IEMA[6]. For further information, refer to Section 19.3.

3.9. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

3.9.1. Consideration for potential to provide enhancement to the environment have been included within each environmental factor chapter below to optimise the benefits and positive aspects of the Scheme. These enhancement measures specified are defined as being over and above mitigation and compensation provided as part of the Scheme, and therefore will not be taken into account when determining the significance of effects on receptors for each environmental factor.

[5] In-combination Climate Change Impacts arise where climate change exacerbates effects on aspect receptors which have been identified in other discipline chapters.
[6] Institute of Environmental Management and Assessment (2015) Climate Change Resilience and Adaptation [online] Available at: https://www.iema.net/assets/templates/documents/iema_guidance_documents_eia_climate_change_resilience_and_adaptation%20(1).pdf [Accessed 27/01/2020].

3.10. ASSESSMENT OF MAJOR ACCIDENTS AND DISASTERS (MA&D)

3.10.1. In line with the 2014 amendment to the EIA Directive (2014/52/EU), the EIA Regulations 2017 require the consideration of the vulnerability of the development (the scheme in this instance) to risks of major accidents and/or disasters which are relevant to the project concerned. Further consideration for this environmental factor has been included within this Scoping Report, including the methodologies considered (refer to Section 17 below).

3.11. ASSESSMENT OF HEAT AND RADIATION

3.11.1. In line with the 2014 amendment to the EIA Directive (2014/52/EU), the EIA Regulations 2017 require the consideration of the vulnerability of the development (the scheme in this instance) to risks of heat and radiation. Due to the nature of the scheme (i.e. a road scheme, not a major chemical or energy facility) and its geographic location, an assessment of heat and radiation is not deemed necessary, therefore this has been scoped out of further assessment.

3.12. COORDINATION OF ASSESSMENTS

3.12.1. The following additional assessments are expected to be required for the Scheme which interact with the environmental assessment to be completed as part of the ES and planning application:

- Habitats Regulations Assessment;
- Water Framework Directive Assessment (a separate scoping assessment is to be completed prior to the ES in order to determine the scope and methodology of the WFD assessment);
- Flood Risk Assessment;
- Surface Water Drainage Strategy; and
- Transport Assessment.

4. ENVIRONMENTAL ELEMENTS SCOPED OUT

4.1.1. Table 4-1 below provides a summary of the environmental elements scoped out of further assessment per environmental factor, therefore it is proposed that these elements will not be considered further within the ES. Additional detail and reasoning is provided within the relevant environmental factor chapter:

Table 4-1 - Environmental elements Scoped Out

Environmental Factor	Element Scoped Out	Phase
Air Quality	▪ Emissions from construction plant and machinery.	Construction
Noise and Vibration	▪ Disturbance to sensitive receptors from noise or vibration from vehicles using diversion routes	Construction
	▪ Disturbance to sensitive receptors from vibration generated by operational activities.	Operation
Cultural Heritage	▪ Effects on various built heritage within close proximity to the Scheme	Construction
	▪ All buried heritage assets	Operation and Cumulative
	▪ The setting of non-designated heritage assets; and ▪ Possible 'important' hedgerows	Construction and Operation
Landscape and Visual Effects	▪ Greenbelt Assessment; ▪ Artificial Lighting; ▪ Visual impacts outside the Zone of Influence; and ▪ Landscape Character impacts outside the study area	Construction and Operation
Biodiversity	Effects on: ▪ Norfolk Valley Fens SAC; ▪ Various Sites of Special Scientific Interest (SSSI); ▪ All Local Nature Reserves (LNR) and National Nature Reserves (NNR); ▪ Various County Wildlife Sites;	Construction and Operation

Environmental Factor	Element Scoped Out	Phase
	▪ White-clawed crayfish	
Road Drainage and the Water Environment/Groundwater	▪ N/A	N/A
Geology and Soils	▪ Potential impacts to future users, third party neighbours, potable water supply and plants from potential contamination within the underlying soils / groundwater.	Operation
Materials and Waste	▪ Material resource consumption and waste generation and disposal	Operation
Climate (Greenhouse Gases)	▪ Disposal of waste; and ▪ land use/land use change and forestry	Construction
	▪ Electricity used for lighting; ▪ Maintenance; ▪ Repair; ▪ land use/land use change and forestry; and ▪ Decommissioning process	Operation
Climate (Climate Resilience)	Effects on (scoped out element in brackets): ▪ Sea (Road, Bridge and ancillary works): • Sea level rise • Storm surge and storm tide • Surface temperature • Currents and waves ▪ Precipitation: • Changes in annual average (Ancillary works) • Drought (Bridges and ancillary works) ▪ Temperature: • Changes in annual averages (Road, bridge and ancillary works) • Solar Radiation (Road, bridge and ancillary works) ▪ Wind:	Construction and Operation

Environmental Factor	Element Scoped Out	Phase
	• Gales and extreme wind events (ancillary works) • Storms (Road and ancillary works) ▪ Relative humidity: • Changes in annual average evaporation (Road, bridge and ancillary works) ▪ Water Quality and soils: • Salinity/pH (Road, bridge and ancillary works) • Runoff (Road, bridge and ancillary works)	
Population and Human Health	▪ Private property and housing; and ▪ Development land and assets	Operation
Major Accidents and Disasters	▪ Natural Hazards • Hydrology • Climatological and metrological ▪ Technological or manmade hazards • Societal • Transport accidents • Pollution accidents • Engineering failures and accidents	Construction and Operation
	▪ Natural Hazards • Biological ▪ Technological or manmade hazards • Utility failures • Malicious attacks	Construction
Traffic and Transport	Traffic & Transportation effects on all users of the transport network	Construction
Heat and Radiation	All	Construction and Operation

5. AIR QUALITY

5.1. CONSULTATION

5.1.1. Table 5-1 below gives the consultation undertaken to date with the Environmental Health Officer (EHO) at Broadland District Council and South Norfolk District Council.

Table 5-1 – Consultation Undertaken to Date

Body/Organisation	Date of Consultation	Key Outcomes of Discussions
Broadland District Council and South Norfolk District Council	4th February 2020	Ongoing, awaiting discussions to conclude. Results of consultation will be considered within the ES.

5.2. STUDY AREA

5.2.1. Different study areas for the air quality assessment are required for construction and operational stages of the Scheme.

5.2.2. There are two study areas for the construction stage comprising the area of potential:

- Dust impacts surrounding construction sites; and
- Air quality impacts due to construction traffic.

5.2.3. The study area for potential dust impacts was defined with reference to Highways England's DMRB LA 105 guidance[7] as the area within 200m of all construction activity. The rationale for limiting the area to within 200m is that any impacts beyond are unlikely to give rise to a significant effect. Figure 5-1 (Appendix D-2) shows this area around the Scheme footprint.

5.2.4. As construction traffic data were not available for this Scoping Report, the study area for potential construction traffic air quality impacts will be defined within the ES in accordance with the same criteria that will be applied to operational stage road traffic (discussed below).

5.2.5. Updated traffic forecasts for the operational stage of the Scheme will be detailed within the ES. DMRB LA 105 scoping criteria will be used to define the study area. Application of these criteria requires details of the Scheme alignment and traffic forecasts for the opening year with and without the Scheme. The criteria include:

- Road alignment change of 5 metres or more; or
- Change in total traffic flow of 1,000 annual average daily traffic (AADT) or more; or
- Change in heavy duty vehicle (HDV) flows of 200 AADT or more.

5.2.6. All the roads that meet one or more of these criteria, and any adjoining roads with traffic forecast data within 200m, form the 'Affected Road Network' (ARN). Changes on roads that are not included

[7] Design Manual for Roads and Bridges Section 3 Part 1 (LA 105), Highways England, November 2019.

within the ARN are unlikely to give rise to a significant effect. As finalised traffic forecasts were not available for this Scoping Report, the study area will be determined when these data become available and detailed within the ES. For this Scoping Report a provisional study area was assumed, based on that previously defined for the SOBC [8], with extension eastwards to include Norwich and the Central Norwich Air Quality Management Area (AQMA)[9]; this is shown in Figure 5-1 (Appendix D-2). The provisional study area includes South Norfolk District Council, Breckland District Council, Norwich City Council and Broadland District Council areas.

5.3. BASELINE CONDITIONS

5.3.1. The baseline air quality conditions were considered in relation to the relevant air quality standards which are set as both objectives and mandatory limit values by the UK Air Quality Regulations[10,11]. In the UK, the air pollutants in relation to human health that are of most concern are nitrogen dioxide (NO2) and fine particulate matter (PM_{10} and $PM_{2.5}$). As well as standards to protect human health, there are also standards to protect sensitive ecosystems, in-particular for oxides of nitrogen (NOx). The standards, objectives and limit values for these pollutants that are relevant to the Scheme are given in Table 5-2.

Table 5-2 – Relevant Air Quality Standards

Pollutant	Measured as	Concentration (µg/m^3)	Requirement
NO_2	Annual mean	40	Not to be exceeded, as a national objective and as an EU limit value
	1-hour (hourly) mean	200	Not to be exceeded, more than 18 times a year as a national objective and as an EU limit value
PM_{10} (particulate matter less than 10 micrometres in diameter)	Annual mean	40	Not to be exceeded, as a national objective and as a EU limit value
	24-hour (daily) mean	50	Not to be exceeded, more than 35 time a year as a national objective and as an EU limit value
$PM_{2.5}$ (particulate matter less than 2.5 micrometres in diameter)	Annual mean	25	Target value

[8] WSP on behalf of Norwich County Council (2019). Norwich Western Link, Strategic Outline Business Case. Available at: https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/norwich/norwich-western-link/timeline

[9] Defra (2019). Air Quality Management Areas (AQMAs). Available at: https://uk-air.defra.gov.uk/aqma/

[10] Air Quality (England) Regulations (2000), Statutory Instrument 928. Available at: http://www.legislation.gov.uk/uksi/2000/928/pdfs/uksi_20000928_en.pdf.

[11] Air Quality (England) (Amendment) Regulations (2002), Statutory Instrument 3043. Available at: http://www.legislation.gov.uk/uksi/2002/3043/pdfs/uksi_20023043_en.pdf.

NO_x	Annual mean	30	Critical level for the protection of vegetation

5.3.2. A review of baseline air quality conditions was undertaken with reference to information published by South Norfolk District Council, Breckland District Council, Norfolk County Council and Broadland District Council, the Department for Environment, Food and Rural Affairs (Defra), and from a baseline NO_2 diffusion tube survey undertaken by WSP, which commenced in September 2019. Local authority and WSP monitoring sites within the study area are shown in Figure 5-2 (Appendix D-3), with survey results detailed in Appendix D-1. Baseline conditions for each local authority within the study area are summarised in Table 5-3.

Table 5-3 – Baseline Conditions within the Study Area

Local Authority	Nitrogen Oxides (NO_x, including NO_2)	Particulates (PM_{10} and $PM_{2.5}$)	Summary
Breckland District Council	The main sources of NO_x are road traffic emissions from vehicles on the A1067 and A47. There are no Breckland District Council monitoring sites within the provisional study area. There are no WSP roadside monitoring sites in this district. Defra background NO_x and NO_2 concentrations[12] are low and reflect the predominately rural character of the area.	There are no monitoring sites for this district within the study area. Defra background PM_{10} and $PM_{2.5}$ concentrations are low and reflect the predominately rural character of the area.	Overall, baseline air quality is good.
Broadland District Council	The main sources of NO_x are road traffic emissions from vehicles on the A1067, A1270, A140 and A47. There are three Broadland District Council monitoring sites within the provisional study area: BN17 on School Road in Drayton, BN21 on Thorpe End, BN22 on Wroxham Road/Ring Road in Sprowston. The annual mean concentrations are well below the 40µg/m^3 objective. There are six WSP roadside monitoring sites in this district: NWL_2, NWL_3, NWL_5 and NWL_6. All are located on the A1067. Annual mean concentrations are well below the 40µg/m^3 objective.	There are no monitoring sites for this district within the study area. Defra background PM_{10} and $PM_{2.5}$ concentrations are low and reflect the predominately rural character of the area.	Overall, baseline air quality is good.

[12] Defra (2017). LAQM Background Maps. Available at: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

	Defra background NO_x and NO_2 concentrations are low and reflect the predominately rural character of the area.		
Norwich City Council	Norwich City Council is the only local authority within the provisional study area to have declared an AQMA (Central Norwich Air Quality Management Area AQMA) for exceedances of the annual mean NO2 objective. The main sources of NO_x are road traffic emissions from vehicles on the A11, A1024, A1042, A146 and A147. Norwich City Council monitors roadside NO_2 concentrations at 16 locations within the AQMA. Concentrations exceeded the annual mean air quality objective of 40µg/m^3 at one location in 2018. The highest concentration was 44.9µg/m^3 at DT13 (Castle Meadow). Away from roadside locations air quality is good (below the 40µg/m^3 objective). Defra background NO_x and NO_2 concentrations are low.	Fine particulate matter (PM_{10} and $PM_{2.5}$) is monitored at one roadside (CM1, Castle Meadow) and one background (CM2, Lakenfields) location. Roadside annual mean concentrations of both pollutants are below their respective objectives of 40µg/m^3 and 25µg/m^3. Defra background $PM1_0$ and $PM_{2.5}$ concentrations are low (below their respective objectives).	Overall, baseline air quality is good.
South Norfolk District Council	The main sources of NO_x are road traffic emissions from vehicles on the A11 and A47. There are three South Norfolk District Council monitoring sites within the provisional study area: DT17 in Costessey, DT27 on the A1074 in Costessey and DT26 on the A11 in Cringleford. Annual mean concentrations are well below the 40µg/m^3 objective. There are two WSP roadside monitoring sites in this district: NWL_8, on the A47, and NWL_9, on the A1047. Annual mean concentrations are well below the 40µg/m3 objective. Defra background NO_x and NO_2 concentrations are low and reflect the predominately rural character of the area.	There are no monitoring sites for this district within the study area. Defra background PM_{10} and $PM_{2.5}$ concentrations are low and reflect the predominately rural character of the area.	Overall, baseline air quality is good.

5.3.3. Defra's PCM roads model data within the provisional study area is shown in Figure 5-2 (Appendix D-3) and includes the A147 and A1042 orbital roads around Norwich as well as main arterial roads away from the centre, most notably, the A1067 and the A1074. 2018 PCM data indicates that roadside annual mean concentrations of all pollutants are below EU limit values. The maximum modelled NO_2 concentration is 37µg/m^3 on the A140, Sweet Briar Road.

VALUE OF ENVIRONMENTAL RESOURCES AND RECEPTORS

5.3.4. The UK Air Quality Regulations identify that the air quality objectives for the protection of human health apply "at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present".

Furthermore, Defra's technical guidance LAQM.TG(16)[13] that advises that the assessment of air quality should focus on locations at which members of the public are likely to be exposed for a period of time appropriate to the averaging period of the objective.

5.3.5. All human receptors with relevant exposure including residential premises, schools and hospitals are regarded as having high sensitivity to changes in concentrations of ambient air pollutants. Human receptors with relevant exposure are located within 200m of the provisional ARN.

5.3.6. The village closest to the Site is Weston Longville, which is over 200m away from the Site shown in Figure 5.1, and therefore can be scoped out of the construction dust assessment, however it is not possible to scope this element out entirely for all receptors.

5.3.7. Statutory designated ecological sites including Ramsar sites (wetlands of international importance) Special Protection Areas (SPAs), Special Areas of Conservation (SAC), Sites of Special Scientific Interest (SSSI), Local Nature Reserves (LNR), local wildlife sites (including County Wildlife Sites (CWS)), nature improvement areas, ancient woodland and veteran trees are regarded as having high sensitivity where there are ecological features that are sensitive to changes in nitrogen deposition.

5.3.8. There are a number of designated ecological sites in the provisional study area within 200m of the Site and the ARN, which are listed in Table 5-4. Whether an assessment on the ecological sites is required will be confirmed upon the receipt of the updated scheme traffic data. Consideration will also be given to other designated sites within the provisional study area.

Table 5-4 – Statutory Designated Sites within 200m

SAC	SSSI	Ancient Woodland	Local Non-Statutory Designated (County Wildlife Site Reference Number)
River Wensum		Mouse Wood Primrose Grove	• Attlebridge Hills (1343) • Broom & Spring Hills (1341) • Gravel Pit Plantation & Church Hill (2304) • Land Adjoining Foxborough Plantation (2116) • Mouse Wood (2050) • Old Covert, Wood Lane (2109) • Primrose Grove Ringland (2305) • River Wensum Pastures (2303) Wensum Pastures at Morton Hall (2070)

5.3.9. The statutory designated sites listed above have been included in the designated sites plan within Appendix D-4.

[13] Defra (2018). Local Air Quality Management Technical Guidance (TG16). Available at: https://laqm.defra.gov.uk/technical-guidance/

5.4. MITIGATION

5.4.1. To minimise the risk of adverse impacts during construction, industry best practice measures will be employed, including good site management and material storage, monitoring and considerate site planning. Appropriate measures will be specified within the Construction Environmental Management Plan (CEMP) for the Scheme.

5.4.2. Once updated scheme traffic data are available, required mitigation measures can be identified and developed. Mitigation of operational phase impacts will only be required if significant adverse effects are likely.

5.5. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

5.5.1. The likely significant effects are considered in Table 5-5, based on the provisional study area.

Table 5-5 – Elements Scoped In or Out of Further Assessment

Element	Phase	Scoped In	Scoped Out	Justification
Emissions from vehicles during construction	Construction	✔		Sensitive receptors (human and designated habitats) within 200m of the Site could be adversely affected by dust, as well as exhaust emissions from construction vehicles. The impact of construction activities on vehicle movements will be assessed guidance where construction activities are programmed to last for more than 2 years. Scheme traffic data are currently unavailable. An assessment will be undertaken where construction traffic exceeds the criteria given in paragraph 5.2.5. This will be limited to the areas of key risk of exceeding air quality thresholds. For construction dust, a simple qualitative assessment will be presented and used to inform the need for appropriate mitigation measures to be included in the CEMP.
Dust generated during construction				
Emissions from vehicles on human health	Operation	✔		The Scheme traffic data are currently unavailable to determine the extent and location of the ARN. Impacts at human receptors are therefore scoped in. Changes in NO_2, PM_{10} and $PM_{2.5}$ concentrations, due to the $Scheme$, may h_{ave} an impact on human receptors and amenity. Mitigation of operational phase impacts will only be required if significant adverse effects are likely.
Emissions from vehicles on designated sites		✔		The Scheme traffic data are currently unavailable to determine the extent and location of the ARN. Impacts on designated sites are therefore scoped in. Changes in NO_X and nitrogen deposition, due to the Scheme, may have an impact on designated ecological sites human receptors and amenity. Mitigation of operational phase impacts will only

Element	Phase	Scoped In	Scoped Out	Justification
				be required if significant adverse effects are likely.
Emissions from plant and machinery.	Construction		✔	Emissions from construction plant and machinery are unlikely to give rise to significant effects. Plant and machinery will be moved around the site. Emissions will be transitory in nature and are unlikely to have a significant impact.

5.6. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

5.6.1. Once the Scheme is operational, it is anticipated that it will improve traffic flows and reduce congestion between the western end of the A1270 (Broadland Northway) and the A47, which may improve air quality in the wider area (subject to traffic modelling and to be considered within the ES following relevant assessment).

5.7. PROPOSED ASSESSMENT METHODOLOGY

5.7.1. The following legislation, plans, policy and guidance are will be considered in the air quality assessment.

LEGISLATION

- Air Quality (England) Regulations 2000 (as amended in 2002)[14,15]; and
- Air Quality Standards Regulations 2010 (as amended in 2016)[16,17].

PLANS

- Norfolk County Council Local Transport Plan[18];
- Norfolk County Council Environmental Policy[19];

[14] Air Quality (England) Regulations (2000), Statutory Instrument 928. Available at: http://www.legislation.gov.uk/uksi/2000/928/pdfs/uksi_20000928_en.pdf
[15] Air Quality (England) (Amendment) Regulations (2002), Statutory Instrument 3043. Available at: http://www.legislation.gov.uk/uksi/2002/3043/pdfs/uksi_20023043_en.pdf.
[16] Air Quality Standards Regulations (2010). Statutory Instrument No. 1001. Available at: http://www.legislation.gov.uk/uksi/2010/1001/contents/made
[17] Air Quality Standards (Amendment) Regulations (2016). Statutory Instrument No. 1184. Available at: http://www.legislation.gov.uk/uksi/2016/1184/made
[18] Norfolk County Council (2011). Connecting Norfolk: Norfolk's Transport Plan for 2026. Available at: https://www.norfolk.gov.uk/what-we-do-and-how-we-work/policy-performance-and-partnerships/policies-and-strategies/roads-and-travel-policies/local-transport-plan
[19] Norfolk County Council (2019). Norfolk County Council's Environmental Policy. Available at: https://www.norfolk.gov.uk/what-we-do-and-how-we-work/policy-performance-and-partnerships/policies-and-strategies/natural-environment-policies/environmental-policy

- Norwich City Council Local Plan[20];
- Broadland Environmental Strategy[21]; and
- Joint Core Strategy[22] (adopted by Broadland, Norwich and South Norfolk).

POLICY

- UK Air Quality Strategy[23];
- UK Clean Air Strategy[24]; and
- National Planning Policy Framework[25].

GUIDANCE

- DMRB LA 105, Air Quality; and
- Defra's Local Air Quality Management Technical Guidance (TG16)[13].

CONSTRUCTION PHASE IMPACTS

Human Receptors

5.7.2. The assessment will follow DMRB LA 105 procedure for detailed assessment[26] and will involve dispersion modelling using ADMS-Roads to predict ambient NO_2, PM_{10} and $PM_{2.5}$ concentrations at representative human receptors.

5.7.3. The following scenarios will be modelled:

- 2019 baseline and model verification; and
- 2025 opening year Do-Minimum (DM) and Do-Something (DS).

5.7.4. Road geometry data will be obtained from Ordnance Survey data products and topographical survey mapping to define the baseline conditions, and CAD drawings for the scheme design as generated by the project design team.

5.7.5. Traffic data for the air quality assessment will be provided by the traffic modelling team.

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[20] Norwich City Council (2014). Norwich Local Plan. Available at: https://www.norwich.gov.uk/info/20199/local_plan/1607/local_plan_policies_map

[21] Broadland District Council (2014). Environmental Strategy for Broadland. Available at: https://www.broadland.gov.uk/directory_record/3769/environmental_strategy_for_broadland

[22] Greater Norwich Development Partnership (2014). Joint Core Strategy for Broadland, Norwich and South Norfolk. Available at: https://www.broadland.gov.uk/downloads/file/1310/joint_core_strategy_adopted_document_2014

[23] Defra and the Devolved Administrations (2007). The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volumes 1 and 2). Available at: https://www.gov.uk/government/publications/the-air-quality-strategy-for-england-scotland-wales-and-northern-ireland-volume-2

[24] Defra (2019). Clean Air Strategy. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770715/clean-air-strategy-2019.pdf

[25] Department for Communities and Local Government (2012). National Planning Policy Framework. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

[26] It should be noted that this assessment will not account for speed banded emissions as this only applies to roads within the strategic road network.

5.7.6. Meteorological observations for 2018 from Norwich airport/Marham will be used for the dispersion modelling as these are the most representative weather stations for the provisional study area.

5.7.7. Modelled road source contributions of annual mean NO_x, PM_{10} and $PM_{2.5}$ will be predicted at monitoring sites in 2018 to enable model verification, and at selected receptors that are representative of relevant exposure (including residential premises, schools and hospitals). Ordnance Survey and Google Street View data will be used to locate these receptors and the receptor points will be adjusted to the nearest relevant façade and relevant height where appropriate. Receptors will be included in sufficient numbers to support professional judgement on significance of effect.

5.7.8. Background air quality data from Defra's PCM modelling and local monitoring will be reviewed to ensure that the most suitable are used in the assessment. NOx to NO2 conversion will be undertaken using the latest Defra NO_x to NO_2 calculator tool[27]. Defra's technical guidance LAQM.TG(16) will be followed to allow the scheme's impact on 24-hour mean PM_{10} concentrations and 1-hour mean NO_2 concentrations, which cannot be derived directly from the modelling, to be determined.

Designated Sites

5.7.9. Depending on the extent of the ARN which is yet to be determined, it may be necessary to quantify impacts on ambient annual mean NOx concentrations and nitrogen deposition rates at designated sites. If required, this will be done in accordance with DMRB LA 105 using data from dispersion modelling with ADMS-Roads and the Air Pollution Information System (APIS)[28]. The findings will be considered by the Project Ecologist.

ASSESSMENT OF VALUE, MAGNITUDE AND SIGNIFICANCE OF EFFECTS

5.7.10. DMRB LA 105 will be used to determine:

- Impacts and significance of effects; and
- Compliance with EU limit values.

5.8. LIMITATIONS AND ASSUMPTIONS

5.8.1. The assessment will be based upon calculation methodologies and data which have inherent limitations and uncertainties. Key limitations and uncertainties and how these will be addressed are outlined below:

- Traffic data used in the air quality assessment will be derived from a validated strategic traffic model;
- The traffic model base year is representative of conditions in 2019;
- 2025 traffic model data will be based on core traffic growth assumptions as the most likely scenario;

[27] Defra (2018). https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc
[28] Joint Nature Conservation Committee *et al*. Air Pollution Information System. Available at: http://www.apis.ac.uk/

- Whilst DMRB LA 105 prescribes speed banded emissions factors as issued by Highways England for assessment of Strategic Road Network schemes, the methodology to be used in the assessment of the Scheme will be based on standard Defra vehicle emissions factors. This is not considered to be a limitation since the speed banded emissions factors are based upon the Defra data;
- Vehicle emissions data will be based on Defra emission factors for road vehicles taken from Emission Factor Toolkit (EFT) version 9; and
- The air quality models to determine operational phase impacts at human and designated site receptors will be verified against monitoring data. Air quality models of road source most commonly tend to underestimate concentrations at receptors. Where appropriate, the systematic differences between monitored and modelled concentrations will be adjusted to improve the confidence in the model predictions.

6. NOISE AND VIBRATION

6.1. CONSULTATION

6.1.1. No specific consultation relating to the assessment of Noise and Vibration as part of the Environmental Statement has been undertaken to date. Consultation with the relevant Environmental Health Officer will occur to support the production of the ES.

6.2. STUDY AREA

6.2.1. The study areas for both the construction noise and vibration and operational noise assessments will be defined based on the principles of the guidance provided in the Design Manual for Roads and Bridges, Volume 11, Section 3, Part 7, LA 111 Noise and vibration (hereafter referred to as LA 111).

CONSTRUCTION NOISE AND VIBRATION

6.2.2. LA 111 states that the construction study areas should include all noise and vibration sensitive receptors that are potentially affected by construction noise and vibration. LA 111 also notes that "*A study area of 300m from the closest construction activity is normally sufficient to encompass noise sensitive receptors*" and that 100m for is normally sufficient to encompass vibration sensitive receptors.

6.2.3. LA 111 also states that the study area for construction noise and vibration should include sensitive receptors in areas where there is a reasonable stakeholder expectation that a construction noise assessment will be undertaken.

6.2.4. With regard to construction traffic noise, LA 111 determines the study area as including a 50m width from the kerb line of public roads with the potential for an increase in baseline noise level of 1 dB(A) or more as a result of the addition of construction traffic to existing traffic levels.

6.2.5. Based on the above the following calculation areas have been proposed for the construction phase:

- Construction noise – 300m from any construction activity
- Construction vibration – 100m from any vibration generating construction activity
- Construction traffic – 50m from the kerb line of public roads with the potential to experience at least a 1 dB change in noise level

It should be noted that the above study areas may need to be revised during the assessment due to the proposed construction activities or stakeholder expectation. Any changes, and the justification for them will be reported in the ES.

OPERATIONAL NOISE

6.2.6. For operational noise, LA 111 advises in NOTE 1 that:

"*An operational study area defined as the following can be sufficient for most projects, but it can be reduced or extended to ensure it is proportionate to the risk of likely significant effects*:

- The area within 600m of new road links or road links physically changed or bypassed by the project;

- The area within 50m of other road links with the potential to experience a short term Basic Noise Level (BNL) change of more than 1.0dB(A) as a result of the project"[29].

6.2.7. LA 111 goes on to advise that "*Variations in the study area can be defined for individual projects*."

6.2.8. The study area will ultimately be defined through details emerging from the detailed traffic modelling and will, therefore, be based on a combination of the Scheme footprint and the predicted change in traffic flows. Finalised traffic forecasts were not available at the time of writing this Scoping Report.

6.3. BASELINE CONDITIONS

BASELINE NOISE SURVEY

6.3.1. At the northern end of the Scheme, the noise climate is dominated by road traffic noise from Fakenham Road (A1067). Moving south, there is some contribution to the noise climate from road traffic on the nearby local roads, albeit at a low level. At the Southern end of the Scheme, the noise climate is dominated by road traffic noise from the A47. The disused RAF Attlebridge airfield is located approximately 3km west of the proposed highway alignment and is thought not to significantly affect the noise climate in the areas as it is not in use.

6.3.2. The A47 is managed by Highways England and is proposed to be dualled and slightly re-routed at the southern end of the Scheme (not within the scope of this Scheme). The noise impacts from this dualling and re-routing will not be addressed in this assessment. The assessment of the Scheme will assume the A47 has been dualled in both the 'with' and 'without' Scheme traffic scenarios as the works are assumed to be complete prior to the opening of the Scheme.

6.3.3. Generally, for receptors not located in close proximity to either the A1067 or A47, the Scheme covers a fairly rural area and the existing ambient noise levels are low.

NOISE SENSITIVE RECEPTORS

6.3.4. Based on the principles of LA 111, examples of noise and vibration sensitive receptors include:

- Dwellings
- Hospitals
- Healthcare facilities
- Education facilities
- Community facilities
- Designated sites, such as Areas of Outstanding Natural Beauty, Special Protection Areas and Public Rights of Way

[29] The Basic Noise Level is described in the Calculation of Road Traffic Noise (CRTN). It does not relate to any specific receptor, but rather is a measure of source noise, at a notional reference distance (typically taken to be 10 metres) from the nearside carriageway edge of a specific length of highway. It is determined by obtaining the estimated noise level from the 18-hour traffic flow and then applying corrections for vehicle speed, percentage of heavy vehicles, gradient and road surface as described in CRTN.

6.3.5. The noise and vibration sensitive receptors which will be assessed as part of the ES will be defined once the study areas for the construction and operational assessments have been determined. The study area is to be defined by the traffic modelling as defined above.

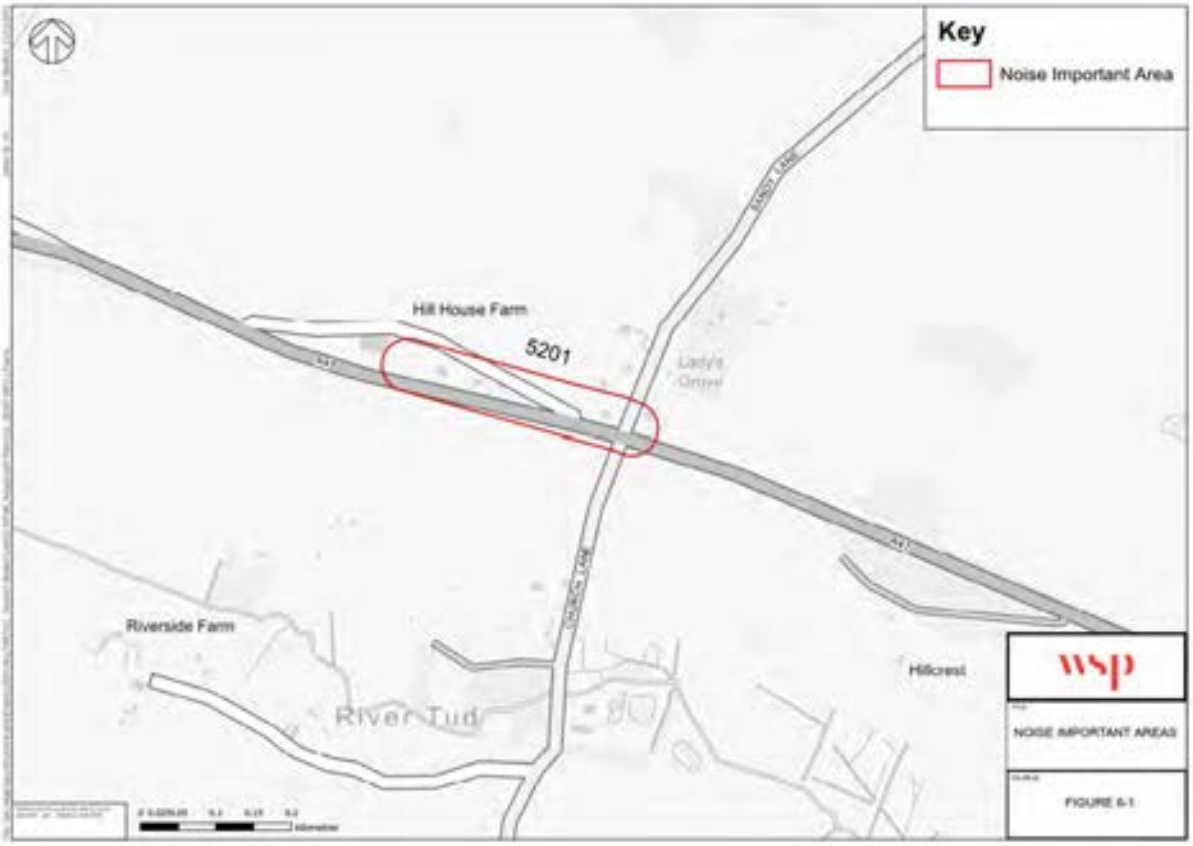
6.3.6. LA 111 does not explicitly refer to the concept of receptor sensitivity, nor does it define sensitivity levels for the above receptors. Rather, it refers to the magnitude of impact based upon the level of change in the noise environment. As the Scheme passes through a predominantly rural area (meaning that the majority of receptors are exposed to low existing noise levels), all sensitive receptors (identified in accordance with LA 111) will be assigned a sensitivity level of 'high'.

NOISE IMPORTANT AREAS

6.3.7. The current Noise Action Plan for major roads (Defra, 2014) outlines numerous Noise Important Areas (NIAs) at Round 3 of the UK noise mapping project, identified in accordance with the requirements of the EU Environmental Noise Directive and associated English Regulations. NIAs are locations where it has been identified that the 1% of the population that are affected by the highest noise levels are located. NIAs are identified as areas which require potential action to reduce noise levels.

6.3.8. . There is one NIA within 1km of the current alignment of the Scheme (NIA ID:5201). This NIA is located on the existing A47, approximately 950m to the west of the proposed Scheme alignment and is shown on Figure 6-1 below..

Figure 6-1 - NIA within 1km of the Scheme (NIA 5201)



6.3.9. As NIA 5201 is over 600m from the Scheme and therefore, outside of the operational noise Study Area, a receptor specific assessment of noise levels affecting sensitive receptors within NIA 5201 will not be undertaken..

6.4. MITIGATION

CONSTRUCTION NOISE AND VIBRATION

6.4.1. Where noise or vibration levels due to the construction phase are predicted to adversely impact sensitive receptors, mitigation measures will be employed to minimise impacts as far as is reasonably possible.

6.4.2. Specific and appropriate mitigation, such as the use of best practicable means and selection of equipment and working methods to minimise noise and vibration, will be determined once detailed assessments have been undertaken through the EIA. However, this is will need to be include a Construction Environmental Management Plan (CEMP).

OPERATIONAL NOISE

6.4.3. Where significant adverse changes in noise levels are predicted, consideration will be given to the potential for incorporating mitigation measures within the design of the Scheme with the aim of reducing noise impacts during operation. Mitigation for operational noise will be considered where either of the following apply:

- Noise level changes as a result of the Scheme are deemed to be significant adverse in accordance with the EIA regulations; and
- Absolute noise levels are above the thresholds identified by National Noise Policy as potentially causing adverse impacts on health and quality of life.

6.4.4. Mitigation measures will be considered in terms of their potential buildability, impact on other environmental topics and value for money considerations.

6.4.5. An assessment will be undertaken in accordance with the Noise Insulation Regulations 1975 (as amended 1988) to determine whether any sensitive receptors are likely to be eligible.

6.5. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

6.5.1. Potential significant effects will be explored in detail through the EIA with a view to minimising and where possible and reasonable, eliminating these potential significant effects.

ELEMENTS SCOPED IN FOR FURTHER ASSESSMENT

6.5.2. An assessment of the following elements is scoped into the noise and vibration assessment:

- Temporary construction noise and vibration effects – A quantitative assessment will be undertaken based on the predicted noise and vibration levels of the likely construction activities associated with the Scheme. The purpose of this assessment will be to identify appropriate mitigation measures and identify any significant temporary adverse noise or vibration effects.
- Temporary construction traffic noise effects - The potential noise impact of construction traffic (works vehicles using the local road network to access or leave the site) will be assessed proportionality to the potential impact. This will ultimately depend on the potential construction routes used by vehicles and the predicted number of vehicles. It is likely that this will be assessed qualitatively.

- Permanent traffic noise effects – A quantitative, receptor specific assessment will be undertaken based on the predicted noise levels arising from the Scheme. This assessment will be based on a detailed 3D alignment of the Scheme as well as predicted traffic data for the Scheme. The purpose of this assessment will be to identify appropriate mitigation measures and report significant beneficial or adverse noise effects.
- Cumulative effects – An assessment of any cumulative temporary construction noise or vibration effects and operational noise effects will be undertaken in appropriate detail based on the size of the respective cumulative developments and their likely noise and vibration impacts. It is likely that cumulative construction noise and vibration effects will be assessed qualitatively.

ELEMENTS SCOPED OUT OF FURTHER ASSESSMENT

6.5.3. An assessment of the following elements is scoped out of the noise and vibration assessment:

- Permanent traffic ground-borne vibration effects – LA 111 advises that should the level of ground-borne vibration (peak particle velocity (PPV)) at a receptor be predicted to rise to above a level of 0.3mm/s, or an existing level above 0.3mm/s is predicted to increase, then this should be classed as a minor adverse impact. A method to predict ground-borne vibration resulting from heavy vehicles passing over a defective road surface (e.g. hitting potholes) is included within Transport and Road Research Laboratory (TRRL) report RR246. However, as the Scheme will introduce a new road, which is assumed to be smooth and maintained in good condition, any ground-borne vibration is expected to be minimal and has therefore been scoped out of this assessment.
- Permanent traffic airborne vibration effects – LA 111 does not include guidance or a calculation methodology for an assessment of operational traffic airborne vibration effects. As the Scheme is not passing within close proximity to sensitive buildings it is considered appropriate to scope out any assessment of permanent traffic airborne vibration effects.
- Temporary diversion route traffic noise – The potential diversion routes due to construction activities on the existing local road network are unknown. However, it is unlikely that any major highways will need to be closed for any significant period of time. Whilst it is anticipated that brief closures will be required on both the A1067 and A47 due to the tying in of the Scheme to these roads, it is assumed that these closures would be of short duration that would not warrant an assessment of potential noise impacts. In addition, the local roads crossing the Scheme which may require more extended closures and associated diversion routes generally carry low numbers of vehicles, meaning that moving these vehicles to another local route would be unlikely to lead to significant noise impacts at nearby receptors. Therefore, assessment of temporary diversion route traffic noise is scoped out of this assessment.

6.5.4. A summary of the elements scoped in and out of the assessment is presented below in Table 6-1.

Table 6-1 – Elements Scoped in or Out of Further Assessment

Element	Phase	Scoped In	Scoped Out	Justification
Disturbance to sensitive receptors from noise and vibration generated by on-site demolition and construction activities	Construction	✔		The Scheme may give rise to noise impacts at sensitive receptors within the construction study area.
Disturbance to sensitive receptors from noise generated by demolition or construction traffic	Construction	✔		An assessment of construction traffic movements will be undertaken in proportion to the potential impacts which depend on both the proposed routes and number of vehicles.
Disturbance to sensitive receptors from noise generated by operational activities.	Operation	✔		The Scheme may give rise to noise impacts at sensitive receptors within the operational study area.
Disturbance to sensitive receptors due to cumulative schemes	Operation/Construction	✔		An assessment of cumulative impacts will be undertaken in proportion to the potential impacts which will be determined once the full list of cumulative schemes is available.
Disturbance to sensitive receptors from noise or vibration from vehicles using diversion routes	Construction		✔	Due to the likely nature of any diversion routes associated with the construction of the Scheme, it is unlikely that significant noise or vibration impacts will arise from traffic using diversion routes.
Disturbance to sensitive receptors from vibration generated by operational activities.	Operation		✔	As the Scheme will be a new and smooth carriageway, any ground-borne vibration is expected to be minimal.

6.6. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

6.6.1. .Where acoustic screening is required, earth bunds will be considered initially with acoustic barriers as a secondary option. The potential for noise enhancement measures (earth bunds or acoustic barriers) will be determined as part of the assessment of the Scheme to support the ES.proposed

6.7. ASSESSMENT METHODOLOGY

LEGISLATION, POLICY AND GUIDANCE

6.7.1. The following policy and guidance will underpin the assessment and will be described in detail in the assessment:

- Highways England (2019). Design Manual for Roads and Bridges, Volume 11, Section 3, Part 7, LA 111 Noise and vibration.
- European Parliament (2002). Directive 2002/49/EC of the European Parliament.
- European Parliament (2014). Directive 2014/52/EC of the European Parliament.
- Ministry of Housing, Communities and Local Government (2019). National Planning Policy Framework.
- Department for Environment, Food, and Rural Affairs (Defra) (March 2010). Noise Policy Statement for England.
- Secretary of State (1988). Noise Insulation (Amendment) Regulations 1988
- Department for Transport Welsh Office (1988). Calculation of Road Traffic Noise (CRTN)
- British Standards Institute (2014). BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise (BS 5228-1)
- British Standards Institute (2014). BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration (BS 5228-2)

6.7.2. Guidance contained in these documents will be used to determine the potential significant noise and vibration effects as a result of the Scheme, with the assessment methodology presented in the section below.

6.7.3. All relevant legislation and policies will be presented in the ES in a table format.

METHODOLOGY

Construction

6.7.4. When considering the assessment of potential noise and vibration effects during the construction stage, LA 111 points to guidance within BS 5228-1 and BS 5228-2. The methodology described in LA 111 is based on comparing the predicted construction noise or vibration levels at a receptor to the Lowest Observed Adverse Effect Level (LOAEL) and Significant Observed Adverse Effect Level (SOAEL) thresholds as introduced in the NPSE.

6.7.5. Construction noise and vibration impacts are dealt with separately in the following sections, although the criteria for determining significant effects has been combined.

6.7.6. The construction noise and vibration predictions will be based on assumptions regarding specific plant items which are likely to be used, the number of them and their percentage on-times. The calculations will be based on methodology contained within BS 5228.

Construction Noise

6.7.7. In accordance with LA 111 it is proposed to use the ABC Method, as described in BS 5228-1 to set the SOAEL for the construction noise assessment. The LOAEL will be set at the existing ambient noise level during the relevant period. LA 111 includes the following table for determining the magnitude of impact from construction noise at a receptor.

Table 6-2 – Magnitude of impact and construction noise descriptors (from LA 111 Table 3.16)

Magnitude of impact	Construction noise level
Major	Above or equal to SOAEL +5dB
Moderate	Above or equal to SOAEL and below SOAEL +5dB
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

Construction Vibration

6.7.8. LA 111 defines the LOAEL and SOAEL for construction vibration as follows:

- LOAEL – 0.3 mm/s PPV
- SOAEL – 1.0 mm/s PPV

6.7.9. LA 111 includes the following table for determining the magnitude of impact from vibration levels at a receptor.

Table 6-3 – Vibration level – magnitude of impact (from LA 111 Table 3.33)

Magnitude	Vibration level
Major	Above or equal to 10 mm/s PPV
Moderate	Above or equal to SOAEL and below 10 mm/s PPV
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

Construction Noise and Vibration Significant effects

6.7.10. For both construction noise and vibration LA 111 states that a significant effect is likely where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- "10 or more days or nights in any 15 consecutive days or nights;
- A total number of days exceeding 40 in any 6 consecutive months."

6.7.11. This criteria for the determination of significant effects will be adopted for the construction noise and vibration assessment in the Environmental Statement.

6.7.12. LA 111 notes that "Calculations may be undertaken at a selection of noise sensitive receptors, or at varying distances from each activity, to represent all receptors in the calculation area".

6.7.13. For the purpose of this assessment, it is considered unnecessary and impractical to predict construction noise (or vibration) levels at every receptor within the study area. Therefore, it is proposed that for each predicted construction activity, the distance at which the SOAEL will be equalled or exceeded (corresponding to a moderate or major magnitude of impact) will be determined. These distances (referred to as SOAEL zones) will be used to determine the properties most likely to experience significant adverse effects during the construction phase.

Operation

6.7.14. The assessment of noise and vibration will be undertaken based on the principles of LA 111. All road traffic noise predictions will be undertaken based on the principles of the calculation methodology presented in the CRTN and LA 111.

6.7.15. The following traffic scenarios will be considered in the assessment:

- Do-Minimum Opening Year (without the Scheme)
- Do-Minimum Forecast Year (without the Scheme)
- Do-Something Opening Year (with the Scheme)
- Do-Something Forecast Year (with the Scheme)

6.7.16. The forecast year is defined as the year within 15 years of the opening year, when traffic flows are highest. This is typically taken as the 15th year after opening.

6.7.17. In accordance with LA 111 the predicted noise level changes for the following comparisons will be considered:

- Short-term – Do-Something Opening Year vs Do-Minimum Opening Year
- Long-term – Do-Something Forecast Year vs Do-Minimum Opening Year
- Long-term without Scheme – Do-Minimum Forecast Year vs Do-Minimum Opening Year

6.7.18. The assessment includes a requirement to determine the change in road traffic noise level at each dwelling (and other sensitive receptors) within the study area. A computerised 3D road traffic noise model will be used to facilitate the assessment.

6.7.19. An assessment of potential magnitude of impacts and associated significance of effects will be undertaken with respect to predicted noise level changes in the short-term and long-term, using guidance presented in the LA 111. The short- and long-term magnitude of impact scales as defined by DMRB are presented in the following table.

Table 6-4 – Magnitude of impact scales from LA 111

Magnitude of Impact	Short term noise change (dB $L_{A10,18hr}$ or L_{night})	Long term noise change (dB $L_{A10,18hr}$ or L_{night})
Negligible	Less than 1.0	Less than 3.0
Minor	1.0 to 2.9	3.0 to 4.9
Moderate	3.0 to 4.9	5.0 to 9.9
Major	Greater than or equal to 5.0	Greater than or equal to 10.0

6.7.20. LA 111 states that the initial assessment of likely significant effects should first be based on the short-term magnitude of impact scale whereby an impact of moderate or major correspond to a likely significant effect, and an impact of negligible or minor correspond to a likely non-significant effect.

6.7.21. Following this initial assessment of potential significance LA 111 suggests that other factors should be considered when determining the potential significance of effect at an individual, or group of receptors. These factors include, but are not limited to:

- The long-term magnitude of impact (as determined by the scale presented in Table 6-4).
- The absolute noise level in terms of the LOAEL and SOAEL thresholds. For example, LA 111 suggests that a receptor experiencing a minor adverse impact which is also above SOAEL would be a likely significant effect.
- Location of the noise sensitive parts of a receptor.
- Acoustic context.
- Likely perception of change by residents.

6.7.22. The absolute noise levels predicted at noise sensitive receptors will be also compared to the LOAEL and SOAEL thresholds as introduced in the NPSE. The operational noise LOAEL and SOAEL thresholds are set in LA 111 Table 3.49.1 which is reproduced below.

Table 6-5 - Operational noise LOAEL and SOAEL thresholds (from LA 111 Table 3.49.1)

Time Period	LOAEL	SOAEL
Day (06:00 – 24:00)	55dB LA10,18hr	68 dB LA10,18hr
Night (00:00 – 06:00)[30]	40_{dB} Lnight, outside (free-field)	55dB Lnight, outside (free-field)

6.7.23. Where noise levels are predicted to exceed these thresholds, adverse effects on health and quality of life can occur. Therefore, mitigation measures will be considered, although the NPSE also notes that mitigation measures should considered within the context of Government policy on sustainable development. This is generally taken to mean that the mitigation options are value for money, whereby the monetised acoustic benefits of the mitigation measure, outweigh the costs.

6.8. LIMITATIONS AND ASSUMPTIONS

6.8.1. To ensure transparency within the EIA process, the following limitations and assumptions have been identified:

- This scoping report is based on currently available information and can be subject to change as the Scheme design progresses.
- Valid traffic data are currently not available but will be for the ES.

[30] Whilst in this table LA 111 states the night-time period to be 00:00 – 06:00 hours, the night-time period is generally taken to be 23:00 – 07:00 hours. In addition, the $L_{night, outside}$ acoustic parameter refers to the time period of 23:00 – 07:00 hours. Therefore, for this assessment the night LOAEL and SOAEL thresholds will be taken for the eight hour period between 23:00 – 07:00.

- The study area cannot be determined until the noise modelling has been undertaken which will define the roads which trigger a significant noise effect.
- The noise modelling will incorporate many different data sources. The outcome of the modelling is, therefore, reliant on the quality of these data sources. Any limitations of these data sources will be reported in the noise and vibration assessment of the ES, along with any implications.
- The noise impacts from the dualling of the A47 are under a separate scheme managed by Highways England). The assessment of the Scheme will assume the A47 has been dualled in both the 'with' and 'without' Scheme traffic scenarios as the works are assumed to be complete prior to the opening of the Scheme;
- The BS 5228-1 and BS 5228-2 calculation methods enable the level of noise and vibration during various construction activities to be determined. However, the precision of any such predictions is necessarily limited by the number of assumptions that have to be made regarding the number and type of plant to be utilised, their location and detailed operating arrangements. Some of this information will be clarified as the Scheme design progresses and later when a contractor is appointed and resources are mobilised, but other information (such as exactly where the plant operates and for how long) would remain uncertain, even after works have commenced.

7. CULTURAL HERITAGE

7.1. CONSULTATION

7.1.1. Consultation has taken place with Norfolk County Council County Historic Environment Officer, regarding the scope of the assessment for buried heritage assets.

Table 7-1 - Consultation Undertaken to Date

Body/Organisation	Date of Consultation	Key Outcomes of Discussions
Norfolk County Council, Historic Environment Officer	10/12/2019	In addition to the ES containing an archaeological desk-based assessment and built heritage impact assessment it is required that some specialist historic environment survey work to be carried out at the EIA stage. Response: The ES will set out an appropriate strategy for site-based investigation. Any archaeological desk-based assessment and built heritage impact assessment needs to be in full compliance with the Standards for Development-led Archaeological Projects in Norfolk. Response: This has been added to the standards and guidance documents that will be consulted. Historic map regression to cover the whole area within the Site. Response: This will be undertaken as part of the EIA. Assessment of existing Aerial Photographic and LiDAR data will cover all of the area within the Site. Response: This will be undertaken as part of the EIA. The Assessment needs to contain a Geoarchaeological element which also take into account Norfolk Historic Environment Record (HER) data relating to finds of Palaeolithic date and include an assessment of potential and impact assessment relating specifically to Palaeolithic archaeology. A geoarchaeological deposit model should be undertaken. Response: The EIA will consult available geology, geotechnical and archaeological information to produce a geoarchaeological deposit model at the western end of the highway alignment in the Wensum Valley. The scope of the model will be proportionate to the extent of impact (localised viaduct pile impacts). A walk-over survey of the entire alignment corridor is required as the Scheme traverses ancient woodland which may contain woodbanks. Response: The walkover survey will be from publicly accessible areas unless the client is able to obtain land access along the whole highway alignment.
Norfolk County Council, Historic Environment Senior Officer	20/12/2019	Further discussion took place regarding the geoarchaeological element of the assessment.

		This should determine the implications for potential Palaeolithic archaeology if the geotechnical investigation in the Wensum Valley records any river terrace deposits. Engagement of a Palaeolithic specialist may be required. If peat deposits are recorded in the geotechnical investigation the stored borehole samples should be analysed by a geoarchaeologist. Response: A specialist contractor will be used to provide the deposit model and view the stored samples.

7.2. STUDY AREA

7.2.1. For buried heritage assets the guidelines in the DMRB Volume 11, Section 3 Part 2: LA 106 Cultural heritage assessment, are for a study area which included the Site (refer to Appendix C) plus any land outside the Site which includes any heritage assets which could be affected. For built heritage the guidelines state that the study area should be wide enough to consider the setting of any designated heritage assets. Consequently, a 1km study area is proposed for above ground and buried heritage assets, based on intervening vegetations and tree belts and a review of the WSP in-house Geographical Information System (GIS) which contains National Heritage List for England (NHLE) designations data. For non-designated buried heritage assets, a 500m study area is proposed.

7.3. BASELINE CONDITIONS

7.3.1. The National Heritage List for England shows that there are no designated (protected) heritage assets on the route corridor, such as Scheduled Monuments and Listed Buildings.

7.3.2. Within the 1km study area there are a number of Listed buildings, which are detailed in Table 7-2.

7.3.3. There are no other designated assets, (World Heritage Sites, Scheduled Monuments, Conservation Areas, Registered Park and Gardens and Registered Battlefields) in the study area.

7.3.4. The scheme passes through open fields and woodland outside known areas of historic settlement. Norfolk Historic Environment Record (HER) data show the scheme passes through several non-designated heritage assets which comprise:

- Several areas of cropmarks of ditches and field boundaries, either undated or of medieval to post-medieval date;
- Two areas of cropmarks of possible enclosures of Iron Age to Roman date;
- Findspots of prehistoric flint flakes, Roman and post-medieval finds;
- A World War Two accommodation and training site at Morton Hall;
- Attlebridge World War Two Airfield; and
- Honingham Park, an 18th century landscape park.

7.3.5. In order to determine the full historic environment potential of the site, a broad range of standard documentary and cartographic sources, including results from any archaeological investigations in the site and a study area around it will be examined in order to determine the likely nature, extent, preservation and significance of any known or possible buried heritage assets that may be present within or adjacent to the Site. This would include a detailed baseline compiled through a broad and standard range of data sources. The following data sources would be consulted:

- Historic England National Heritage List for England (NHLE) – Statutory designations (Scheduled Monuments; statutorily Listed Buildings; Registered Parks and Gardens; Historic Battlefields);
- Norfolk Historic Environment Record (HER) – The primary repository of archaeological information. This includes information from past investigations, local knowledge, find spots, and documentary and cartographic sources;
- National Record of the Historic Environment (NRHE) – A national database maintained by Historic England. This is not as comprehensive as the HER but can occasionally contain additional information. This is accessible via Pastscape website. This would be consulted for the Site and its immediate vicinity only;
- Local Planning Authority Conservation Area – Conservation Areas hold special architectural or historic interest;
- Local Planning Authority Archaeological priority area – Areas of interest identified by the local authority. There is likely to be a requirement for archaeological investigation (initially a desk-based assessment) as part of any planning application;
- British Geological Survey (BGS) Solid and drift geology digital map; online BGS geological borehole record data – Subsurface deposition, including buried geology and topography, this can provide an indication of potential for early human settlement, and potential depth of archaeological remains;
- Groundsure – historic Ordnance Survey maps from the 1st edition (1860s) onwards;
- Norfolk Record Office, Norwich – Historic maps (e.g. Tithe, enclosure, estate), published journals and local history;
- Historic England Archive – Swindon Vertical and specialist (oblique) aerial photographs;
- Bluesky – 1m resolution Digital Terrain Model LiDAR data;
- WSP – Geotechnical site investigation data;
- WSP – Topographical survey data;
- WSP – Proposed Development drawings (architectural and engineering plans and sections); and
- Internet – historical background and local planning policy information.

7.3.6. The assessment would also include a site walkover inspection where there is public access (or where the client has arranged land access) to determine the topography of the site and existing land use, and to provide further information on areas of possible past ground disturbance and general historic environment potential.

7.3.7. The site inspection will also include designated assets located within 1km from the Scheme for the purposes of scoping designated heritage assets and their intervisibility with the Scheme, as required by Historic England settings guidance (GPA3, HE 2017), and for the settings assessment itself.

7.4. MITIGATION

7.4.1. An appropriate mitigation strategy would aim to reduce or offset any significant adverse effects identified in the ES chapter for archaeology and cultural heritage.

7.4.2. Measures to mitigate effects would normally consist of design adjustments, to allow significant resources to be protected and retained (preservation in situ) or, where this is not feasible, investigation and recording before and during development, with dissemination at an appropriate level (preservation by record).

7.4.3. As heritage assets are an irreplaceable resource, it is generally considered as standard practice within the planning system to implement mitigation measures in order to offset any level of adverse

effect on a heritage asset, including minor adverse. This is to ensure that finite and irreplaceable remains are not removed/lost without record. The level of mitigation proposed is, in each case, proportionate to the significance of the asset being affected.

7.4.4. The mitigation strategy identified for the Scheme would be reported in the ES chapter. Some site-based investigation will be required to clarify the archaeological potential of the site, e.g. geophysical prospection followed by trial evaluation trenches. This might be followed by mitigation in the form of targeted archaeological excavation and recording, and/or an archaeological watching brief for remains of lesser significance. If the evaluation reveals little or no potential, no further work may be required.

7.4.5. Considering the likely archaeological sensitivity of the study area and the scale and nature of the Scheme, initial site-based investigation will likely be required prior to the determination of planning consent. Sufficient time (e.g. six months) will need to be allowed within the planning application to allow a staged programme of geophysical survey and where required, archaeological trial trench evaluation.

7.5. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

CONSTRUCTION PHASE

7.5.1. The following effects will be considered:

- Permanent loss, truncation and/or disturbance to known or possible buried archaeological remains due to construction activities, including preliminary site strip (including temporary access, construction compounds and topsoil storage areas), landscaping and planting;
- Permanent removal of above ground heritage assets, including upstanding earthworks and surviving elements of the historic landscape; and
- Temporary impacts to the setting of designated heritage assets during construction (e.g. from light and noise).

OPERATIONAL PHASE

7.5.2. The following effects will be considered:

- Permanent changes to the setting of designated above ground heritage assets.

7.5.3. There is the potential for permanent changes to the setting of designated above ground heritage assets at operation stage as a result of visual impacts from road infrastructure including lighting columns and signage, traffic and associated traffic noise. There is the potential for permanent changes to the night time setting of assets with the introduction of some minor street lighting at the A47 (southern) end of the scheme, leading up to the junction with the A47. There will also be signage lighting on the signs at junctions.

7.5.4. This potential impact is based on the nature of the development, the location and setting of the asset in relation to the Scheme and from the initial site walkover.

Table 7-2 – Elements Scoped in or Out of Further Assessment

Element	Phase	Scoped In	Scoped Out	Justification
Barn 50m north west of Low Farm House Grade II Listed barn	Operation	✔		Potential for permanent long-term impacts to the asset's setting, including visual impact of road infrastructure, lighting, traffic and associated traffic noise.
Berry Hall Grade II listed former vicarage, now house	Operation	✔		Potential for permanent long-term impacts to the asset's setting, including visual impact of road infrastructure, lighting, traffic and associated traffic noise.
Icehouse Grade II listed	Operation	✔		Potential for permanent long-term impacts to the asset's setting, including visual impact of road infrastructure, lighting, traffic and associated traffic noise.
Church of St Peter Grade I listed	Operation	✔		Potential for permanent long-term impacts to the asset's setting, including visual impact of road infrastructure, lighting, traffic and associated traffic noise.
Assets in Morton on the Hill: 1 * Grade II* listed building 4 x Grade II listed buildings	Operation	✔		Potential for permanent long-term impacts to the asset's setting, including visual impact of road infrastructure, lighting, traffic and associated traffic noise.
Assets in Honingham: 3 x Grade II listed buildings	Operation	✔		Potential for permanent long-term impacts to the asset's setting, including visual impact of road infrastructure, lighting, traffic and associated traffic noise.
Assets in Weston Longville: 1 x Grade I listed building 4 x Grade II listed buildings	Operation	✔		Potential for permanent long-term impacts to the asset's setting, including visual impact of road infrastructure, lighting, traffic and associated traffic noise.
Buried heritage assets recorded on the Norfolk HER	Construction	✔		Potential for direct physical impacts from road construction, construction compounds and retention ponds.

Element	Phase	Scoped In	Scoped Out	Justification
Previously unrecorded buried heritage assets	Construction	✔		Potential for direct physical impacts from road construction, construction compounds and retention ponds.
Barn 50m north west of Low Farm Grade II Listed barn	Construction		✔	Construction phase activities are short-term and temporary. The impacts from the phases of construction activities are not considered to be a significant change and have therefore been scoped out.
Berry Hall Grade II listed former vicarage, now house	Construction		✔	Construction phase activities are short-term and temporary. The impacts from the phases of construction activities are not considered to be a significant change and have therefore been scoped out.
Icehouse Grade II listed	Construction		✔	Construction phase activities are short-term and temporary. The impacts from the phases of construction activities are not considered to be a significant change and have therefore been scoped out.
Church of St Peter Grade I listed	Construction		✔	Construction phase activities are short-term and temporary. The impacts from the phases of construction activities are not considered to be a significant change and have therefore been scoped out.
Assets in Morton on the Hill: 1 x Grade II* listed building 4 x Grade II listed buildings	Construction		✔	Construction phase activities are short-term and temporary. The impacts from the phases of construction activities are not considered to be a significant change and have therefore been scoped out.
Assets in Honingham: 3 x Grade II listed buildings	Construction		✔	Construction phase activities are short-term and temporary. The impacts from the phases of construction activities are not considered to be a significant change and have therefore been scoped out.
Assets in Weston Longville: 1 x Grade I listed building 4 x Grade II listed buildings	Construction		✔	Construction phase activities are short-term and temporary. The impacts from the phases of construction activities are not considered to be a significant change and have therefore been scoped out.

Element	Phase	Scoped In	Scoped Out	Justification
All buried heritage assets	Operation		✔	An assessment of operational effects on buried heritage assets will be scoped out on the basis that, once the Scheme has been completed, no further ground disturbance will occur.
All buried heritage assets	Cumulative		✔	An assessment of cumulative effects has been scoped out. Cumulative effects are 'elevated' effects which occur where the combined effect of the Scheme with other Schemes in the vicinity, on a discrete and significant shared heritage asset/resource, is more severe than that reported at the site. This is on the basis that for intangible and deeply buried heritage assets it is not feasible to quantify accurately the nature of the resource across the assessment study area, which would enable the identification of a cumulative impact and potential elevated effect.
The setting of non-designated heritage assets.	Construction and Operation		✔	In accordance with the proportionality of NPPF, the significance of non-designated above ground heritage assets is not considered sufficient enough to warrant individual settings assessment. Such assets are not protected from demolition.
Possible 'important' hedgerows	Construction and Operation		✔	The assessment of hedgerows will be covered by the Ecology specialist chapter.

7.6. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

7.6.1. There are no enhancement measures in Highways England's Licence and the National Policy Statement for National Networks which are applicable to built and buried heritage assets. Nevertheless, the approach to the assessment will follow standard good practice to minimise harm whilst maximising opportunities in respect of the historic environment.

7.7. PROPOSED ASSESSMENT METHODOLOGY

7.7.1. The ES Chapter would set out the planning framework in respect of buried heritage assets (archaeological remains) along with the methodology for assessing the environmental effects predicted during the construction and operation (completed development) phases. It would provide a summary overview of the baseline conditions. The guidance used during the preparation of the Chapter will be as follows:

- Department for Transport, (2014), National Policy Statement for National Networks;
- Ministry of Housing, Communities and Local Government, (2019) National Planning Policy Framework;

- Chartered Institute for Archaeologists (CIfA), 2014, Standard and Guidance for Historic Environment Desk-based Assessment;
- Historic England, 2017, Conservation Principles, Policies and Guidance Consultation Draft;
- Historic England, 2017, The Setting of Heritage Assets, Historic Environment Good Practice in Planning: Note 3, Second Edition;
- Design Manual for Road and Bridges (DMRB) 2019, Volume 11, Section 3 Part 2, LA106 Cultural heritage assessment; and
- Norfolk County Council, 2018, Standards for Development Led Archaeological Projects in Norfolk.

7.7.2. The assessment of potential effects on heritage assets in the ES will include:

- Identifying above ground and known and potential buried predicted heritage assets that may be affected by the Scheme;
- Evaluating the significance of heritage assets, based on existing designations and professional judgement where such resources have no formal designation in accordance with DMRB methodology. This will consider factors which may have affected asset survival;
- Predicting the magnitude of change (impact) upon the known or potential heritage significance of heritage assets during the construction phase and operation/completed phase and the likely resulting significance of environmental effect;
- Considering the mitigation measures that have been included within the development proposals and any additional mitigation that might be required in the design and construction or operational lifetime of the Scheme to reduce or offset likely adverse effects;
- Quantifying predicted built heritage assets that may be affected in terms of setting by the Scheme; and
- Quantifying any residual effects (those that might remain after mitigation – i.e. major, minor or negligible).

7.7.3. The ES chapter would be supported by a technical appendix in the form of a full illustrated historic environment desk-based assessment (HEDBA). This would include a detailed baseline compiled through a broad and standard range of data sources (see Baseline Conditions above).

7.8. LIMITATIONS AND ASSUMPTIONS

7.8.1. To ensure transparency within the EIA process, the following limitations and assumptions have been identified:

- Best endeavours have been made to ensure that the baseline data is accurate and up to date. It is assumed that information on the HER database is accurate;
- The main limitation to the assessment of effects on buried heritage assets is the nature of the archaeological resource - buried and not visible - which means it can be difficult to predict accurately the presence and likely significance of buried heritage assets, and the impact of the project upon such assets, based primarily on a desk-based sources. The principle sources of information on heritage resources are the HER and the NRHE, which list all known archaeological sites and finds. This information provides an initial indication of assets present rather than a definitive list of all potential archaeological assets because the full extent of a buried heritage resource cannot be known prior to site-specific archaeological field investigation;
- Current understanding may be limited, in particular for periods not present or poorly presented in the historical record (prehistoric, Roman and early medieval periods) where no past

archaeological investigation of the site has been carried out. Therefore, the presence and extent, date, nature, survival and significance of possible, previously unrecorded, buried heritage assets are largely uncertain; and

- Where information is not available, professional judgement will be used to assess archaeological potential. This approach is based on other relevant data, for example the nature and depth of subsurface geological deposits as noted in geotechnical surveys and BGS data (this can provide an indication of the likely nature, depth, and survival of archaeological remains, if present), and the history of past land use as shown on historic maps (which is useful for determining likely truncation and survival.

7.8.2. Notwithstanding these limitations, the methodology proposed here is considered robust, utilising reasonably available information, and conforms to the requirements of local and national guidance and planning policy. Typically, appropriate standard archaeological prospection and evaluation techniques are utilised to reduce the uncertainties inherent in any desk-based assessment, as part of an overall EIA mitigation strategy.

8. LANDSCAPE AND VISUAL EFFECTS

8.1. CONSULTATION

8.1.1. Consultation with Norfolk County Council Landscape Team was conducted in March 2020 in order to discuss and agree the location of viewpoints for the Landscape and Visual Impact Assessment (LVIA), ahead of the winter landscape survey. Landscape Officers have also been present within the design group meeting which was landscape focussed.

8.2. STUDY AREA

8.2.1. The study area for the landscape and visual assessment would comprise the area from which the road and its associated structures and traffic is likely to be visible from, and therefore with the potential of having a significant effect. The study area will be agreed with the LPA in advance of the assessment.

8.2.2. A preliminary Zone of Theoretical Visibility (ZTV) has been plotted using Google Earth. The preliminary ZTV has also been informed through a review of Ordnance Survey 1:25,000 mapping, satellite imagery, google street view and previous field work. The ZTV is a 'bare-ground' ZTV (taking no account of screening by trees, woodlands, buildings or structures) based on a viewer eye height of 1.6m and a development height of 4m above the centreline of the road to account for high sided vehicles, as recommended in GLVIA3[31] , and using the Ordnance Survey Terrain 5 digital terrain model. The Scheme is broadly contained visually within a 2km radius; therefore, the study area for landscape character and visual amenity has been defined as a 2km buffer from the centreline of the highway alignment. The study area extends to the same distance at the termination points of the Scheme. The study area would be subject to review upon the establishment of a second 'with screening' ZTV and would be subject to being confirmed and amended as required following field work and in consultation with relevant stakeholders.

8.2.3. The study area for the assessment of landscape character would reflect the agreed ZTV but would extend to include an assessment of the relevant and impacted (directly or indirectly) landscape character areas in their entirety. That way, the effect on the whole of the character area will be assessed.

8.3. BASELINE CONDITIONS

POLICY

8.3.1. The Scheme falls within the boundary of Broadland District Council, a district within the area of Norfolk County Council. Breckland District Council and South Norfolk District Council are located to the south-west and south of the Scheme. Broadland District Council references within its Local

[31] Landscape Institute and Institute of Environmental Management and Assessment (2013) Guidelines for Landscape and Visual Impact Assessment 3rd Edition, London: Routledge.

Development Framework a number of statutory documents containing national and district policies and guidance for development. These include:

- National Planning Policy Framework (NPPF)[32];
- Planning Policy Guidance 15: Planning and the Historic Environment[33];
- Landscape Character Assessment (SPD)[34]; and
- Broadland Local Plan:
  - Joint Core Strategy DPD (Broadland, Norwich and South Norfolk)[35];
  - Development Management DPD[36];
  - Site Allocations DPD[37]; and
  - Growth Triangle Area Action Plan[38].

LANDSCAPE

8.3.2. The wider surrounding landscape generally has a gently undulating topography cut by shallow river valleys. At a district level, the land rises gradually from the low lying 'broads' in the east to around 60m AOD in the north west near Guestwick[39]. The Scheme area reflects that of the wider area with rolling hills to its south and the River Wensum valley, running from east to west, at its north.

8.3.3. The predominant soil type across much of the district is brown earth. Along the river valleys, the alluvium deposited on the valley floor gives rise to peat and gley soils.

8.3.4. The Site is located almost entirely on greenfield agricultural land, bounded by hedgerows and featuring areas of woodland, scrub, small wooded copses, individual trees, ditches, farms and other rural buildings.

8.3.5. Areas of ancient woodland have been identified within 50m of the Scheme, which form part of Primrose Grove and Mouse Wood.

LANDSCAPE DESIGNATIONS

8.3.6. There are no Areas of Outstanding Natural Beauty (AONB) or National Parks within the study area, however, Norfolk Coast AONB and the North Norfolk Heritage Coast are located within North Norfolk District around 20km north of the Scheme. There are no registered Historic Parks and Gardens or Country Parks located within 2km of the Scheme. The Scheme does run through

[32] Ministry of Housing, Communities and Local Government, 2019, National Planning Policy Framework
[33] Ministry of Housing, Communities and Local Government, 2014, Planning Practice Guidance. Historic Environment: Advises on enhancing and conserving the historic environment.
[34] Broadland District Council, 2012, Landscape Character Assessment Supplementary Planning Document (SPD)
[35] Greater Norwich Development Partnership (GNDP), 2011, Joint Core Strategy for Broadland, Norwich and South Norfolk (Amended January 2014)
[36] Broadland District Council, 2015, Development Management Development Plan Document (DPD)
[37] Broadland District Council, 2016, Site Allocations Development Plan Document (DPD)
[38] Broadland District Council, 2016, Growth Triangle Area Action Plan
[39] Broadland District Council, 2012, Landscape Character Assessment Supplementary Planning Document (SPD)

Honingham Park, an 18th century landscape park and a non-designated heritage asset, as outlined in Section 7.4.4 above.

Information on internationally, nationally, and locally designated sites near the Scheme area can be found in Chapter 9: Biodiversity (Section 9) of this Scoping Report.

PUBLIC RIGHTS OF WAY

8.3.7. There are no National Trails or Sustrans Cycle Routes within 500m of the Scheme. 'Sustrans: Fakenham to Harwich' route runs from Norwich northwest towards Reeham around 1.5km north of the Scheme. There are a number of Public Rights of Way (PRoW) within close proximity to the Scheme area including:

- Attlebridge FP4;
- Attlebridge FP5;
- Ringland FP1;
- Ringland FP2;
- Ringland FP3;
- Ringland FP4;
- Ringland FP7;
- Weston Longville FP9; and
- Honingham RB1.

8.4. MITIGATION

DESIGN MEASURES

8.4.1. Design measures with the intention to avoid or reduce the potential for significant effects shall include:

- Design progression of the Scheme alignment (in accordance with Design Manual for Roads and Bridges Volume 10 design advice[40]) to ensure as best fit as possible with the scale and character of the landscape setting;
- Avoiding the loss of existing vegetation where possible and including appropriate boundary treatments for the setting, including the reinstatement of local characteristic boundary treatments such as fencing and hedgerows;
- Consideration of opportunities for introducing or modifying earthworks, including potential for the inclusion of screening earthworks where considered appropriate and the scope to vary embankment slope profiles to help integrate the Scheme;
- An appropriate Design and Landscape Strategy that respects the local character of the landscape and helps to integrate the Scheme within the landscape;
- Selective placement of planting to provide a visual screen function for local views. It is envisaged that the Design and Landscape Strategy will incorporate native species mixes appropriate to the location; and

[40] Highways Agency (2001) Design Manual for Roads and Bridges Volume 10 (online) (Accessed August 2019)

- Input into the Scheme design and finish of the structures, including the proposed viaduct over the River Wensum to integrate into the local character and reduce the visual impact of the structure where possible.

8.4.2. The mitigation measures described above are not exhaustive. Landscape and visual mitigation shall be reviewed and discussed with key stakeholders and the design team, to help further inform the identification and agreement of mitigation measures during both operation and construction.

8.5. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

8.5.1. The Scheme, during its construction and subsequent operation, is expected to potentially affect the landscape in the following ways:

- The addition of exposed earthworks, plant, machinery, cranes, temporary lighting, and temporary barriers at construction;
- The additional exposure of the Scheme alignment, particularly new junctions, and traffic movement through the landscape where there is currently an absence of an existing road;
- The presence of a new viaduct structure at a scale not currently present, modifying the way in which the existing river valley is perceived;
- Alteration of existing landform (cuttings and embankments);
- Loss of established field pattern; and
- Loss of existing vegetation.

8.5.2. The Scheme, during its construction and subsequent operation is expected to potentially affect visual amenity in the following ways:

- Visual intrusion of construction activities into existing rural views;
- The potential visual exposure of the Scheme alignment, particularly new junctions, structures, the crossing of the River Wensum and traffic movements into views where there is currently an absence of an existing road;
- Changes in perception of views within a currently rural, dark and tranquil setting; and
- Increased visibility of new structures due to changes in vegetation.

8.5.3. The LVIA Chapter of the ES will consider effects on landscape and visual receptors within the agreed study area.

8.5.4. Table 8-1 shows which elements have been scoped in or out of the assessment and the justification for each.

Table 8-1 – Elements Scoped in or Out of Further Assessment

Element	Phase	Scoped In	Scoped Out	Justification
Visual impacts within the zone of visual influence	Construction and Operation	✔		Impacts have the potential to be significant within the zone of visual influence and therefore will be assessed through consideration of key views, sensitive visual receptors and selected viewpoints.
Landscape character impacts	Construction and Operation	✔		Impacts have the potential to be significant within the study area, therefore relevant

Element	Phase	Scoped In	Scoped Out	Justification
inside the study area				character areas will be identified and assessed in the ES.
National Character Area 78 and 84	Construction and operation	✔		Although large in geographical extent, the Scheme has the potential to modify local characteristics that contribute to an understanding of the wider landscape. An assessment of the effect on National Character Area 78 and 84 has therefore been scoped in.
Broadland and Breckland District Landscape Typologies	Construction and Operation	✔		Although large in geographical extent, the Scheme has the potential to modify local characteristics that contribute to an appreciation of the district landscape typology. An assessment of the effect on relevant landscape typologies has therefore been scoped in.
Greenbelt Assessment	Construction and Operation		✔	The Scheme is not located within Greenbelt; therefore, this is not relevant to this assessment.
Artificial Lighting	Construction		✔	Whilst temporary lighting effects on night-time views at construction will not be considered as a separate entity, artificial lighting (e.g. for health and safety), if identified, will be considered as part of the overall impacts during construction
Artificial Lighting	Operation		✔	The Scheme will include some lighting columns at the junction with the A47 and signage lighting at junctions during operation. It is considered this lighting would not materially affect sensitive receptors and therefore consideration of artificial lighting and night-time views is not required.
Visual impacts outside the Zone of Influence	Construction and Operation		✔	If views are afforded outside the ZVI, these would be from a distance and/ or affect a small proportion of the view only. They are therefore not likely to be significant and are therefore scoped out.
Landscape Character impacts outside the study area	Construction and Operation		✔	The Scheme will not directly impact Landscape Character Areas (LCA) beyond the study area. Where there is inter-visibility it would be at a distance and small scale in nature such that the Scheme would not affect the perception of the landscape. Effects would not be considered significant, therefore Character areas outside the study area have been scoped out.

8.6. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

8.6.1. The following enhancement measures would be considered during the development of the Scheme design:

- Reinstatement and improvement of surrounding field boundaries, field margins and River Wensum corridor;
- Inclusion of planting diversity;
- Improvement to NMU routes;
- Potential for landscaping located on the proposed green bridges;
- Consideration of SuDS principles in ponds and drainage features; and
- Improving connectivity of existing woodlands, including habitat connectivity.

8.7. PROPOSED ASSESSMENT METHODOLOGY

8.7.1. For the ES, a detailed landscape and visual assessment will be prepared in accordance with DMRB guidance, LA 107 Landscape and Visual Effects[41] and informed by the GLVIA3, where the latter places greater emphasis on the explanation and justification for assessment criteria and conclusions, appropriate to the Scheme being assessed.

8.7.2. The baseline review undertaken to date has included the following:

- Review of national and local planning policy;
- Review of relevant planning policy in relation to landscape;
- Review of National Character Areas; Regional and Local Landscape Character Landscape Strategies;
- Review of listed buildings;
- Review of work previously undertaken as part of the Northern Distributor Road (now known as the A1270 Broadland Northway) and the accompanying landscape and visual impact assessment;
- Identification of public rights of way, national cycle routes and permissive routes; and
- Analysis of the potential landscape and visual impacts using Ordnance Survey Mapping, computer modelling (ZTV), desk-based review and web-based aerial imagery.

8.7.3. Additional baseline review to be undertaken to support the ES will include the following:

- Refinement of ZTV;
- Refinement of Study area;
- Identification of character areas; and
- Identification and agreement of viewpoint locations with LPA.

[41] Highways England, 2019, LA 107 Landscape and Visual Effects (Revised January 2020)

SIGNIFICANCE CRITERIA

Landscape

8.7.4. Landscape effects relate to any direct physical change on the landscape caused by the Scheme, or how the landscape is perceived following the development. Landscape impact assessment considers these effects, both in terms of the individual components of the landscape and on the structure, coherence and character of the landscape as a whole.

8.7.5. For effects on the landscape resource, the assessment of their significance is determined by considering the magnitude of impact arising from the Scheme on each of the features and elements that make up the character of the resource, bearing in mind the value of the landscape (and/or of specific features and elements), and the ability of the landscape to accommodate change of the type proposed (i.e. its sensitivity).

8.7.6. Landscape sensitivity will depend on the character of the receiving landscape, the nature of the Scheme and the type of change. Indicative sensitivity criteria guidance for the landscape resource is set out in LA 107, paragraph 3.18 - 3.22 (Table 3.22).

8.7.7. The magnitude of impact on the landscape resource is the degree of change that would arise if the Scheme were to be completed (i.e. 'Do Something'), as compared with a 'Do Minimum' situation. Factors to consider are the scale of the impact, the nature of the impact, whether it is an adverse or beneficial change, and the timescale involved (i.e. temporary, short, medium or long term/permanent). Indicative criteria guidance is set out in LA 107, paragraph 3.23 - 3.24 (Table 3.24).

8.7.8. Significance of effect categories are set out in LA 104, paragraph 3.5 - 3.9 (Table 3.7), using a five-point scale ranging from Neutral to Very Large.

8.7.9. LA 107 makes it clear that these criteria are not prescriptive, and in making qualified judgements the landscape professional needs to be able to demonstrate to others a consistent and justifiable argument.

Visual

8.7.10. Visual effects relate to changes in the composition and character of views available in the area affected by the Scheme. Visual impact assessment considers the changes to the views available to people who experience these effects, who may be living or working in the area, enjoying recreational activities or simply passing through.

8.7.11. For effects on visual amenity, the assessment of their significance is determined by considering the sensitivity of the visual receptor with the magnitude of the impact on that visual receptor arising from the Scheme.

8.7.12. Visual sensitivity is categorised by the sensitivity of the visual receptor and will include people in their homes, users of public rights of way and other areas of open space or recreational landscapes, people at work and people travelling along roads or railway lines. Indicative sensitivity criteria guidance for visual amenity is set out in LA 107, paragraph 3.40 – 3.41 (Table 3.41).

8.7.13. The magnitude of impact on visual amenity is the degree of change that would arise if the Scheme were to be completed (i.e. 'Do Something'), as compared with a 'Do Minimum' situation.

8.7.14. Factors to consider are the scale of the impact, the nature of the impact, whether it is an adverse or beneficial change, and the timescale involved (i.e. temporary, short, medium or long term/permanent). Indicative criteria guidance is set out in LA 107, paragraph 3.42 – 3.43 (Table 3.43).

8.7.15. Significance of effect categories are set out in LA 104, paragraph 3.5 - 3.9 (Table 3.7), using a five-point scale ranging from Neutral to Very Large .

8.7.16. As per landscape, LA 107 makes it clear that these criteria are not prescriptive, and in making qualified judgements the landscape professional needs to be able to demonstrate to others a consistent and justifiable argument.

8.7.17. Cumulative landscape and visual effects of the Scheme in association with other proposed developments will be considered as required, along with identification of mitigation and enhancement where appropriate.

8.7.18. The text will be accompanied by suitable figures and plans including:

- Landscape Character and Designations Plan;
- Viewpoint Location Plan and Zone of Visual Influence; and
- Viewpoint Photograph Sheets.

8.8. LIMITATIONS AND ASSUMPTIONS

8.8.1. To ensure transparency within the EIA process, the following limitations and assumptions have been identified:

- Site surveys for landscape and visual effects will make use of publicly accessible locations where possible, using representative viewpoints used to help describe the general nature of views from nearby receptors. Access to private property will be sought in consultation with landowners where publicly accessible locations are not possible; and

9. BIODIVERSITY

9.1. CONSULTATION

9.1.1. This section covers consultation with both statutory and non-statutory bodies relating to the Environmental Impact Assessment (EIA) for biodiversity. Consultation comprised regular engagement through face to face meeting and will continue until the submission of the planning application. For the purpose of this report, the latest consultation was dated 21st January 2020. The majority of consultation has been undertaken with the statutory consultees Natural England and the Environment Agency, see Table 9-1. However consultation with non statutory nature conservation organisations, via an Ecology Liaison Group (ELG), has been undertaken[42]. The following nature conservation organisations have been invited to join the ELG:

- Natural England;
- Norfolk Wildlife Trust;
- Royal Society for the Protection of Birds (RSPB);
- Woodland Trust;
- Norfolk and Norwich Naturalist Society;
- Wensum Valley Birdwatching Society;
- Toadwatch;
- Norwich Bat Group;
- Buglife;
- Norfolk Amphibian and Reptile Group;
- Friends of the Tud Valley;
- Norfolk Badger Trust;
- Costessey Conservation Volunteers; and
- Friends of the Tud Valley.

9.1.2. To date the following organisations have either not been able to attend or chosen not to attend; RSPB, Costessey Conservation Volunteers, Buglife, Woodland Trust, Norfolk Amphibian and Reptile Group.

9.1.3. Consultation has been ongoing since June 2016, covering multiple alignment options prior to announcement of the preferred alignment in June 2019. For the purpose of this report, the scope for biodiversity assessment will focus primarily on the Scheme design as of February 2020 and considers consultation with both statutory and non-statutory bodies.

9.1.4. The below table provides a summary of correspondence between statutory bodies Natural England and the Environment Agency.

[42] Formed of statutory and non-statutory bodies to promote discussion between groups from varying ecological backgrounds on the potential constraints, mitigation and enhancement opportunities relating to the Scheme.

Table 9-1 – Consultation Undertaken to Date with Natural England and the Environment Agency

Body/Organisation	Date of Consultation (Meetings)	Discussion	Key Outcomes of Discussions
Environment Agency	6th May 2016	Discussion regarding the River Wensum. The Environment Agency provided a list of existing pressures. It was noted that the crossing of the River Wensum is the primary concern of the Environment Agency. Concerns were also raised with regards to the River Tud which may also be impacted.	Crossing points for the River Wensum and River Tud were to be considered at the design stage.
Natural England	1st June 2016	Discussion regarding Habitats Regulations Assessment (HRA).	It was agreed that an HRA would be undertaken.
		Discussion regarding the River Wensum Special Area of Conservation (SAC) and the importance of the immediate surrounding habitats.	It was agreed that favoured method of crossing would be a viaduct.
		Discussion regarding ecological issues for consideration, with regards to the SAC.	It was agreed that Desmoulin's whorl snail *Vertigo moulinsiana*, white-clawed crayfish *Austropotamobius pallipes*, brook lamprey *Lampetra planeri,* bullhead *Cottus gobio* and river water-crowfoot *Ranunculus fluitans* will be considered.
		Discussions regarding the importance of the Wensum corridor for barbastelle *Barbastella barbastellus*.	It was agreed that bat surveys will be included within the scope and design measures should be included to minimise impact at the river crossing and reduce artificial lighting.
		Discussion regarding the potential impacts on ancient woodland.	It was agreed that the Scheme should look to avoid ancient woodland.
		Discussion regarding the potential impacts on great created newts *Triturus cristatus*, badgers *Meles meles,* barn owls *Tyto alba* and water voles *Arvicola amphibius*.	It was agreed that these features will be considered.
		Discussion regarding the relevant contacts for local biodiversity information.	Natural England recommended that the following organisations are consulted: Norfolk

Body/Organisation	Date of Consultation (Meetings)	Discussion	Key Outcomes of Discussions
			Biodiversity Information Service (NBIS) and Norfolk Wildlife Trust.
Environment Agency and Natural England	12th July 2017	Discussion regarding ecological surveys and enhancement opportunities.	It was agreed that ecological surveys of the River Wensum will be required, and the Scheme should seek to maximise opportunities for enhancements where possible.
Environment Agency and Natural England	18th October 2018	The proposed viaduct crossing for the River Wensum was presented and discussed.	Environment Agency and Natural England responded to say they would require detailed design before providing advice.
		Discussion regarding Sustainable Urban Drainage (SuDS).	It was agreed that SuDS will be strictly functional as maintenance activities such as dredging could have a detrimental impact on biodiversity.
Natural England		Discussion on ecological survey work undertaken to date. Natural England queried how protected species were being considered.	A range of protected species and habitat surveys were presented and agreed upon by Natural England. Key issues that will be addressed will involve the loss of habitat connectivity for bats and the reduction of the collision risk on bats from cars. Bat gantries will not be considered as a mitigation option.
		Discussion regarding HRA relating to the River Wensum SAC.	It was agreed that notwithstanding HRA caselaw, mitigation should be included within the outline design.
Natural England	8th March 2019	Discussion on baseline survey scope for 2019 and 2020.	Natural England agreed with the survey scope.
		Discussion on bat activity methodology.	It was agreed that there would an emphasis on using larger numbers of automated detectors for bat activity surveys.

Body/Organisation	Date of Consultation (Meetings)	Discussion	Key Outcomes of Discussions
		Discussion on aquatic survey methodology.	It was agreed to undertake aquatic surveys beyond the River Wensum, looking at functional linkage.
		Discussion on white-clawed crayfish.	It was agreed that although likely absent from the River Wensum, white-clawed crayfish surveys would still be undertaken.
		Discussion regarding fish mitigation.	It was agreed that the Scheme would look to maintain connectivity between the main river channel to tributaries, spawning grounds and fry refuges.
		Discussion regarding macrophytes.	It was agreed not to dismiss the significance of Ranunculus as an indicator of river type even if absent during surveys.
		Discussion regarding National Vegetation Classification (NVC)	Natural England advised to survey for rare arable plants.
Natural England	13th June 2019	Discussion regarding the baseline survey scope including biodiversity net-gain.	The survey scope was agreed.
		Discussion regarding the feasibility studies to inform the HRA.	The following were agreed: Hydrogeological Assessment; Shading Analysis; and Review of flora and fauna in the specific location of the viaduct and shadowing impact areas.
Ecology Liaison Group (ELG)	18th July 2018	Formation of ELG, comprising both statutory and non-statutory organisations. The purpose of the ELG is to share local knowledge from various nature conservation backgrounds, discussing biodiversity concerns relating to the Scheme, and potential enhancement opportunities for biodiversity features.	The overall aim of the group is a collaborative approach towards a post-development goal of biodiversity net-gain.
Environment Agency and Natural England	13th August 2019	Discussions regarding ongoing survey work.	Survey work to focus on preferred highway alignment (the Scheme). It was

Body/Organisation	Date of Consultation (Meetings)	Discussion	Key Outcomes of Discussions
			acknowledged that the Site boundary was not fixed, therefore further survey work will likely be required once this is established.
		Biodiversity net-gain and a potential joined up approach with Highways England was discussed.	Various options for biodiversity net-gain are being looked at.
		Concerns raised regarding the potential impact of the ground investigation works on ecology.	An ecological method statement will be produced and where necessary works would be supervised by an Ecological Clerk of Works (ECoW).
		Discussion regarding the use of a Bailey bridge for potential temporary access of the River Wensum during construction.	Environment Agency and Natural England indicated they would need to discuss and consider this further.
		Discussion regarding the shading analysis relating to the viaduct design.	No objections regarding the methodology.
Ecology Liaison Group (ELG)	25th October 2019	Within this meeting, the group was divided into two where biodiversity issues relating to the Scheme could be discussed.	The information discussed will be considered in relation to the design and mitigation strategy.
Natural England and Environment Agency	5th November 2019	Discussion regarding potential impacts of the Scheme on biodiversity features.	It was agreed that compensation be provided through biodiversity net-gain and strategic linkage of habitats. Wildlife crossings such as underpasses for bats and badgers to be considered.
Natural England and Environment Agency	21st January 2020	Discussion regarding the loss of bat foraging habitat to be compensated through planting and restoration of woodland.	Agreed in principle.
		Discussion regarding the use of Natural England licencing policy	No objections, although there is a lack of baseline data at this stage, therefore this mitigation approach is to be formally agreed.

Body/Organisation	Date of Consultation (Meetings)	Discussion	Key Outcomes of Discussions
		principles[43], with a focus on wetland habitat creation rather than fencing and translocation for great crested newts	
		It was discussed that a low number of reptiles had been identified from survey work to date. It was suggested to Natural England that reptiles could be moved to suitable adjacent habitat or newly created habitat in advance of construction.	No objections, although there is a lack of baseline data at this stage, therefore this mitigation approach is to be formally agreed.
		Discussion over whether surveys could take a pragmatic approach for barn owls, assuming presence beyond the Scheme, providing suitable mitigation.	Natural England agreed in principle, although there is a lack of baseline data at this stage, therefore this mitigation approach is to be formally agreed.
		Discussion over the potential impacts on water voles from vibration arising from piling. Natural England advised that water voles cannot be moved into another water vole territory. Wider survey extents may be required to determine territories. Mitigation options discussed included temporary trapping; or accepting temporary disturbance and enhance surrounding area.	No objections, although there is a lack of baseline data at this stage, therefore this mitigation approach is to be formally agreed.
		Discussion as to a join mitigation strategy regarding water vole habitat creation, which could also benefit Desmoulin's whorl snail.	Approach to be considered as part of the mitigation strategy.

9.1.5. Information has been obtained from Norfolk Biodiversity Information Service (NBIS) initially in 2018 based on the previous six route options. An updated request was made in March 2020 for all

[43] Natural England (2016). Proposed new policies for European Protected Species licensing. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/575709/eps-consultation-outcome.pdf

statutory and non-statutory designated sites and protected / notable species and habitats within 2km of the Scheme. This request was extended to 6km for barbastelle records. With reference to data validity guidance (CIEEM 2019[44]), further consultation will be undertaken with NBIS, The Norwich Bat Group, the British Trust for Ornithology (BTO) and The Barn Owl Conservation Network in 2021.

9.1.6. Study Area Table 9-5 below set out the proposed study areas for the biodiversity features potentially impacted by the Scheme. Any deviations from the study areas defined below will be in line with professional judgement and best practice. For each feature the study area has been defined in line with the proposed baseline methodology, encompassing two parts, a desk study and a field survey (where considered appropriate).

Table 9-2 – Study Area for Biodiversity Features – Designated Sites

Biodiversity Feature	Study area
Internationally designated sites Ramsar sites, Special Area of Conservation (SACs) and Special Protection Areas (SPAs).[45]	Desk Study Internationally designated sites and functionally linked land within and up to 10km from the Scheme. SACs where bats are noted as one of the qualifying interests, within and up to 30km from the Scheme.
Nationally designated sites Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR) and Local Nature Reserves (LNR).	Desk Study Within and up to 5km from the Scheme.
Local non-statutory designated sites County Wildlife Sites[46] (CWS) and Roadside Nature Reserves (RNR).	Desk Study Within and up to 2km from the Scheme. Field Survey Within the Scheme.

[44] CIEEM (2019). Advice Note on the Lifespan of Ecological Reports & Surveys. Chartered Institute of Ecology and Environmental Management. Winchester.
[45] Internationally designated sites also consider Candidate SACs (cSAC), Sites of Community Importance (SCI), Potential SPAs (pSPA), Possible SACs (pSACs) and proposed Ramsar sites.
[46] In Norfolk, local wildlife sites are referred to as County Wildlife Sites (CWS).

Table 9-3 – Study Area for Biodiversity Features - Habitat

Biodiversity Feature	Study Area
Ancient woodland	Desk Study Within and up to 200m from the Scheme.
Important hedgerows[47]	Field Survey Hedgerow survey – Full length of all hedgerows directly connected to the Scheme. This will include all hedgerows that fall outside the Scheme, but are immediately connected to a hedgerow within the Scheme.
Habitat of Principal Importance (HPI)[48]	Desk Study Within and up to 200m from the Scheme.
	Field Survey Phase 1 habitat survey - Within and up to 50m from the Scheme. River habitat survey (RHS) – 500m section of the River Wensum (250m either side of the viaduct crossing location). Off-site creation/enhancement for biodiversity net-gain considered up to 6km beyond Scheme.
Non-priority habitat[49]	Field Survey Phase 1 habitat survey - Within the Scheme. Off-site creation/enhancement for biodiversity net-gain considered up to 6km beyond Scheme.

Table 9-4 – Study Area for Biodiversity Features - Flora

Biodiversity Feature	Study Area
Protected/notable flora	Desk Study Biological records for all protected/notable flora within and up to 2km from the Scheme. SACs designated for macrophytes within and up to 2km from the Scheme.
	Field Survey Phase 1 habitat survey - Within the Scheme. National vegetation classification (NVC): All woodland within the Scheme. Macrophyte survey – 100m section of the River Wensum and ordinary watercourses within the Scheme (50m either side of crossing point).

[47] The Hedgerow Regulations (1997). Criteria for determining 'Important' hedgerows.

[48] Natural Environment and Rural Communities Act (2006). Habitat of Principal Importance (HPI).
[49] For the purpose of informing the biodiversity net-gain calculations only.

Biodiversity Feature	Study Area
Notable, veteran and ancient trees.	Please referrer to arboriculture section.

Table 9-5 – Study Area for Biodiversity Features - Fauna

Biodiversity Feature	Study Area
White-clawed crayfish	Desk Study SAC's designated sites for white-clawed crayfish within and up to 2km from the Scheme. Biological record data for white-clawed crayfish within and up to 2km from the Scheme.
	Field Survey White-clawed crayfish survey – 200m section of the River Wensum (100 m either side of the viaduct crossing location).
Fish	Desk Study SAC's designated sites for fish within and up to 2km from the Scheme. Biological record data for fish 2km up and down stream of all proposed watercourse crossing points.
	Field Survey Electric fishing – 100m section of the River Wensum and ordinary watercourses within the Scheme (50m either side of crossing point).
Amphibians (great crested newts *Triturus cristatus* and common toad *Bufo bufo*)	Desk Study Statutory designated sites for amphibians within and up to 2km from the Scheme. Biological record data for amphibians (including active European Protected Species Mitigation Licences for great crested newts) - within and up to 2km from the Scheme.
	Field Survey Great crested newt habitat suitability index (HSI) and environmental DNA (eDNA) presence/absence surveys - Within and up to 500m from the Site. Great crested newt population estimate surveys (where presence confirmed) - Within and up to 250m from the Scheme. Common toad within and up to 250m from the Scheme (incidental survey only).
Birds	Desk Study Ramsar and SPA sites designated sites for birds within and up to 10km from the Scheme. Biological record data for birds within and up to 2km from the Scheme.
	Field Survey Wintering bird survey - Within and up to 100m from the Scheme. Breeding bird survey - Within and up to 100m from the Scheme. Barn owl survey (incidental records only) - Within and up to 25m from the Scheme for trees and 100m for structures – undertaken in alongside the bat surveys.

Biodiversity Feature	Study Area
Bats	Desk Study Statutory designated sites for bats within and up to 30km from the Scheme. Biological record data for bats (including active European Protected Species Mitigation Licences) - within and up to 2km from the Scheme. Extended to 6km for barbastelle.
	Field Survey Tree roosting bats - Within and up to 25m from the Scheme. Structure roosting bats - Within and up to 100m from the Scheme. Hibernating bats (structures only) - Within and up to 500m from the Scheme. Foraging and commuting bats - Within the Scheme. Radiotracking surveys extended up to 6km[50].
Badgers	Desk Study Biological record data for badgers within and up to 2km from the Scheme.
	Field Survey Badger survey - Within and up to 50m from the Scheme. Survey scope extended to cover the following woodlands; Rose Carr, The Nursery, Primrose Grove, Long Plantation, Spring Hills, Attlebridge Hills, Foxburrow Plantation, Old Covert and Unknown Woodland South of Ringland Lane. Badger bait marking survey – Within and up to 1km from Long Plantation and Foxburrow Plantations woodlands.
Otter *Lutra lutra*	Desk Study Biological record data for otter within and up to 2km from the Scheme.
	Field Survey Otter survey - Within the Site. Extended to 300m beyond the Scheme along all watercourses and associated riparian habitat (upstream and downstream).
Water vole	Desk Study Biological record data for water vole within and up to 2km from the Scheme.
	Field Survey Water vole survey - Within the Site - extended to 300m beyond the Site along all watercourses and associated riparian habitat (upstream and downstream).
Other Species of Principal	Desk Study Biological record data for SPI (not listed above) within and up to 2km from the Scheme.

[50] Radio-tracking surveys are more flexible as they depend on movement of bats. It is estimated that the survey could extend up to 6km from the Scheme.

Biodiversity Feature	Study Area
importance[51](SPI) - mammals- Brown hare *Lepus europaeus*, polecat *Mustela putorius* and hedgehog *Erinaceus europaeus*	Field Survey SPI will be considered incidentally during the survey work within the Scheme.
Reptiles	Desk Study Biological record data for reptiles within and up to 2km from the Scheme.
	Field Survey Reptile presence/absence survey - Within the Scheme.
Desmoulin's whorl snail	Desk Study SAC's designated for Desmoulin's whorl snail within and up to 2km from the Scheme. Biological record data for Desmoulin's whorl snail 2km up and down stream of all proposed watercourse (including ditches) crossing points.
	Field Survey Desmoulin's whorl snail survey - River Wensum and associated floodplain between the Fakenham Road bridge and the Ringland Road Bridge.
Terrestrial invertebrates	Desk Study Biological record data for terrestrial invertebrates within and up to 2km from the Scheme.
	Field Survey Terrestrial Invertebrate survey - Within the Scheme.
Aquatic macroinvertebrates	Desk Study Biological record data for aquatic macroinvertebrates within and up to 2km from the Scheme.
	Field Survey Aquatic macroinvertebrate survey – 100m section of all watercourse crossing points.

9.2. BASELINE CONDITIONS

9.2.1. Baseline data collection commenced in July 2018 based on the six potential highway alignment options. Survey work continued, focussing on the Preferred option (the Scheme) from July 2019. As of the 10th February 2020, the broad extent of works has been set but is still subject to small changes. This section outlines the findings gathered to date and scope of further field surveys required to complete the baseline in line with defined study areas presented above. This data will be

[51] Natural Environment and Rural Communities Act (2006). Species of Principal Importance (SPI).

used as part of the baseline for the ES. The methodologies detailed below have been informed by consultation, best practice guidelines and professional judgement. Baseline data collection has been designed to ensure validity in line with guidance (CIEEM 2019[52]).

DESIGNATED SITES

Internationally Designated Sites

9.2.2. A desk study using the online resource MAGIC[53] identified the following internationally designated sites within 10km of the Scheme, increased to 30km for bats.

Table 9-6 – Internationally Designated Sites

Site and designation	Approximate distance and direction from Scheme
River Wensum SAC[54]	Within the Site
Norfolk Valley Fens SAC[55]	6.3km south-west
Paston Great Barn SAC[56]	26km north-east

Nationally Designated Sites

9.2.3. A desk study using the online resource MAGIC[57] identified the following nationally designated sites within 5km of the Scheme.

Table 9-7 – Nationally Designated Sites within 5km of the Scheme

Site and designation	Approximate distance and direction from Scheme
River Wensum SSSI[58]	Within the Site
Swannington Upgate Common SSSI[59]	2.2km north

[52] CIEEM (2019). Advice Note on the Lifespan of Ecological Reports & Surveys. Chartered Institute of Ecology and Environmental Management. Winchester.
[53] MAGIC (2002). Multi-agency Geographic Information for the Countryside.
[54] JNCC. River Wensum. Designated Special Area of Conservation (SAC). https://sac.jncc.gov.uk/site/UK0012647
[55] JNCC. Norfolk Valley Fens. Designated Special Area of Conservation (SAC). https://sac.jncc.gov.uk/site/UK0012892
[56] JNCC. Paston Great Barn. Designated Special Area of Conservation (SAC). http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?eucode=UK0030235
[57] MAGIC (2002). Multi-agency Geographic Information for the Countryside.
[58] Natural England (1993). River Wensum. Site of Special Scientific Interest (SSSI). https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1006328.pdf
[59] Natural England (1985). Swannington Upgate Common. Site of Special Scientific Interest (SSSI). https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1000149.pdf

Site and designation	Approximate distance and direction from Scheme
Alderford Common SSSI[60]	2.3km north-west
Hockering Wood SSSI[61]	2.4km west
Whitwell Common SSSI[62]	4.9km north-west

Local Non-Statutory Designated Sites

9.2.4. Information was obtained from NBIS in March 2020 regarding local non-statutory designed sites within 2km of the previous six highway alignment options. The below list has been refined to show only the sites within 2km of the Scheme, a number of these are identified on Appendix B-1.

Table 9-8 – Local Non-Statutory Designated Sites within 2km of the Scheme

Site and designation	Approximate distance and direction from Scheme
River Wensum Pastures, Ringland Estates CWS (Ref: 2303)	Within the Site
Broom & Spring Hills CWS (Ref: 1341)	Within the Site
Wensum Pastures at Morton Hall CWS (Ref: 2070)	Within the Site
Land adjoining Foxburrow Plantation CWS (Ref: 2116)	Within the Site
Fakenham Road, Roadside Nature Reserve (RNR) (Ref: 2116)	Within the Site.
Primrose Grove CWS (Ref: 2305)	Within the Site.
Old Covert, Wood Lane CWS (Ref 2109)	10m west
Gravelpit Plantation and Church Hill CWS (Ref: 2304)	10m east
Mouse Wood CWS (Ref: 2050)	15m west
Attlebridge Hills CWS (Ref: 1343)	20m north

[60] Natural England (1986). Alderford Common. Site of Special Scientific Interest (SSSI). https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1000483.pdf
[61] Natural England (1984). Hockering Wood. Site of Special Scientific Interest (SSSI). https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1002623.pdf
[62] Natural England (1985). Whitwell Common. Site of Special Scientific Interest (SSSI). https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1002058.pdf

Site and designation	Approximate distance and direction from Scheme
Triumph & Foxburrow Plantations CWS (Ref:1344)	400m north
Walsingham Plantation CWS (Ref: 1351)	510m east
Hall Hills/Ringland Covert CWS (Ref: 2105)	570m east
Church Hill Common CWS (Ref: 1340)	630m east
Fen West of East Tuddenham CWS (Ref: 660)	660m south
Fen Plantation CWS (Ref: 2117)	670m south
River Tud at Easton and Honingham CWS (Ref: 250)	675m south-east
Park Grove CWS (Ref: 2033)	730m west
Dryhill Plantation CWS (Ref: 2113)	900m east
Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plantation CWS (Ref: 2296)	960m south-east
Jennis' Wood CWS (Ref: 2113)	1.1km east
Marriott's Way CWS (Ref: 2176)	1.2km north
Ave's Gap CWS (Ref:2306)	1.3km east
Lake adjacent to Concrete Plant CWS (Ref: 1346)	1.6km north-west
Bush Meadow Plantation CWS (Ref: 1347)	1.7km north-west
Weston Meadow CWS (Ref: 1345)	1.7km west
Lenwade Pits (East) CWS (Ref: 1349)	1.8km north-west
Ringland Pits CWS (Ref: 1339)	2km east

HABITAT

Ancient Woodland

9.2.5. A desk study using the online resource MAGIC identified ancient woodland within 200m of the Scheme, which formed part of Primrose Grove and Mouse Wood. The Scheme is over 30m from Primrose Grove ancient woodland (south) and Mouse Wood ancient woodland (west) is located adjacent to the pre-existing Wood Lane, a road considered as a possible access route to the Scheme. No direct impacts are expected, therefore no further survey work for ancient woodland will be undertaken.

Important Hedgerow Survey

9.2.6. The full length of all hedgerows directly connected to the Scheme will be subject to survey. This includes hedgerow that are themselves outside the Scheme, but immediately connected to a hedgerow within the Scheme. Hedgerow surveys will be completed with reference to the Hedgerow Regulations. Where hedgerows do not meet the criteria for 'Important' under these regulations, hedgerows will still be considered in relation to HPI criteria, refer to the section below.

9.2.7. To date, hedgerows which met the criteria for 'Important' have been identified within the Scheme with further survey work to be undertaken in 2020 to complete the baseline.

Habitats of Principal Importance

Desk Study

9.2.8. A desk study using the online resource MAGIC identified HPI within the Scheme, and up to 200m from the Site. The following HPI were returned:

- Floodplain Grazing Marsh[63];
- Deciduous Woodland (officially Lowland Mixed Deciduous Woodland)[64]; and
- Lowland Fens[65].

Habitat Survey

9.2.9. Within and up to 50m from the Site, consideration will be given to whether habitats qualify, or could qualify as HPI (including HPI identified on MAGIC), following habitat descriptions published by the Joint Nature Conservation Committee (JNCC 2008[66]). Survey work in 2019 has identified the following HPI in addition to the above:

- Rivers[67];
- Ponds[68];
- Hedgerows[69]; and

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[63] UK Biodiversity Action Plan Priority Habitat Descriptions: Coastal and Floodplain Grazing Marsh - http://data.jncc.gov.uk/data/82b0af67-d19a-4a89-b987-9dba73be1272/UKBAP-BAPHabitats-07-CoastFloodGrazingMarsh.pdf

64 UK Biodiversity Action Plan Priority Habitat Descriptions: Lowland Mixed Deciduous Woodland - http://data.jncc.gov.uk/data/2829ce47-1ca5-41e7-bc1a-871c1cc0b3ae/UKBAP-BAPHabitats-30-LowlandMixedDecWood.pdf

65 UK Biodiversity Action Plan Priority Habitat Descriptions: Lowland Fens - http://data.jncc.gov.uk/data/6fe22f18-fff7-4974-b333-03b0ad819b88/UKBAP-BAPHabitats-27-LowlandFens.pdf

66 Joint Nature Conservation Committee (2008). UK Biodiversity Action Plan.

[67] UK Biodiversity Action Plan Priority Habitat Descriptions: Rivers - http://data.jncc.gov.uk/data/01d6ab5b-6805-4c4c-8d84-16bfebe95d31/UKBAP-BAPHabitats-45-Rivers-2011.pdf

[68] UK Biodiversity Action Plan Priority Habitat Descriptions: Ponds - http://data.jncc.gov.uk/data/dec49c52-a86c-4483-90f2-f43957e560bb/UKBAP-BAPHabitats-42-Ponds.pdf

[69] UK Biodiversity Action Plan Priority Habitat Descriptions: Hedgerows - http://data.jncc.gov.uk/data/ca179c55-3e9d-4e95-abd9-4edb2347c3b6/UKBAP-BAPHabitats-17-Hedgerows.pdf

- Wet Woodland[70]

9.2.10. To inform the Biodiversity Net-Gain calculation (see Biodiversity Net-Gain section below), all habitats (not just HPI) within the Site will be surveyed and mapped with reference to standard Phase 1 habitat survey methodology (JNCC 2010[71]). Phase 1 Habitat Survey is a standard technique for classifying and mapping British habitats. The dominant plant species will be recorded, and habitats classified according to their vegetation types.

9.2.11. To date, a Phase 1 habitat survey within the Scheme has been undertaken with further survey work scheduled for 2021 to complete the baseline.

River Habitat Survey

9.2.12. A River Habitat Survey (RHS) will be completed in Summer 2020 on the River Wensum with reference to methodologies set out within the RHS guidance (Environment Agency 2003[72]).

Biodiversity Net-Gain

9.2.13. The biodiversity baseline calculation will include all habitats (other than irreplaceable[73] habitats and statutory designated sites) within the Site prior to development. This baseline is informed by the Phase 1 Habitat data and results of the condition assessment, with reference to the Biodiversity Metric 2.0 (Natural England 2019[74]). The metric constitutes industry recognised best practice for quantifying biodiversity value.

FLORA

Protected/Notable Flora

Phase 1 Habitat Survey

9.2.14. To date, a Phase 1 habitat survey within the Scheme has been undertaken with further survey work scheduled for 2020 to complete the baseline (results will be included within the ES). A Phase 1 Habitat Survey will be completed within the Site to identify any protected/notable flora, including plant species listed under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended).

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[70] UK Biodiversity Action Plan Priority Habitat Descriptions: Wet Woodland - http://data.jncc.gov.uk/data/2829ce47-1ca5-41e7-bc1a-871c1cc0b3ae/UKBAP-BAPHabitats-64-WetWoodland.pdf

71 Joint Nature Conservation Committee (2010). Handbook for Phase 1 Habitat Survey – A Technique for Environmental Audit. JNCC, Peterborough.

[72] Environment Agency (2003). River Habitat Survey In Britain and Ireland.

73 Following Defra guidance, irreplaceable habitats (e.g. veteran tress) within the Scheme footprint will be identified and excluded from biodiversity unit calculations. It is noted that net-gain or no net-loss of biodiversity cannot be achieved for the Scheme as a whole if there is a negative impact on an irreplaceable habitat or statutory designated site for nature conservation. As such a different approach will be taken for irreplaceable habitats.

74 Natural England (2019). The Biodiversity Metric 2.0 – auditing and accounting for biodiversity. User Guide. Natural England Joint Publication JP029.

9.2.15. A list of plant species will be compiled, with relative plant species abundance estimated using the DAFOR scale[75]. The scientific names for plant species will be based on those in the New Flora of the British Isles (Stace 2019[76]).

National Vegetation Classification (NVC)

9.2.16. To date, no NVC survey has been undertaken. Survey work, in line with the methodology described below, is scheduled for 2021 to complete the baseline.

9.2.17. Woodland and grassland habitat within the Scheme will be considered further where a NVC survey will be undertaken. The NVC survey will be carried out in accordance with the following best practice survey guidance:

- The National Vegetation Classification: Users' Handbook (JNCC 2006[77]);
- British Plant Communities: Volume 1 – Woodland and scrub communities (Rodwell 1991[78]);
- A review of coverage of the National Vegetation Classification (Rodwell 2000[79]);
- National Vegetation Classification – ten years' experience using the woodland section (Goldberg 2003[80]);
- National Vegetation Classification: Field Guide to Woodland (Kirby 2004[81]); and
- British Plant Communities Volume 3 – Grassland and Montane Communities[82].

Macrophyte Survey

9.2.18. To date macrophyte surveys (September 2019) have identified river-water crowfoot within the River Wensum. Further survey work in line with the below methodology is scheduled for 2020 to complete the baseline.

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75 The DAFOR scale has been used to estimate the frequency and cover of the different plant species as follows: Dominant (D) - >75% cover, Abundant (A) – 51-75% cover, Frequent (F) – 26-50% cover, Occasional (O) – 11-25% cover, Rare (R) – 1-10% cover., The term 'Locally' (L) is also used where the frequency and distribution of a species are patchy and 'Edge' (E) is also used where a species only occurs on the edge of a habitat type.
76 Stace, C (2019). New Flora of the British Isles. C&M Floristics. Suffolk.

77 Joint Nature Conservation Committee (2006). National Vegetation Classification: Users' Handbook. JNCC. Peterborough.
78 Rodwell (Ed.) (1991). British Plant Communities: Volume 1 – Woodland and scrub communities. Cambridge University Press.
79 Rodwell, J et al. (2000). Review of coverage of the National Vegetation Classification. Joint Nature Conservation Committee Report No. 302.
80 Goldberg, E. (Ed.) (2003).National Vegetation Classification – ten years' experience using the woodland section. Joint Nature Conservation Committee Report No. 335.
81 Kirby, K et al. (2004). National Vegetation Classification: Field Guide to Woodland. JNCC. Peterborough.
82 Rodwell J..S (1992). British Plan Communities Volume 3 – Grassland and Montane Communities.

9.2.19. Macrophytes will be surveyed with reference to the Water Framework Directive (WFD) Technical Advisory Group's methodology for rivers[83, 84]. This method conforms with guidance standard for surveying of aquatic macrophytes in running waters. The survey will cover 100m section, 50m either side of all watercourse crossing points with the Scheme.

Notable, veteran and ancient trees

9.2.20. Please referrer to arboriculture section.

FAUNA

9.2.21. Surveys relating to specific fauna will only be undertaken in areas considered suitable habitat. It is noted that there will be areas that fall within the field survey area that are considered unsuitable to support certain fauna.

White-clawed crayfish Survey

9.2.22. Surveys have been undertaken within the River Wensum (September 2019), with reference to good practice guidelines (Peay, 2003[85]). The survey area covered a 200m section of the river, 100m either side of the viaduct crossing point.

9.2.23. Survey work identified the presence of the non-native signal crayfish *Pacifastacus leniusculus* within the stretch of the River Wensum which was surveyed, with no white-clawed crayfish returned. No further surveys are required..

Fish Survey

9.2.24. To date, no survey work for fish has been completed, with survey work in line with the below methodology scheduled for 2020 to complete the baseline.

9.2.25. Electric fishing will be undertaken along a 100m section of the River Wensum and ordinary watercourses within the Scheme (50m either side of crossing point). The survey will be undertaken with reference to standard electric fishing methods and techniques guidelines (Environment Agency 2016[86]), which conform to British Standard (BS EN 14011: 2003[87]).

Amphibians

Great crested newt Survey

[83] UK Technical Advisory Group on the Water Framework Directive (2008). UK Environmental Standards and Conditions (Phase 1).
[84] UK Technical Advisory Group on the Water Framework Directive (2014). UKTAG River Assessment Method Macrophytes and Phytobenthos.
[85] Peay S (2003). Monitoring the White-clawed Crayfish *Austropotamobius pallipes*. Conserving Natura 2000 Rivers Monitoring Series No. I, English Nature, Peterborough.
[86] Environment Agency (2016). Guidelines for Electric Fishing Best Practice. R&D Technical Report W2-054/TR.
[87] British Standard BS EN 14011:2003 – Water quality. Sampling of fish with electricity.

9.2.26. To date, no survey work for great crested newts has been undertaken. Survey work, in line with the below methodology is scheduled for 2021 to complete the baseline.

9.2.27. All ponds within and up to 500m from the Scheme will be subject to a Habitat Suitability Index (HSI) and Environmental DNA (eDNA) presence/absence survey for great crested newts. The HSI and eDNA surveys will be completed with reference to the ARG UK Advice Note (ARG 2010[88]) and the Technical Advice Note for Field and Laboratory Sampling of Great Crested Newt Environmental DNA[89].

9.2.28. Where eDNA confirms presence of great crested newts, ponds within and up to 250m from the Scheme will be subjected to further population estimate surveys. A minimum of six surveys will be undertaken on each pond, involving a minimum of three survey techniques; egg searching, netting, bottle trapping and torching[90]. This survey effort will enable a flexible approach to licensing to be applied.

Common toad Survey

9.2.29. Although a survey methodology will not be designed specifically for common toad, any evidence of this species presence will be recorded incidentally during survey for great crested newts and reptiles.

Birds

Wintering Bird Survey

9.2.30. Survey work undertaken in 2018/19 returned no observations of significant over-wintering assemblages, with the Scheme predominantly supporting small numbers of farmland species. A second year of survey work is scheduled to be undertaken in 2020/21 to complete the baseline.

9.2.31. Wintering bird surveys will be undertaken up to 100m from the Scheme. Four surveys will be undertaken, with one visit each month (November to February). Surveys will be completed with reference to the British Trust for Ornithology (BTO) Wintering Farmland Bird Survey methodology (Gillings et al 2008[91]).

9.2.32. During each survey visit the surveyor will walk slowly, approaching all suitable habitat within 50m and scanning and listening for birds. The starting point and direction of the route walked will be varied on each survey visit; this serves to minimise bias, as birds may be active at different times of

[88] Amphibian and Reptile Groups of the United Kingdom (2010). ARG UK Advice Note 5. Great Crested Newt Habitat Suitability Index.
[89] Biggs, J.,Ewald, N., Valentini, A., Gaboriaud, C., Griffiths, R.A., Foster, J., Wilkinson, J., Arnett, A., Williams, P and Dunn, F (2014). Analytical and methodological development for improved surveillance of the Great Crested Newt. Appendix 5. Technical advice note for field and laboratory sampling of great crested newt (*Triturus cristatus*) environmental DNA. Freshwater Habitats Trust, Oxford.
[90] Langton, T.E.S., Beckett, C.L., and Foster, J.P (2001). Great Crested Newt Conservation Handbook, Froglife, Halesworth.
[91] Gillings, S., Wilson, A.M., Conway, G.J., Vickery, J.A., Fuller, R.J., Beavan, P., and Toms, M.P (2008). BTO Research Report No. 494: Wintering Farmland Bird Survey. Thetford: British Trust for Ornithology.

day in different areas. The locations of birds seen and heard will be mapped using standard BTO two letter codes and activity symbols.

Breeding Bird Survey

9.2.33. To date, no survey work for breeding birds has been undertaken. Survey work is scheduled for 2021, in line with the below methodology to complete the baseline.

9.2.34. .

9.2.35. Breeding bird surveys will be undertaken up to 100m from the Scheme. Five surveys will be undertaken across April, May and June. Surveys will be completed with reference to standard methods based on the Common Bird Census (Marchant 1983[92]).

9.2.36. During each survey visit the surveyor will walk slowly, approaching all suitable habitat within 50m and scanning and listening for birds. The starting point and direction of the route walked will be varied on each survey visit; this serves to minimise bias, as birds may be active at different times of day in different areas. The locations of birds seen and heard will be mapped using standard BTO two letter codes and activity symbols. Where breeding activity is observed this was recorded in accordance with the following categories:

- Non-breeder – Birds observed flying over, considered to still be on migration or a summering non-breeder.
- Possible breeding – Birds observed singing or present in suitable habitat in breeding season.
- Probable breeding – A pair observed in suitable habitat, territorial behaviour observed in the same place on at least two separate occasions, or by many individuals simultaneously on one day, or birds observed visiting a probable nest site, showing courtship or display behaviour in suitable breeding habitat or nest building.
- Confirmed breeding – Nest containing eggs or young seen or heard, adults observed carrying faecal sac or food, feigning injury as a distraction display or entering or leaving a nest site in circumstances indicating an occupied nest, a used nest or eggshells found or recently fledged or downy young recorded (showing evidence of dependency on adults).

9.2.37. Field observations from all survey visits will be combined to produce species specific map records. The expected outcome of this technique is that mapped registrations fall into clusters, approximately coinciding with breeding territories.

Barn owl Survey

9.2.38. No specific surveys have been undertaken to date, but the presence of barn owls has been noted within the Scheme during tree surveys for bat roosts.

9.2.39. A predominantly desk based approach will be used to identify nest sites/foraging areas and mitigate for the likely impact of the Scheme on the barn owl breeding population that utilise the surrounding landscape of the Scheme. The method will involve:

- Requesting barn owl records from local record centres (NBIS and the BOCN);

[92] Marchant, J.H (1983). Common Birds Census Instructions. BTO, Tring.

- Identify potential barn owl nesting sites likely to be lost; and
- Estimating the number of breeding pairs likely to be using the area within 1.5km of the Scheme, using record centre data and field results, to calculate the number of nest boxes to be installed and identify preferential locations for these (will be considered up to 20km from the Scheme).

9.2.40. To complement the data gathered as detailed above, all agricultural structures within and up to 100m from the Scheme and all trees within and up to 25m from the Scheme will be surveyed for evidence of barn owl. Surveys will be undertaken with reference to best practice (Shawyer 2011[93]).

9.2.41. This approach has been developed with reference to Natural England's comments received on the 21st January 2020 (see Table 9-1 above).

Bats

9.2.42. All bat surveys will be undertaken within reference to good practice guidelines (Collin 2016[94]).

Preliminary Bat Roost Assessment

Trees

9.2.43. To date, survey work has identified trees that either support roosting bats or have the potential to support roosting bats. Survey work in line with the below methodology is scheduled in 2020 to complete the baseline.

9.2.44. All trees within and up to 25m from the Scheme will be subject to a preliminary bat roost assessment (PBRA).

9.2.45. A visual inspection of the trees from ground level using binoculars and a high-powered torch will be undertaken to search for features which may provide potential roosting opportunities for bats such as: woodpecker holes, rot holes, splits and cracks, dead limbs and/or flaking bark. All features will be visually inspected for evidence indicating use by roosting bats such as droppings, urine staining, and scratch marks/characteristic staining (from fur oils).

9.2.46. Where features can be reached from ground-level, they will be inspected by a licensed bat surveyor using a torch and/or an endoscope.

Structures

9.2.47. To date, no survey work for bats roosting in structures has been completed with work scheduled for 2020, in line with the below methodology to complete the baseline.

9.2.48. All structures within and up to 100m from the Scheme will be inspected, to enable an assessment of bat roost suitability and to search for evidence indicating the current or historic use of the structure by roosting bats.

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[93] Shawyer, C.R (2011). Barn Owl *Tyto alba* Survey Methodology and Techniques for use in Ecological Assessment: Developing Beset Practice in Survey and Reporting.
[94] Collins, J. (ed.) (2016). Bat Surveys for Professional Ecologists. Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.

9.2.49. A systematic visual inspection of the exterior of the structures using binoculars and a torch will be carried out to search for features which may provide roosting opportunities for bats.

9.2.50. Structures considered to be of low, moderate or high suitability for bat roosts based on external inspection will be subject to an internal inspection[95] using visual observation, a high-powered torch and an endoscope where necessary and safe to do so.

Follow-up Presence/Absence Surveys

9.2.51. Follow-up presence/absence surveys for trees and structures will be undertaken on a case by case basis and will be decided based on the information gathered during the preliminary bat roost assessment. This will allow for flexibility with regards to potential roosts and will ensure the appropriate survey method is applied. For example, an inconclusive internal inspection due to an obstruction of a feature.

9.2.52. To date, survey work has confirmed the presence of tree roosting bats. Further survey work for both trees and structures is scheduled for 2020/21 in order to complete the baseline.

Evening Emergence/Dawn Return-to-roost Surveys

9.2.53. Structures identified as being of moderate or high suitability, and trees identified as being of moderate or high suitability to support roosting bats will be subject to evening emergence and/or a dawn return-to-roost surveys (if considered the most suitable follow up survey method).

9.2.54. Surveyors will use Echometer Touch and Elkon Batloggers to listen and record bat echolocation calls. Surveyors will map the flight-lines used by observed bats and note features used to exit or enter structures/trees. Records of bat activity not associated with emergence/re-entry will also be recorded.

9.2.55. Where suitable (such as in a woodland where there is limited visibility at dawn/dusk), surveyors will be assisted by a thermal imaging or infra-red cameras.

Aerial Tree Inspection

9.2.56. Any trees considered as holding Moderate or High potential to support tree-roosting bats will be subject to an aerial inspection (where considered safe and practical to do so). Surveys will involve a detailed inspection of tree features using an endoscope, Polekam™ or torch. Trees will be accessed using a rope and harness or a ladder. All evidence of bats will be recorded.

Hibernation Survey

9.2.57. Hibernation surveys were undertaken in January and February 2019 on suitable structures up to 500m from the Scheme. The following sources of information were used to search for potentially hibernation structures:

- Freely available current mapping such as Ordnance Survey (OS) maps;
- Heritage reports;

[95] Subject to access and the condition of the structure (e.g. asbestos presence, hazardous loft void).

- Historic OS maps (MAGIC); and
- Specialist ground databases and websites[96].

9.2.58. Hibernating bats have been identified during these surveys. Further survey work, in line with the below methodology is scheduled to complete the baseline.

9.2.59. Suitable structures up to 500m from the Scheme will be subject to hibernation surveys for bats. Two surveys will be undertaken, one in January and one in February (2021).

9.2.60. Structures that will be considered comprise:

- Churches;
- Barns; and
- Bunkers.

9.2.61. The interior and exterior of each accessible structure will be inspected for evidence of hibernating bats. High-powered torches, endoscopes and binoculars will be used as appropriate to improve visual assessment of any identified features. Where hibernating bats are present or suspected to be present, the following measures will be implemented to minimise disturbance:

- Noise levels to be kept to a minimum;
- Infra-red filters will be used to reduce disturbance, where possible, except where it is necessary to use white light to take photographs for identification;
- The amount of time spent photographing will be kept to a minimum; and
- A maximum of two surveyors will be present within proximity to a hibernating bat at any given time, to prevent a rise in temperature.

Vantage Point Surveys

9.2.62. Linear features (to be severed by the Scheme) will be selected from areas where high barbastelle activity has been identified during survey work in 2019. These features comprise woodland edges, glades, hedgerows and watercourses.

9.2.63. Vantage point surveys will comprise surveyors stood up to 30m apart along linear features, both equipped with a thermal imaging camera, Echometer Touch bat detector and a two-way radio transceiver.

9.2.64. Surveys will commence at sunset, continuing for a minimum of two to three hours afterwards. Surveyors will observe all barbastelle activity along the linear feature, whilst in constant communication with each other. This method is designed to establish the use of the feature by barbastelle helping to distinguish between foraging and commuting activity.

Radio-tracking

9.2.65. Radio-tracking was undertaken in May 2019. Barbastelle commuting routes, foraging areas and maternity roosts were identified up to 500m from the Scheme. Further survey work is scheduled in 2020, in line with the below methodology to complete the baseline.

[96] http://follies.org.uk/index.php/map

9.2.66. A survey period of two weeks will be undertaken in late July 2020. The survey session will include the trapping of bats at pre-determined locations, predominantly in woodland/tree-dominated habitats adjacent to, or within the radiotracking study area (up to 6km from the Scheme). Trapping will be undertaken using harp traps and mist nets, alongside acoustic lures (Sussex Autobats) to improve trapping efficiency.

9.2.67. In accordance with the conditions of a Natural England licence, target bats will be radio-tagged, with a primary species of interest barbastelle and secondary priority species including bats from the genera Myotis. Tagged bats will be simultaneously or subsequently followed by radio tracking teams during the survey session to locate and identify roost sites and to examine nocturnal flying activity of the tagged bats, with a focus on collecting activity data for bats within the study area and other key areas considered potentially important to barbastelle bat population(s). Where access permits, emergence counts of roost sites will be undertaken to determine the status/function of the roost.

9.2.68. Up to 15 barbastelle bats will be radio tracked within the radiotracking study area, with trapping focussing on core areas of activity identified during 2019 survey work. Work will again be undertaken by experienced ecologists dedicated experts who will work under a project licence issued by Natural England.

Automated Detector Surveys

9.2.69. Automated detector surveys were undertaken along the highway alignment in 2019 which identified a minimum of nine bat species within the Site. Further survey work will be undertaken in 2020/21 in line with the below methodology to complete the baseline.

9.2.70. Automated, static bat detectors (SM4s) will be placed along sections of impacted habitat (such as a severed hedgerows, woodland edge and watercourses) to record bat call data over five consecutive nights. These surveys will be undertaken between May and September inclusive.

Badgers

Badger Survey

9.2.71. All areas within and up to 50m from the Site will be surveyed for evidence of badger with reference to the standard methodology[97].

9.2.72. Where present, evidence indicative of badger will be recorded

9.2.73. Where setts are recorded, their status and level of activity will be noted. With reference to guidance (Natural England 2009[98]), sett status will be categorised as follows: main setts, annexe setts, subsidiary setts and outlying setts.

9.2.74. Sett entrances or holes will be broadly categorised based on use or level of activity as follows: well used holes, partially used holes and disused holes.

[97] Harris, S., Cresswell, P. & Jefferies, D. (1989). Surveying Badgers, Bristol: The Mammal Society.
[98] Natural England. (2009). Guidance on 'Current Use' in the definition of a Badger Sett, Peterborough: Natural England.

9.2.75. To date, survey work has identified the presence of badger within the Scheme. Evidence of setts, commuting and foraging activity have been recorded. Further badger survey work is scheduled for 2020 to complete the baseline.

Badger Bait Marking Survey

9.2.76. Following on from the initial badger survey work in 2019, further badger bait marking surveys will be undertaken to establish the territory sizes of badger clans that may be impacted by the Scheme.

9.2.77. The methods will follow standard guidance (Delahay et al. 2000[99]). The surveys will comprise of putting out badger bait (such as peanuts and syrup) mixed with coloured pellets at previously identified main, annex and outlier badger setts. This bait, containing harmless indigestible plastic coloured markers, is then consumed by resident badgers. During subsequent defecation the badgers deposit these coloured markers in latrines/dung-pits throughout their range, including other setts used by the social group, and on boundaries of their territory. By undertaking systematic surveys of latrine and dung-pit sites and noting the colour of the markers contained in each, the boundaries of adjacent badger social groups can be determined. Surveys will run for three consecutive weeks in February and March 2021.

9.2.78. Camera traps will also be deployed at the same time as the bait marking survey with an aim at bolstering confidence in the results by providing video evidence of specific sett badger activity.

Otter Survey

9.2.79. All watercourses and associated riparian habitat within and extended up to 300m beyond the Site (up and down stream), will be subject to an otter survey.

9.2.80. The survey will comprise two visits within the appropriate season (April to September), each incorporating three elements:

- Walked survey of all watercourses, conducting a thorough visual inspection of the banks and immediate vicinity for otter or their field signs (including spraints, footprints, holts and couches);
- Recording all habitat variables and features relevant to otter (general habitat type, shore/bank substrate, bordering land use, vegetation, disturbance level, bank profile and water depth); and
- The recording of any field signs or evidence relating to other relevant wildlife (for example water vole, mink *Neovision vison* or brown rat *Rattus novegicus*).

9.2.81. Surveys will be undertaken with reference to best practice for monitoring otter (Chanin 2003[100]).

9.2.82. Although no specific otter surveys have been completed to date, an otter was observed within the River Wensum during the 2019 white-clawed crayfish survey. Further otter survey work is scheduled for 2020 to complete the baseline.

[99] Delahay R. J et al. (2000). The use of marked bait in studies of the territorial organization of the European Badger (*Meles meles*). Mammal Rev. Volume 30. Printed in Great Britain.
[100] Chanin P (2003). Monitoring the Otter *Lutra lutra*. Conserving Natura 2000 Rivers Monitoring Series No 10. English Nature, Peterborough.

Water vole Survey

9.2.83. All watercourses and associated riparian habitat within and extended up to 300m beyond the Site (up and down stream), will be subject to a water vole survey.

9.2.84. The survey will comprise two visits within the appropriate season for water vole surveys (spring and summer/early autumn), each incorporating three elements:

- A walked survey of the watercourse to conduct a thorough visual inspection of the banks and immediate vicinity for water voles or their field signs. (Field signs include faeces, latrines, feeding stations, burrows, 'lawns', nests, footprints and runways in vegetation);
- The recording of habitat variables and features relevant to water voles (for example general habitat type, shore/bank substrate, bordering land use, vegetation, disturbance level, bank profile, water depth); and
- The recording of any field signs or evidence relating to other relevant wildlife (for example otter, American mink or brown rat).

9.2.85. Surveys will be undertaken with reference to the Water Vole Mitigation Handbook (Dean et al 2016[101]).

9.2.86. Surveys undertaken in 2019 identified evidence of water vole on the banks of the River Wensum. Further survey work is scheduled for 2020 to complete the baseline.

Other Species of Principal Importance – Mammals

9.2.87. No dedicated methodology will be applied for other SPI mammals, although incidental recordings will be noted during the wider survey work. For example, recording foraging hedgehogs *Erinaceus europaeus* during a bat survey or polecat Mustela putorius caught on a camera trap.

Reptile Survey

9.2.88. To date, reptile survey work has identified common reptile species (Common lizard *Zootoca vivipara*, adder *Vipera berus*, grass snake *Natrix helvetica* and slow-worm *Anguis fragilis*), native to Norfolk within the Scheme. Further reptile survey work is scheduled for 2021 to complete the baseline

9.2.89. A reptile presence/absence survey will be undertaken within the Site. With reference to best practice (Froglife, 1999[102]) the survey will comprise seven visits, each incorporating two elements:

- Survey of artificial refugia; and
- Visual observation of habitats and natural refugia present.

[101] Dean, M., Strachan, R., Gow, D. and Andrews, R. (2016). The Water Vole Mitigation Handbook (The Mammal Society Mitigation Guidance Series).

[102] Froglife, 1999. Reptile Survey: an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Advice Sheet 10.

9.2.90. Artificial refugia[103] will be installed within suitable habitat and allowed to bed down for two weeks prior to the beginning of survey visits. The DMRB (Highways Agency 2019[104]) advises that a mixture of materials should be used as refugia and where possible this should include the use of corrugated metal. Bitumen felt, corrugated metal and corrugated bitumen cut into 0.5m x 0.5m will therefore be used as artificial refugia. Refugia will be sited in suitable basking spots, close to cover, within habitat parcels identified to provide suitable conditions for reptiles.

9.2.91. It should be noted that this method is not specifically designed for use in demonstrating absence of reptiles from a development site, rather the focus is on identifying key reptile sites and increasing recording of reptiles.

9.2.92.

Desmoulin's whorl snail Survey

9.2.93. To date, survey work has identified Desmoulin's whorl snail within the Scheme. Further survey work is scheduled for 2020 to complete the baseline.

9.2.94. The River Wensum and the floodplain will be subject to a walkover to assess suitability to support Desmoulin's whorl snail. Survey work will be undertaken within the appropriate season (July to November), in line with best practice guidelines (Killeen 2003[105]). Detailed survey work will be undertaken at pre-determined sampling locations where sub-samples of terrestrial molluscs will be taken. The mollusc community will be sampled by holding a white plastic tray near the base of vegetation, bending the vegetation over the tray and shaking vigorously. Molluscs present will be identified in the field by a Desmoulin's whorl snail expert.

9.2.95. The following variables will be recorded at each sampling location:

- Canopy cover (shade);
- Average height of vegetation;
- Moisture content of soil;
- Vegetation composition (DAFOR scale);
- Open water;
- Litter depth;
- Field layer;
- Slope;
- Aspect; and
- NVC community.

[103] Artificial refugia are used to assist with the detection of reptiles within suitable habitat. The materials warm up and retain heat, and therefore are attractive to basking reptiles. The settling in period allows favourable conditions i.e. suitable humidity and temperature gradient to develop and for reptiles present within the habitat to become aware of the refugia.
[104] Highways Agency, 2019. LA 118 Biodiversity Design. Design Manual for Roads and Bridges, 10(Section 4).
[105] Killeen, I.J., and Moorkens, E.A (2003). Monitoring Desmoulin's Whorl Snail, *Vertigo moulinsiana*. Conserving Natura 2000 Rivers Monitoring Series No. 6, English Nature, Peterborough.

Terrestrial Invertebrate Survey

9.2.96. Surveys for terrestrial invertebrates will comprise a combined walkover and targeted Spring survey followed by a targeted summer survey with reference to current guidance (Sutherland 2006[106]). Sampling of target groups will cover those most closely associated with the habitats found across the Scheme, including groups such as; Coleoptera, Diptera, Hemiptera, Hymenoptera and Lepidoptera. These groups will be sampled using practical entomology methods that include; sweeping, beating, grubbing, pitfall and pan trapping, light trapping and direct search and observation.

9.2.97. Survey data will be recorded and annotated on Geographic Information Systems (GIS) mapping software, samples will be sent for identification/verification, and any terrestrial invertebrate assemblage analysis will be undertaken using the analytical tool "Pantheon" with results produced for reporting purposes.

9.2.98. To date, no terrestrial invertebrate surveys have been undertaken. Surveys are scheduled for 2021 to complete the baseline.

Aquatic Macroinvertebrate Survey

9.2.99. To establish the composition of the aquatic macroinvertebrate community in the watercourses potentially affected by the Scheme, samples will be taken at a total of five pre-determined location, during the spring (March -May) and another five samples in the autumn (September-November). The survey will cover 100m sections of all watercourse crossing points within the Site.

9.2.100. Samples will be collected following the Environment Agency procedure, which conforms to Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters (BS EN ISO 10870: 2012[107]).

9.2.101. To date, no aquatic macroinvertebrate surveys have been undertaken. Surveys are scheduled for 2020/21 to complete the baseline

9.3. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

9.3.1. Table 9-9 below provides a description of likely significant effects on biodiversity features during the construction and operational phases of the Scheme. It is important to note that this section has been written in line with CIEEM EcIA guidelines and does NOT consider mitigation measures which would minimise/eliminate the identified likely significant effects. Mitigation measures are still being developed for the Scheme and will be reported within the ES. This section is aimed at scoping in or out biodiversity features for or from further assessment. The following likely significant effects are considered:

- Pollution;
- Disturbance;

[106] Sutherland, W.J (2006). Ecological census techniques: A handbook. Cambridge, UK: University Press.
[107] British Standard BS EN ISO 10870:2012: Water Quality. Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters.

- Habitat loss; and
- Degradation of habitat quality.

Table 9-9 - Biodiversity Scoped in or Out of Further Assessment

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
Internationally designated sites				
River Wensum SAC	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u> Habitat loss: Increased shading throughout construction period (viaduct). Water quality reduction through sedimentation or pollution incident. Degradation of river-bank arising from shading impacts on vegetation. Habitat degradation through pollution or reduction in air quality leading to reduced functionality of habitat to support qualifying features. <u>Operation Phase</u> Habitat loss: increased shading of river and floodplain once operational (viaduct). Loss of supporting habitat may lead to species mortality (Desmoulin's whorl snail). Water quality reduction through sedimentation or pollution incident: Degradation of river-bank arising from shading impacts on vegetation. Reduced functionality to support species using the watercourse. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support qualifying features. Disturbance through lighting, noise, visual[108] and vibration.
Norfolk Valley Fens SAC	Construction and Operation		✔	No likely significant effects are expected due to the following: <u>Construction and Operational Phases</u> Degradation through pollution and reduction in air quality: Given the substantial distance from the

[108] Movement from vehicles or people.

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				Scheme (approximately 6km), with no hydrological links, increase in nitrogen deposition from cars is not expected to affect this feature. Disturbance: the Scheme is not expected to increase visitor pressure on this feature once operational.
Paston Great Barn SAC	Construction and Operation		✔	No likely significant effects are expected due to the following: <u>Construction and Operational Phases</u> Substantial distance from the Site.
National statutory designated sites				
River Wensum SSSI	Construction and Operation	✔		As above for River Wensum SAC.
Alderford Common SSSI; Swannington Upgate Common SSSI; Whitewell Common SSSI; Buxton Heath SSSI; Hockering Wood SSSI; and Rosie Curston's Meadow, Mattishall SSSI All Local Nature Reserves (LNR) and National Nature Reserves (NNR)	Construction and Operation		✔	No likely significant effects are expected due to the following: <u>Construction and Operational Phases</u> Degradation through pollution and a reduction in air quality: substantial distance and no hydrological links between these features and the Scheme, therefore an increase in nitrogen deposition from cars is not expected to affect these features. Disturbance: The Scheme is not expected to increase visitor pressure on these features once operational.
Local non-statutory designated sites				
River Wensum Pastures, Ringland Estates CWS	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u> Habitat loss: direct loss of habitat due to the construction of the viaduct piers, permanent maintenance roads, construction compounds

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				(including construction creep) and non-motorised user (NMU) routes. Habitat degradation through pollution or reduction in air quality. Operation Phase Habitat degradation through pollution or reduction in air quality. Habitat loss: increased shading from the viaduct has the potential to effect habitat within the CWS during the growing season. Disturbance: potential increase in visitor pressure due to NMU route improvements within the CWS.
Attlebridge Hills CWS	Construction and Operation	✔		Likely significant effects are expected due the following: Construction Phase Habitat loss: potential for direct loss of habitat through construction creep (currently 20m from Scheme). Habitat degradation through pollution or reduction in air quality. Operation Phase Habitat degradation through reduction in air quality.
Broom & Spring Hills CWS	Construction and Operation	✔		Likely significant effects are expected due the following: Construction Phase Habitat loss: direct loss of habitat within the CWS, through land take and potential construction creep. Habitat degradation through pollution or reduction in air quality. Operation Phase Habitat degradation through pollution or reduction in air quality.
Wensum Pastures at Morton Hall CWS	Construction and Operation	✔		Likely significant effects are expected due the following: Construction Phase Habitat loss: direct loss of habitat due to the construction of the viaduct piers, permanent maintenance roads, construction compounds

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				(including construction creep) and non-motorised user (NMU) routes. Habitat degradation through pollution or reduction in air quality. Operation Phase Habitat degradation through pollution or reduction in air quality. Habitat loss: increased shading from the viaduct has the potential to effect habitat within the CWS during the growing season. Disturbance: potential increase in visitor pressure due to NMU route improvements within the CWS
Primrose Grove CWS	Operation	✔		Likely significant effects are expected due the following: Construction Phase Habitat loss: direct loss of habitat within the CWS and potential construction creep. Habitat degradation through pollution or reduction in air quality. Operation Phase Habitat degradation through pollution or reduction in air quality
Gravelpit Plantation and Church Hill CWS	Construction and Operation	✔		Likely significant effects are expected due the following: Construction Phase Habitat loss: potential for direct loss of habitat through construction creep (currently 10m from Scheme). Habitat degradation through pollution or reduction in air quality. Operation Phase Habitat degradation through reduction in air quality.
Land adjoining Foxburrow Plantation CWS	Construction and Operation	✔		Likely significant effects are expected due the following: Construction Phase Habitat loss: direct loss (including severance) of habitat within the CWS, construction of NMU routes and potential construction creep. Habitat degradation through pollution or reduction in air quality.

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				Operation Phase Habitat degradation through pollution or reduction in air quality. Disturbance: potential increase in visitor pressure due to NMU route improvements within the CWS.
Old Covert, Wood Lane CWS	Construction and Operation	✔		Likely significant effects are expected due the following: Construction Phase Habitat loss: potential for direct loss of habitat through construction creep (currently 10m from Scheme). Habitat degradation through pollution: potential for liquid runoff entering the groundwater during construction, effecting the functionality of the habitats within the CWS. Habitat degradation through pollution or reduction in air quality. Operation Phase Habitat degradation through pollution or reduction in air quality.
Mouse Wood CWS	Construction and Operation	✔		Likely significant effects are expected due the following: Construction Phase Habitat degradation through pollution: potential for liquid runoff entering the groundwater due to increased construction traffic on the B1535. Potential impact on the functionality of the habitats within the CWS. Habitat degradation through reduction in air quality: Potential for increased nitrogen deposition arising from construction access along the B1535, adjacent to the CWS. Disturbance through lighting, noise, visual and vibration: Construction access along the B1535, adjacent to the CWS. Operation Phase Habitat degradation through reduction in air quality: Increased traffic within 200m of CWS.
Fakenham Road (RNR)	Construction	✔		Likely significant effects are expected due the following:

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				Construction Phase Habitat loss: Direct loss of RNR to facilitate development.
Dryhill Plantation CWS; Ave's Gap CWS; Hall Hills/ Ringland Covert CWS; Ringland Pits CWS; Jennis' Wood CWS; Walsingham Plantation CWS; Marriott's Wat CWS; Triumph & Foxburrow Plantations; Bush Meadow Plantation CWS; Lake adjacent to Concreted Plant CWS; Lenwade Pits (East) CWS; Church Hill Common CWS; Weston Meadow CWS; Mouse Wood CWS; Park Grove CWS; Fen West of East Tuddenham CWS; Fen Plantation CWS; and Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plantation CWS.	Construction and Operation		✔	No likely significant effects are expected due to the following: Construction and Operational Phase No hydrological links and substantial distance from these features to the Scheme (over 200m), therefore an increase in nitrogen deposition from traffic is not expected to affect these features. Disturbance: the Scheme is not expected to increase visitor pressure on these features once operational.

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
Habitat				
Ancient Woodland	Construction and Operation	✔		Construction Phase Habitat loss: potential for impacts on habitat through construction creep (Primrose Grove ancient woodland is at least 30m from the Scheme). Habitat degradation through pollution or reduction in air quality. Operation Phase Habitat degradation through reduction in air quality: Increased traffic within 200m of ancient woodland.
Important Hedgerows	Construction and Operation	✔		Likely significant effects are expected due the following: Construction Phase Habitat loss: direct loss (including severance and fragmentation) of important hedgerows. Potential for construction creep within root protection area. Habitat degradation through pollution or reduction in air quality. Disturbance through lighting, noise, visual and vibration where hedgerow supports a species listed under Schedule 5 of the Wildlife and Countryside Act 1981. Operation Phase Habitat degradation through pollution or reduction in air quality. Disturbance through lighting, noise, visual and vibration where hedgerow supports a species listed under Schedule 5 of the Wildlife and Countryside Act 1981.
Habitat of Principal Importance (HPI)	Construction and Operation	✔		Likely significant effects are expected due the following: Construction Phase Habitat loss: direct loss (including severance and fragmentation) of HPI. Potential for construction creep within root protection area (hedgerows and woodland). Habitat degradation through pollution or reduction in air quality. Operation Phase

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				Habitat degradation through pollution or reduction in air quality.
Non-priority habitats	Construction	✔		Likely significant effects are expected due the following: <u>Construction Phase</u> Habitat loss: direct loss (including severance and fragmentation) of non-priority habitat. Habitat loss affects the functionality of non-priority habitat to support protected/notable species and biodiversity net-gain. Habitat degradation through pollution and reduction in air quality: Potential for liquid runoff entering directly into HPI waterbodies or the groundwater during construction. Pollution could affect the functionality of non-priority habitat to support protected/notable species and biodiversity net-gain. <u>Operation Phase</u> Habitat degradation through pollution or reduction in air quality: impact on biodiversity net-gain targets.
Flora				
Protected/Notable Flora	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u> Habitat loss: potential for direct loss (including severance and fragmentation) of habitat supporting protected/notable flora (including potential effect of culverting on macrophytes). Degradation of habitat quality: potential for the spread of invasive non-native species (INNS) either within or beyond the Site. Potential effect on existing habitat within or beyond the Scheme not currently supporting INNS. Habitat contamination through pollution or reduction in air quality: Reduced functionality of habitat to support protected/notable flora. <u>Operation Phase</u> Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support protected/notable flora.

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				Disturbance: potential increase in visitor pressure due to NMU route improvements. Risk of trampling protected/notable flora.
Notable, veteran and ancient trees	Construction	✔		Please refer to arboriculture section.
Fauna				
White-clawed crayfish	Construction and Operation		✔	No likely significant effects are expected due to the following: <u>Construction and Operation Phases</u> Likely absence: Surveys undertaken in 2019 confirmed likely absence of white-clawed crayfish within the River Wensum due to the presence of the non-native signal crayfish. Signal crayfish out-compete the white-clawed crayfish through competition from refuges, reproduction interference and predation (Peay 2002 [109]). Recolonization is now considered very unlikely.
Fish	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u> Habitat loss: the installation of the proposed culverts will result in the direct loss of habitat which would reduce the amount of resources available to fish. Culverts have the potential to fragment fish populations through the prevention or delay of in-stream migrations. They may also block the exchange of individuals among populations, reducing gene flow and disrupting the ability of "source" populations to support declining populations nearby. Watercourse contamination through pollution: potential for pollution of watercourse, resulting in harm to fish. Disturbance through lighting, noise, visual and vibration: potential for underwater noise to result in fish behavioural responses.

[109] Peay S (2003). Monitoring the White-clawed Crayfish *Austropotamobius pallipes*. Conserving Natura 2000 Rivers Monitoring Series No. I, English Nature, Peterborough.

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				Operation Phase Watercourse contamination through pollution: potential for toxic substances associated with traffic to enter the water course. These substances are directly toxic to fish and fish spawn.
Amphibians (Great crested newt and common toad)	Construction and Operation	✔		Likely significant effects are expected due the following: Construction Phase Habitat loss: potential direct loss (including severance/fragmentation) of terrestrial and breeding habitat, affecting distribution, abundance. Potential for killing or injury through destruction of supporting habitat. General construction activities (e.g. improper storage of materials): killing or injury. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support amphibian activity. Disturbance through lighting, noise, visual and vibration: potential effect on amphibian behaviour. Operation Phase Collision risk: killing or injury. Habitat degradation through pollution or reduction in air quality: Reduced functionality of habitat to support amphibian activity. Disturbance through lighting, noise, visual and vibration: potential effect on amphibian behaviour.
Birds	Construction and Operation	✔		Likely significant effects are expected due the following: Construction Phase Habitat loss: direct loss of habitat supporting nesting and foraging birds. Potential to effect distribution, abundance, and direct mortality (destruction of active nests). General construction activities (e.g. improper storage of materials): killing or injury.

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				Habitat degradation through pollution or reduction in air quality: Reduced functionality of habitat to support bird activity. Disturbance through lighting, noise, visual and vibration: potential effect on bird behaviour. <u>Operation Phase</u> Collision risk: killing or injury. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support bird activity. Disturbance through lighting, noise, visual and vibration: Potential effect on bird behaviour.
Bats	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u> Habitat loss: direct loss of habitat supporting roosting, foraging and commuting bats. potential for killing or injury. Severance / fragmentation of habitat: potential effect on bat activity (e.g. severance of barbastelle commuting routes), distribution and abundance. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support bat activity. Disturbance: potential disturbance from noise, lighting and vibration during construction, affecting bat activity (e.g. disturbance of an active roost or a commuting bat). <u>Operation Phase</u> Collision risk: killing or injury. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support bat activity. Disturbance through lighting, noise, visual and vibration: potential effect on bat activity (e.g. disturbance of an active roost or a commuting bat).
Badgers	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u>

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				Habitat loss: direct loss of habitat supporting setts, commuting and foraging badgers. Potential for killing or injury through destruction of setts. Potential effect on the distribution and abundance of badgers. Severance / fragmentation of habitat: potential to segregate existing badger clans. General construction activities (e.g. not capping pipes at night): killing or injury. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support badger activity. Disturbance through lighting, noise, visual and vibration: potential effect on badger activity, such as vacating a nearby sett. <u>Operation Phase</u> Collision risk: killing or injury. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support badger activity. Disturbance through lighting, noise, visual and vibration: Potential effect on badger behaviour.
Otter	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u> Habitat loss: potential for direct loss of habitat supporting otter holts, foraging and commuting activity. Potential effect on distribution and abundance. Potential for killing or injury. Severance / fragmentation of habitat: potential to prevent otter movement along existing commuting routes. General construction activities (e.g. not capping pipes at night): killing or injury. Habitat degradation through pollution or reduction in air quality: Reduced functionality of habitat to support otter activity. Disturbance through lighting, noise, visual and vibration: potential effect on otter activity, such as vacating a holt or preventing foraging or commuting activity. <u>Operation Phase</u> Collision risk: killing or injury.

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				Habitat degradation through pollution or reduction in air quality: Reduced functionality of habitat to support otter activity. Disturbance through lighting, noise, visual and vibration: potential effect on otter behaviour.
Water vole	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u> Habitat loss: potential for direct loss of habitat supporting water vole burrows, foraging and commuting activity. Potential effect on distribution and abundance. Potential for killing or injury. Severance / fragmentation of habitat: potential to prevent water vole movement along existing commuting routes. General construction activities (e.g. working too close to a bank supporting a burrow): killing or injury. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support water vole activity. Disturbance through lighting, noise, visual and vibration: potential effect on water vole activity, such as vacating a burrow or preventing foraging or commuting activity. <u>Operation Phase</u> Collision risk: killing or injury. Habitat contamination through pollution or reduction in air quality: reduced functionality of habitat to support water vole activity. Disturbance through lighting, noise, visual and vibration: potential effect on water vole behaviour.
Other Species of Principal Importance – Terrestrial Mammals (hedgehog, polecat and brown hare).	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u> Habitat loss: potential for direct loss of habitat supporting resting, foraging or commuting SPI. Potential effect on distribution and abundance. Potential for killing or injury. Severance / fragmentation of habitat: potential to prevent SPI movement across territories.

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				General construction activities (e.g. improper storage of materials): killing or injury. Habitat degradation through pollution or reduction in air quality: Reduced functionality of habitat to support SPI activity. Disturbance through lighting, noise, visual and vibration: potential effect on SPI behaviour. <u>Operation Phase</u> Collision risk: killing or injury. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support SPI activity. Disturbance through lighting, noise, visual and vibration: potential effect on SPI behaviour.
Reptiles (Common and widespread)	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u> Habitat loss: potential for direct loss of habitat supporting reptiles. Potential effect on distribution and abundance. Potential for killing or injury. Severance / fragmentation of habitat: potential to separate existing populations of reptiles. General construction activities (e.g. improper storage of materials): killing or injury. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support reptile activity. Disturbance through lighting, noise, visual and vibration: Potential effect on reptile behaviour. <u>Operation Phase</u> Collision risk: killing or injury. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support reptile activity. Disturbance through lighting, noise, visual and vibration: potential effect on reptile behaviour.
Desmoulin's whorl snail	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u>

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				Habitat loss: potential for direct loss of habitat supporting Desmoulin's whorl snail. (including habitat loss through shading impacts). Potential for effect on distribution and abundance. Potential for killing or injury. Severance / fragmentation of habitat: potential to separate existing populations of Desmoulin's whorl snail. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support Desmoulin's whorl snail activity. Disturbance through lighting, noise, visual and vibration: potential effect on Desmoulin's whorl snail behaviour. <u>Operation Phase</u> Habitat loss: Potential for direct loss of supporting habitat through an increase in shading (limiting the growth of supporting vegetation) arising from the construction of the viaduct and culverts. Potential effect on distribution and abundance, possibly leading to mortality. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support Desmoulin's whorl snail activity. Disturbance through lighting, noise, visual and vibration: potential effect on Desmoulin's whorl snail behaviour.
Terrestrial Invertebrates	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u> Habitat loss: potential for direct loss of habitat supporting terrestrial invertebrates. Potential to effect distribution and abundance. Potential for killing or injury. Habitat degradation through pollution or reduction in air quality: Reduced functionality of habitat to support terrestrial invertebrate activity. Disturbance through lighting, noise, visual and vibration: potential effect on terrestrial invertebrate behaviour. <u>Operation Phase</u> Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support terrestrial invertebrate activity.

Biodiversity Feature	Phase	Scoped In	Scoped Out	Likely Significant Effect (in the absence of mitigation)
				Disturbance through lighting, noise, visual and vibration: potential effect on terrestrial invertebrate behaviour.
Aquatic macroinvertebrates	Construction and Operation	✔		Likely significant effects are expected due the following: <u>Construction Phase</u> Habitat loss: potential for direct loss of habitat supporting aquatic macroinvertebrates. Potential to effect distribution and abundance. Potential for killing or injury. Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support aquatic macroinvertebrate activity. Disturbance through lighting, noise, visual and vibration: potential effect on aquatic macroinvertebrate behaviour. <u>Operation Phase</u> Habitat degradation through pollution or reduction in air quality: reduced functionality of habitat to support aquatic macroinvertebrate activity. Disturbance through lighting, noise, visual and vibration: potential effect on aquatic macroinvertebrate behaviour.

9.4. MITIGATION

9.4.1. Ecological mitigation for the Scheme are still being developed and will be reliant on a sufficient ecological baseline, expected to be completed by Summer 2021. Mitigation measures outlined in this section are based on:

- Available baseline data (survey work completed to date);
- Consultation (Natural England, Environment Agency and ELG groups);
- Cross-discipline collaboration;
- Evidence of success at similar infrastructure schemes;
- Good practice guidelines; and
- Professional judgement.

9.4.2. As a priority, the mitigation hierarchy will be adhered to, with the Scheme looking to consider all options to avoid potential adverse effects on biodiversity features:

- Avoidance/prevention: measures taken to avoid or prevent adverse effects, for example works to be undertaken outside of the nesting bird period (March to August inclusive);
- Reduction/mitigation measures taken to reduce adverse effects, for example retaining walls or pollution interceptors; and

- Compensation/offsetting: measures taken to offset significant residual adverse effects, such as those which cannot be entirely avoided or mitigated to the point that they become insignificant. For example, habitat creation or enhancement.

9.4.3. Establishing the biodiversity value of the Scheme will help to inform habitat mitigation requirements for biodiversity net-gain post-development. Habitat compensation will involve replanting lost woodland, hedgerows and grassland. Although the biodiversity net-gain process only considers habitat, the Scheme will look to incorporate species mitigation requirements through habitat creation and enhancement, particularly through improving habitat connectivity.

9.4.4. Habitat severance and fragmentation by the Scheme will be considered, helping to ensure that species commuting and foraging across the existing landscape are appropriately mitigated for. Barbastelle bats are one of the key features located within the study area. Mitigation measures currently being considered as part of the design are underpasses and green bridges. These features have proven effective on similar projects, and are considered appropriate mitigation, helping to ensure barbastelle bats can maintain their commuting route once the Scheme is operational. Bat gantries will not be considered as a mitigation feature for bats within the Scheme.

9.4.5. It is important to note that although the primary function of green bridges and underpasses are to maintain barbastelle commuting routes, these crossing points will benefit other species that may be impacted by the Scheme.

9.4.6. Badger specific underpasses will be incorporated into the Scheme, to ensure that badgers can maintain their existing commuting routes. Badger fencing will be used, where appropriate to ensure that they are guided to the safe crossing points, reducing collision risk.

9.4.7. In line with consultation regarding fish from Natural England and the Environment Agency, the culvert design will meet the criteria specified in the Environment Agency's Fish Pass Manual (Armstrong et al 2010[110]). The specific design criteria will be determined by the fish species identified through survey work.

9.4.8. All species afforded legislative protection will be mitigated for through the appropriate Natural England licencing procedures. Where considered appropriate, this may involve the translocation of certain species in advance of construction phase to either adjacent or newly created habitat.

9.4.9. During the construction phase adherence to best practice pollution prevention guideline, outlined by the Guidance for Pollution Prevention (GPP) series, with specific reference to GPP5: Works and maintenance in or near water (Natural Resources Wales (NRW) 2018[111]). The Environment Agency have withdrawn their guidance but the NRW guidance is applicable.

9.4.10. An Ecological Clerk of Works (ECoW) will be appointed during the construction phase, to ensure all ecological method statements are followed correctly, avoiding and/or minimising risk to biodiversity

[110] Armstrong, G.S., Aprahamian, M.W., Fewings, G.A.,Gough, P.J., Reader, N.A. and Varallo, P.V. (2010). Environment Agency Fish Pass Manual: Guidance Notes On The Legislation, Selection and Approval Of Fish Passes In England And Wales. Environment Agency, Bristol.
[111] Natural Resources Wales (2018). Guidance for Pollution Prevention: Works and maintenance in or near water: GPP5.

features. To avoid potential adverse effects upon protected species, their breeding and movement will be considered through specific mitigation measures. For example:

- Timing of construction works will be planned to avoid periods such as the nesting bird season (March to September inclusive) or the sensitive lifecycle stages of the fish present.

9.4.11. All measures to protected biodiversity features during the construction phase will be incorporated within the Construction Environmental Management Plan. Specific measures relating to compensation and enhancement works for protected / notable habitats and species, involving habitat creation and enhancement will be incorporated within a Habitat and Species Environmental Management Plan (or similar).

9.5. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

9.5.1. The Scheme will look to provide ecological enhancement where considered appropriate. Typical enhancement will likely comprise the provision of artificial habitat such as bird and bat boxes, hibernacula and invertebrate mounds.

9.5.2. As previously mentioned in Paragraph 9.6.2, habitat creation/enhancement through biodiversity net-gain will also focus on providing further opportunities for wildlife. For example, a grassland mix of 40% wildflowers to 60% grasses would provide further nectaring opportunities for invertebrate species.

9.5.3. Woodland enhancement will provide further benefits for species such as birds, badgers, invertebrates and amphibians.

9.5.4. With regards to great crested newts, the Scheme will look to implement Natural England Licencing Policies, where there is greater flexibility to dispense with exclusion and relocation activities by providing an investment in habitat provision which would be managed in the long term for the benefit of the species. Creation of new wetland habitat within proximity to existing populations will provide an enhancement in habitat for great crested newts.

9.6. PROPOSED ASSESSMENT METHODOLOGY

9.6.1. An assessment of likely ecological effects associated with Scheme will be undertaken with reference to methodology published by the Chartered Institute of Ecology and Environmental Management (CIEEM 2018[112]), the British Standard for Biodiversity (BS 420020:2013[113]) and DMRB LA108[114].

- Identification of important biodiversity features;
- Determining the geographic scale at which each feature is important; and
- Determining likely significant effects on each feature.

9.6.2. The scale at which features are important will be determined with reference to their nature conservation status (i.e. rarity or threat/pressure); their 'biodiversity conservation' importance (which

[112] CIEEM (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1. Chartered Institute of Ecology and Environmental Management, Winchester.
[113] British Standard BS 420020:2013. Biodiversity. Code of practice for planning and development.
[114] Highways England, 2019, LA 108 Biodiversity (Revised January 2020)

related to the need to conserve representative areas of different habitats and the genetic diversity of species populations); and legal status. A review of the legislation, policy and the sensitivity of each biodiversity feature will be undertaken, and the scale of importance will be determined within a geographical context on the following basis:

- International;
- National (England);
- County (Norfolk);
- Local (Broadland District); and
- Negligible.

9.6.3. The CIEEM method proposed that regional importance may be used. However, this scale has not been used in this assessment, as there is no objective, unambiguous source of information for East Anglia as to what population status, level of rarity or threat/pressure would qualify for 'regional importance'.

9.6.4. Table 9-10 is broadly based on criteria proposed by CIEEM and outlines the criteria to be taken into consideration for determining the importance of biodiversity features. The CIEEM method does not prescribe how to define different geographical levels of importance but provides general guidance. Table 9-10 shows how CIEEM guidance has been interpreted in the context of the proposed assessment.

Table 9-10 – Description of Geographical Scales of Ecological Importance

Importance	Criteria
International	All statutory sites designated or classified under international conventions or European legislation. Habitat types of international conservation importance listed on Annex I of the Habitats Directive. Any regularly occurring/large population of a species of international conservation importance listed on Annexes II, IV and V of the Habitats Directive and Annex I of the Birds Directive.
National (England)	Sites considered to be important in a national context and protected through national legislation. For example, a site which would meet the published selection criteria for national designation such as SSSI selection guidelines. Habitat types that are considered priorities for conservation in England. For example, Ancient Woodland, a large area of HPI. Any regularly occurring/large population of a nationally important species (e.g. England Red Data Book or species listed under the Wildlife and Countryside Act 1981). A large population of a species identified as SPI. A species population which would qualify for SSSI designation.
County (Norfolk)	Sites recognised by local authorities such as CWS's or RNR's. County sites that the designating authority has determined meet the published ecological selection criteria for designation. A diverse hedgerow network comprising mostly 'Important' hedgerows. Degraded areas of HPI.

Importance	Criteria
	Any regularly occurring populations of SPI, Amber/Red Listed under the Birds of Conservation Concern (BoCC) (Eaton et al 2015[115]) or a species listed in a county/district Biodiversity Action Plan (BAP). A regularly occurring, locally significant population of a country/district important species.
Local (Broadland District)	Areas of habitat that appreciably enrich the local habitat resources (e.g. species-rich hedgerows, ponds). Sites that retain other elements of semi-natural vegetation that, due to their size quality or the wider distribution within the local area, are not considered for the above classifications. Populations/assemblages of species that appreciably enrich the biodiversity resource within the local context. Sites supporting populations of county/district important species that are not threatened or rare in the region or county and are not integral to maintaining those populations.
Negligible	Common and widespread species and habitats.

9.6.5. It is impractical and inappropriate in line with CIEEM guidance for an ecological assessment to consider every habitat and species that may be affected by the Scheme. Accordingly, a threshold importance level is set and all biodiversity features that are of 'local' or higher importance will be subject to assessment.

9.6.6. Ecological effects will be assessed using professional judgement and in the absence of mitigation or compensation measures. The following factors will be considered, whether the effect is; positive/negative, its magnitude, its spatial extent, its duration, its reversibility and the frequency and timing of the effect:

- **Positive and negative** - "*Positive and negative impacts and effects should be determined according to whether the change is in accordance with nature conservation objectives and policy*".
- **Extent** - "*The extent is the spatial or geographical area over which the impact/effect may occur under a suitably representative range of conditions*."
- **Magnitude** - "*Magnitude refers to size, amount, intensity and volume*."
- **Duration** - "*Duration should be defined in relation to ecological characteristics as well as human timeframes*."
- **Frequency and timing** - "*The number of times an activity occurs will influence the resulting effect*."
- **Reversibility** - "*An irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A*

[115] Eaton, M., Aebischer, N., Brown, A., Hearn, R., Lock, L., Musgrove, A., Noble, D., Stroud, D., and Gregory, R (2015). Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man.

reversable effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation."

9.6.7. Effect significance will be assessed according to the CIEEM guidance which states that:

- "*Significance is a concept related to the weight that should be attached to effects when decisions are made. For the purpose of EcIA, 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features' (explained in Chapter 4) or for biodiversity in general. Conservation objectives may be specific (e.g. for a designated site) or broad (e.g. national/local nature conservation policy) or more wide-ranging (enhancement of biodiversity). Effects can be considered significant at a wide range of scales from international to local" (paragraph 5.25, page 24).*

9.6.8. CIEEM recommends that when considering significant effect, the following should be taken account of:

- *For designated sites – is the project and associated activities likely to undermine the site's conservation objectives, or positively or negatively affect the conservation status of species or habitats for which the site is designated, or may it have positive or negative effects on the condition of the site or its interest/qualifying features?*
- *For ecosystems – is the project likely to result in a change in ecosystem structure and function? (paragraph 5.30, page 24).*

9.6.9. Consideration of conservation status is important for evaluating the effects of impacts on individual habitats and species and assessing their significance:

- *Habitats – conservation status is determined by the sum of the influences acting on the habitat that may affect its extent, structure and functions as well as its distribution and its typical species within a given geographical area.*
- *Species – conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area (paragraph 5.33, page 25).*

9.6.10. As part of the methodology, a cumulative effects assessment will be undertaken in accordance with CIEEM guidance.

9.6.11. Ecological effects will be described in relation to the geographic scale at which they are regarded as significant – from international to local. It should be noted that in line with the guidance issued by CIEEM, an impact which has been considered as significant in ecological terms is the same as significant in EIA terms.

9.6.12. The CIEEM method is relevant for the assessment of ecological effects associated with both the construction and operational stages of the Scheme.

HABITATS REGULATIONS ASSESSMENT (HRA)

9.6.13. Pursuant to the Conservation of Habitat and Species Regulations 2017 (as amended) an assessment will be undertaken of the Scheme's effects on the River Wensum SAC in accordance with the four-stage process, summarised below. It is proposed that information relating to HRA will not be duplicated in the ES but will be cross-referenced within the biodiversity chapter as appropriate.

Stage 1

9.6.14. Identify whether it is likely that the Scheme, either alone or in combination with other projects, will have a likely significant effect on the Riven Wensum SAC. The threshold is a very low one and the conclusion will be affirmative unless significant effects can be excluded on the basis of objective evidence.

Stage 2

9.6.15. If there is an affirmative conclusion at Stage 1, an Appropriate Assessment will be undertaken to assess the effect of the Scheme, either alone or in combination with other projects, on the integrity of the River Wensum SAC in view of its conservation objectives.

Stage 3

9.6.16. Examine alternative solutions to achieve the objectives of the project where adverse effects are identified.

Stage 4

9.6.17. Where it is concluded under Stage 3 that no alternative solutions exist and where adverse impacts remain the final stage is to assess whether the Scheme must be carried out for imperative reasons of over-riding public interest (IROPI) and, if so, whether compensatory measures needed to maintain the overall coherence of the River Wensum SAC can be achieved.

9.7. LIMITATIONS AND ASSUMPTIONS

9.7.1. To ensure transparency within the EIA process, this report is based on the following assumptions:

- Survey work to complete the baseline is ongoing and is expected to be completed by the end of 2021. In order to complete an impact assessment, sufficient baseline data will be required;
- The scope is based on the Scheme design as of 10th February 2020. Further alterations to the scope may be required following any changes to the design of the Scheme;
- The scope is still to be agreed following consultation with the relevant statutory organisations; and
- The scope will only consider species native to Norfolk.

10. ROAD DRAINAGE AND THE WATER ENVIRONMENT

10.1. CONSULTATION

10.1.1. Consultation comprised of regular engagement through emails, conference calls and face to face meetings and will continue until the submission of the planning application. For the purpose of this report, the last consultation was dated 21st February 2020 via email. An overview of consultation undertaken for the Scheme (to date) is summarised in Table 10-1 – Consultation undertaken to date below.

Table 10-1 – Consultation undertaken to date

Body/Organisation	Date of Consultation	Key Outcomes of Discussions
Joint Environment Agency/Natural England meeting with Norfolk County Council	18 October 2018	Initial discussions on flood risk, design levels and requirements for climate change, water quality, biodiversity & WFD.
Joint Environment Agency/Natural England meeting with Norfolk County Council	08 March 2019	WSP query the re-designation status of the River Tud - not yet confirmed. Discussion regarding flood risk, design levels and requirements for climate change; potential construction mitigation for effects of the bridge structure to rivers and floodplains; and opportunities for surface water design, SuDS, infiltration as possible drainage strategy.
Joint Environment Agency/Natural England meeting with Norfolk County Council	13 June 2019	Discussion of proposed scope to inform Outline Business Case and understanding of the Flood Risk Assessment.
Environment Agency	09 August 2019	WSP shared scope of works for the Water Environment EAR Chapter and Flood Risk Appraisal to support Outline Business Case.
Joint Environment Agency/Natural England meeting with Norfolk County Council	13 August 2019	Discussion of flood risk scope. Surface water surveys.
Environment Agency	16th August 2019	E-conference meeting to discuss the preliminary ground investigation observation borehole placement rationale with the Environment Agency. Meeting ended in agreement of proposed borehole placement strategy and proposed monitoring scheduling.
Environment Agency	28 August 2019	The Environment Agency agreed with flood risk appraisals at Outline Business Case stage.
Environment Agency	04 November 2019	WSP shared methodology for updating the Environment Agency approved CH2M 2016 1D model of the Upper

Body/Organisation	Date of Consultation	Key Outcomes of Discussions
		Wensum to inform the Flood Risk Appraisal and Flood Risk Assessment.
Joint Environment Agency/Natural England meeting with Norfolk County Council	05 November 2019	Discussion on surface water: modelling and Flood Risk Assessment.
Environment Agency	21 November 2019	Response from Environment Agency to confirm understanding that updated 1D hydraulic model will be developed to support the Outline Business Case. After which the hydraulic model will be further developed into a 1D-2D linked hydraulic model to support the Flood Risk Assessment for the submission of the planning application. Comments provided on methodology.
Environment Agency/ Natural England	14 January 2020	WSP share viaduct substructure plans with Natural England and the Environment Agency.
Joint Environment Agency/Natural England meeting with Norfolk County Council	21 January 2020	Discussion on requirements of WFD Screening Assessment.
Environment Agency	24 January 2020	WSP issue revised methodology for flood risk modelling following receipt of EA comments on 21 November 2019
Norfolk County Council (as Lead Local Flood Authority)	29 January 2020	In person and Skype meeting to discuss proposed drainage strategy and design for watercourse crossings and water quality treatment measures.
Environment Agency	03 February 2020 (response received 10 March 2020)	WSP send data request letter with an accompanying study area of interest to Environment Agency. The letter is to inform the Road Drainage and Water Environment chapter of the Environmental Statement
Environment Agency	10 February 2020	Environment Agency provide comment on constructability and implications for flood risk, water quality and WFD. Environment Agency also confirms floodplain compensation is to be provided during construction phase of the Scheme.
Natural England	21 February 2020	Natural England comment on constructability of the Scheme, particularly the protection of the River Wensum, its flora, fauna and supporting processes (ground and surface hydrology). Natural England also state discharges to surface waters with potential to enter the river should be

Body/Organisation	Date of Consultation	Key Outcomes of Discussions
		of sufficient quality not to have an adverse effect on the River Wensum, with appropriate pre-treatment as required.
Lead Local Flood Authority (Norfolk Country Council)	09 March 2020	Meeting with LLFA regarding drainage proposals and catchments. Updated LLFA on design development and LLFA expressed preferences for elements of design and information to be included in further submissions.
Lead Local Flood Authority (Norfolk Country Council)	27 March 2020	Teleconference with LLFA regarding drainage proposals. Various elements of drainage strategy agreed in principle pending further technical information to be supplied.
Environment Agency/Natural England	30 March 2020	Information issued to EA and NE via email in place of meeting regarding general update on flood risk assessment scope, WFD assessment, drainage strategy and works within the Wensum floodplain. EA have provided responses in relation to drainage details required and recommendations regarding culverts and bridges.
Lead Local Flood Authority (Norfolk Country Council)	30 April 2020	Correspondence from LLFA confirming that they have no objection to proposed outline drainage strategy in principle (in response to technical information issued on 8th and 22nd April 2020), pending further details and assessments to be provided.

10.2. STUDY AREA

10.2.1. The study area for the assessment of impacts to surface water features has been defined by the likely risk to these features. The risk of direct impacts has considered features within 0.5km of the Scheme footprint, refer to Appendix B-2. This is considered appropriate for assessment of risks such as spillage or overland migration of contaminants. The risk of indirect impacts to surface water features is dependent on hydraulic connectivity and flow characteristics (i.e. how easily pollutants could migrate downstream) however a study area of up to 1km is considered appropriate for the assessment of risks to downstream water quality and geomorphology. This may change during the assessment if the works are considered likely to be pose risk to features further than 1km from the Scheme.

10.2.2. The study area for the assessment of impacts to groundwater resources includes features up to 1km from the Scheme. The importance of groundwater receptors greater than 1km from the Scheme will be considered with regard to the connectivity to features within the study area. Receptors considered to be of high importance will be included in the study area. These features may include groundwater abstractions (public and private), local and regional aquifers. The study area is distance is considered appropriate for the assessment of indirect effects.

10.2.3. It is recognised that the Scheme should not increase the risk of flooding (surface water and groundwater) to people and property elsewhere (to be confirmed by the Flood Risk Assessment), most notably through the reduction of floodplain storage. The identification of possible compensation areas is currently being undertaken and will be subject to further investigation through the use of hydraulic modelling discussed in this report. To date, an indicative area identified for floodplain

compensation areas identified has been incorporated within the RLB of the Scheme. The extent of any changes to flood risk will be confirmed as part of the Flood Risk Assessment (FRA).

10.3. BASELINE CONDITIONS

10.3.1. To inform the scoping stage, a desk-based assessment of available resources has been undertaken:

- Environment Agency's online Flood Map for Planning[116];
- Environment Agency's online Flood Risk from Surface Water map[117];
- Environment Agency's online Flood Risk from Reservoirs map[118];
- Environment Agency's Recorded Flood Outlines map[119];
- Environment Agency's online Catchment Data Explorer[120];
- Environment Agency's Anglian River Basin Management Plan[121];
- Greater Norwich Area Level 1 Strategic Flood Risk Assessment[122]
- Ordnance Survey (OS) Mapping[123];
- Environment Agency LiDAR Digital Terrain Model[124];
- Flood Estimation Handbook Web Service[125];
- DEFRA Magic Map online GIS portal[126];
- British Geological Survey (BGS) Geology of Britain Viewer[127];
- British Geological Survey (BGS) Geoindex[128]; and
- Envirocheck Report[129].

10.3.2. An initial site walkover was conducted on 4th December 2019 to inform the findings of the Geomorphological Appraisal Technical Note and Flood Risk Appraisal (which have been undertaken to form the scope of further stand-alone assessments supplementing the ES). The walkover included a rapid river survey to assess the current surface water features and geomorphological processes acting within the study area.

[116] Environment Agency (2019) available online: https://flood-map-for-planning.service.gov.uk/
[117] Environment Agency (2019) available online: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map
[118] Environment Agency (2019) available online: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map
[119] Environment Agency (2019) available online: https://data.gov.uk/dataset/16e32c53-35a6-4d54-a111-ca09031eaaaf/recorded-flood-outlines
[120] Environment Agency (2019) available online: https://environment.data.gov.uk/catchment-planning/
[121] Environment Agency (2019) available online: https://environment.data.gov.uk/catchment-planning/RiverBasinDistrict/5
[122] Greater Norwich Area Strategic Flood Risk Assessment available online: https://www.broads-authority.gov.uk/__data/assets/pdf_file/0006/1037355/2017s5962-Greater-Norwich-Area-SFRA-Final-v2.0.pdf
[123] Ordnance Survey (2019) available online: https://osmaps.ordnancesurvey.co.uk/
[124] Environment Agency (2019) available online: https://environment.data.gov.uk/DefraDataDownload/?Mode=survey
[125] https://fehweb.ceh.ac.uk/GB/map last accessed Nov 2019
[126] DEFRA (2019) available online: https://magic.defra.gov.uk/MagicMap.aspx
[127] British Geological Survey (2019) available online: http://mapapps.bgs.ac.uk/geologyofbritain/home.html
[128] British Geological Survey (2019) available online: https://www.bgs.ac.uk/geoindex/
[129] Envirocheck mapping, Landmark Information Group, May 2019.

10.3.3. Ecological receptors and impacts are discussed in Chapter 9: Biodiversity. Groundwater quality issues are discussed in Chapter 11: Geology and Soils.

10.3.4. Information regarding the ecological significance of watercourses and other water features (including Groundwater-Dependent Terrestrial Ecosystems (GWDTE's) such as wet woodlands) within close proximity of the Scheme will be obtained as part of Chapter 9: Biodiversity of the ES and will inform the Road Drainage and Water Environment Chapter.

10.3.5. Further information will be obtained to supplement and verify the baseline conditions during the course of preparing the ES. Figure 10-1 provides an overview of the Water Environment Constraints for the Scheme.

EXISTING BASELINE

Main Rivers

10.3.1. The River Wensum is the only main river crossed by the Scheme. The River Wensum is a low gradient groundwater (chalk aquifer) dominated chalk stream. The River flows south-easterly for approximately 78km through the county of Norfolk, from its source (at an altitude of 75m) on Colkirk Heath near South Raynham and Whissonsett to its confluence with the River Yare in Norwich. The river typology for the entire study area is classified as a 'Group A: lowland river with shallow gradients and rich geology; Type III Chalk river and other base-rich rivers with stable flows[130]. The catchment area as measured at the gauging station Costessey Mill (NRFA Station Number 34004)131 is 571 km^2.

10.3.2. The floodplain of the River Wensum in this locality is mostly comprised of managed grassland with areas of fen, wet grassland, woodland and wet woodland. The floodplain has historically been drained for agricultural purposes by series of Internal Drainage Board 'main drains' managed by Norfolk Rivers Internal Drainage Board (IDB). The drains run parallel to the river, and the join the main channel below each impoundment. Other than Fakenham, Taverham, and Dereham there are few urban areas that influence the river. The River Wensum is well known for its fishing amenity.

10.3.3. The River Wensum is described as having a complex underlying geology and landforms which results in the river exhibiting a higher density of tributaries than is characteristic of 'classic' chalk rivers. This characteristic also influences the availability of material that can be washed into catchment during rainfall events, and some of the sub-catchments tend to accrete large volumes of sediment. The catchment has been significantly impacted by the influence of intensive arable agriculture, which dominates much of the river corridor.

10.3.4. A site visit conducted on the 4th December 2019 within the study area, and immediate reach where the Scheme crosses the River Wensum, observed a series of sinuous and over-widened channels.

[130] Joint Nature Conservation Committee- Terrestrial habitat classification scheme. Available online at https://jncc.gov.uk/our-work/terrestrial-habitat-classification-schemes/ [last accessed February 2020]
[131] The National River Flow Archive. Available online at: https://nrfa.ceh.ac.uk/data/station/info/34004 [last accessed February 2020]

The material visually inspected on both banks was cohesive comprising of silt and sand. The banks were predominantly vegetated with a simple vegetation structure.

10.3.5. The River Wensum lies within the Anglian River Basin District (RBD); the Management Catchment is Broadland Rivers, and the Operational Catchment is the Wensum. The study reach forms part of the Wensum US Norwich waterbody (GB105034055881). The waterbody is designated heavily modified and is currently achieving Moderate status. The hydromorphological status 'Supports Good' and hydrological regime currently 'Does Not Support Good'. A summary of the WFD classification is provided in Table 10-2.

Table 10-2 - WFD classification data for Wensum US Norwich water body, Cycle 2 (Source: Environment Agency 2020)

WFD Classification: Wensum US Norwich (ID: GB105034055881)			
Classification Item	Current Status	Objective	RNAG
Overall Water Body	Moderate	'Good' by 2027	Disproportionate burdens No known technical solution is available
Ecological	Moderate	Good' by 2027	Disproportionate burdens No known technical solution is available
Chemical	Good	-	
Protected Area	Drinking Water Protected Area, Nitrates Directive, Habitats and Species Directive and Urban Waste Water Treatment Directive.		

*RNAG= Reasons for not achieving good

10.3.6. The channel of the River Wensum is one of 31 rivers in the United Kingdom designated a 'whole river' Site of Special Scientific Interest (SSSI)[132] in 1993 in recognition of its calcareous lowland river characteristics. The River Wensum is also one of 16 rivers in England to be selected as a Special Area of Conservation (SAC)[133] under the European Unions 'Habitats and Species' Directive'. The River Wensum is designated for, amongst other species, its macrophytes (Ranunculus) vegetation which occurs sporadically throughout much of the river's length. Stream water-crowfoot is the dominant Ranunculus species but thread-leaved water-crowfoot and fan-leaved water-crowfoot are also present. Assessment of species will be presented in Chapter 9: Biodiversity.

10.3.7. The river is also under the Demonstration Test Catchment (DTC)[134] program which was launched in England to provide research to help inform both policy and practical approaches for reducing diffuse pollution and improving the ecological status of freshwater. The potential for ecological effects on these designations from the Scheme will be addressed under the scope of Chapter 9: Biodiversity.

10.3.8. The River Tud, a main river and tributary of the River Wensum, is located approximately 300m to the south of the southern extent of the scheme. The River Tud rises from its source on East Dereham

[132] Natural England- Designated Sites View Available online at: https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S1006328&SiteName= [last accessed February 2020]
[133] Joint Nature Conservation Committee
[134] Demonstration Test Catchments – Overview. Available online http://www.demonstratingcatchmentmanagement.net/ [last accessed February 2020]

and flows in an easterly direction for approximately 27km to its confluence with the River Wensum below Hellesdon Mill approximately 14.8km downstream of the Scheme crossing over the River Wensum (NGR 619831, 310153) outside of the study area.

Other Surface Water Features

10.3.9. The Scheme crosses one unnamed ordinary watercourse located between Honingham and Western Green under the jurisdiction of Norfolk County Council as Lead Local Flood Authority (LLFA) at NGR 610339, 313493. The watercourse flows south from Weston Green and joins the River Tud to the east of Honingham approximately 2km downstream of the Scheme.

10.3.10. The Scheme crosses two significant overland flow paths between Weston Road (NGR TG 11652 14387) and Ringland Lane (NGR TG 12528 15116), believed to be ephemeral ordinary watercourses. The flows paths discharge to the River Wensum.

10.3.11. There are numerous land drains and pond features within the within the floodplain of the River Wensum which were most probably installed for agricultural land management purposes. The ditches are under the jurisdiction of Norfolk Rivers IDB.

Groundwater

10.3.12. The main characteristics of the geology (superficial and bedrock) that underlies the Scheme are described in Chapter 12: Geology and Soils and considers both published information and the findings of the historic ground investigation completed in 2007.

10.3.13. The study area is dominated by White Chalk Subgroup (bedrock geology), designated a major aquifer and Principal Aquifer, deemed capable of supporting water supplies at a regional scale, meaning they usually provide a high level of water storage (Environment Agency, 2020). Principal Aquifers may support water supply and/or river baseflow on a strategic scale.

10.3.14. The superficial deposits in the study area are dominated by Sheringham Cliffs Formation to the north and these deposits are composed of sands and gravels. Alluvium and River Terrace Deposits are present along the river channel. The Alluvium is composed of clay, silt, sand and gravel and the River Terrace Deposits are composed of sand and gravel. The south of the site is dominated by the Lowestoft Formation and its composition varies between clay, sand and gravel. There are also sporadic superficial Head Deposits and Happisburgh Glacigenic Formation deposits in the study area. Both are variable in composition and are generally composed of poorly sorted clay, silt, sand and gravel.

10.3.15. The Lowestoft Formation, Alluvium and River Terrace Deposits are classified as Secondary A Aquifers by the Environment Agency. Secondary A Aquifers are defined as permeable strata capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of baseflow to rivers. The Head Deposits are classified as Secondary B Aquifers and these are defined as having low permeability layers which may store and yield limited amounts of groundwater but may support local water supplies. The Sheringham Cliffs Formation is classified as both a Secondary A and Secondary Undifferentiated Aquifers by the Environment Agency. Secondary Undifferentiated Aquifers are geologies which have been classed as either Secondary A or B Aquifers historically.

10.3.16. The Groundwater Vulnerability maps show the vulnerability of groundwater to a pollutant discharged at a ground level based on the hydrological, geological, hydrogeological and soil properties within a single square kilometre. The Groundwater Vulnerability map shows that the study area is on the

boundary between a Major Aquifer High and a Major Aquifer Intermediate, which means that these units can transmit pollution to groundwater easily to the below lying White Chalk Subgroup (Principal Aquifer).

10.3.17. The BGS Hydrogeological Map Sheet 4 Northern East Anglia Sheet 1 (Figure 4) presents Chalk groundwater contours obtained in 1975. Although this data is historic, it still provides a useful baseline to identify regional groundwater flow directions for the study area. The map shows Chalk groundwater flow towards the centre of site to the River Wensum from the south west and north east, groundwater then flows along the River Wensum in a south easterly direction. This correlates with the local topography where the landscape slopes down to the north east towards the River Wensum, and southwest towards the A47 and the River Tud.

10.3.18. The surface water and groundwater relationship is undefined, however it is assumed groundwater contributes baseflow to both the River Wensum and the River Tud. This will be assessed further at ES Stage.

10.3.19. The site is located within a Groundwater Source Protection Zone (SPZ) Total Catchment Zone 3. The purpose of SPZs is to provide additional protection to safeguard drinking water quality through constraining the proximity of an activity that may impact upon drinking water. Zones around location sites are defined by groundwater travel times to an abstraction. SPZ Total Catchment Zone 3 is defined as the area around a source within which all groundwater recharge is presumed to be discharged at source and defined by a 400-day travel time to the source.

10.3.20. A data request to determine any nearby licensed and unlicensed groundwater abstractions will be completed moving to ES Stage.

10.3.21. The Environment Agency classifies the onsite aquifers to be within the ‘Broadland Rivers Chalk & Crag’ (GB40501G400300) groundwater waterbody, as shown on the Data Catchment Explorer interactive webtool. The groundwater water body underlies the entire site and the River Basin Management Plan (RBMP) classifications and objectives, as defined by the WFD, of the waterbody are presented in Table 10-3.

Table 10-3 - WFD classification data for Broadland Rivers Chalk & Crag, Cycle 2 (Source: Environment Agency 2020)

Waterbody ID	GB40501G400300	Waterbody Name	Broadland Rivers Chalk & Crag
Waterbody Type	Groundwater Body	Groundwater Area	3075.935km^2
National Grid Ref.	TG5140908672		
Description	The groundwater waterbody underlies the entire study area. The northern area of the Scheme crosses the River Wensum. This includes the superficial Alluvium, River Terrace Deposits, Head Deposits and Sheringham Cliffs Formation, and White Chalk Subgroup (Chalk) bedrock deposit. The Environment Agency has classified the superficial deposits as Secondary A and Secondary B Aquifers. The White Chalk Subgroup (Chalk) is classified as a Principal Aquifer.		
Overall Status	Poor	Status Objective	Good 2027
Overall Quantitative Status	Poor	Status Objective	Good 2021
Overall Chemical Status	Poor	Status Objective	Good 2027
Protected Area Designation	Nitrates Directive (NVZ12GW010780, NVZ12GW010710, NVZ12GW010790 & NVZ12GW011710), Drinking water protected Area (UKGB40501G400300).		
Reason for not achieving Good status	Groundwater Abstraction; Agricultural and Rural Land Management		
Waterbody Measures	N/A		

Flood Risk

Fluvial Flood Risk

10.3.22. Review of the Environment Agency Flood Map for Planning (Rivers and Sea) indicates that the majority of the Scheme alignment is located in the low-risk Flood Zone 1 where the risk of flooding from fluvial sources is less than 1 in 1000 (0.1%) in any year. However, the Scheme does include sections located in the medium risk Flood Zone 2, where the risk of fluvial flooding is between 1 in 1000 (0.1%) and 1 in 100 (1%) in any year, and the high-risk Flood Zone 3, where there is a greater than a 1 in 100 (1%) risk of fluvial flooding in any year associated with the River Wensum and the unnamed ordinary watercourse located between Honingham and Weston Green (see Appendix B-2).

10.3.23. Flooding from the River Wensum in the vicinity of the Scheme is largely confined to the surrounding rural floodplain and open green space. According to historic flooding records kept by the Environment Agency, the largest flood on the Wensum occurred in 1912. More recently, two rainfall events occurred on the 27 of May and the 20th of July 2014 and resulted in the flooding of 80 properties within the Norwich urban area. Along the reach of interest, no flooding incidents have been reported. There are a number of receptors within the wider area including villages both

upstream and downstream of the Scheme (Attlebridge and Ringland) as well as other isolated properties in the mapped fluvial floodplain within the study area.

10.3.24. Further consultation with both the Environment Agency and Norfolk County Council will take place during the next stage of planning to provide up-to-date records of the historic flood risk in the study area.

10.3.25. The 1D Flood Modeller Pro hydraulic model of the Upper Wensum (CH2M, 2016) obtained from the Environment Agency provides an improved understanding of the fluvial flood risk in the vicinity of the Scheme and a basis for assessing the impact of the scheme on third parties.

10.3.26. Existing floodplains have the potential to be impacted by any crossings and earthworks through them or by changes to nearby existing roads.

Surface Water Flood Risk

10.3.27. Review of the Environment Agency Flood Risk from Surface Water map indicates that sections of the Scheme are at high, medium and low risk of flooding from surface water sources. Flooding from surface water is typically associated with natural overland flow paths and local depressions in topography where surface water runoff can accumulate during or following heavy rainfall events.

10.3.28. In this locality, it is believed that areas at risk of surface water flooding are limited to fluvial flow associated with watercourses and drainage ditches that are not mapped on the flood map due to catchment size. This indicates that fluvial flood flows will broadly remain within the watercourse channels up to the 1 in 1000-year event.

10.3.29. Between Weston Road (NGR TG 11652 14387) and Ringland Lane (NGR TG 12528 15116) two significant overland flow paths are identified, believed to be ephemeral ordinary watercourses, coinciding with the location of Head deposits in this area and the alignment of an existing drain respectively as shown in Appendix B-2.

10.3.30. This will be qualitatively assessed further within the Environmental Statement.

Risk from Reservoir Failure

10.3.31. There is reservoir flood risk in the study area as indicated by the Environment Agency Flood Risk from Reservoirs[135] map. Within the study area, the maximum breach extents are mapped to flow beneath the existing A1067 Fakenham road bridge and conveyed downstream within the River Wensum floodplain. The Flood Risk from Reservoirs Map only represents reservoirs designated under the Reservoirs Act 1975 with a volume of 25,000m^3 or greater and does not include other large storage features. This will be qualitatively assessed further within the Environmental Statement.

[135] Risk of Flooding from Reservoirs - Maximum Flood Extent. Available at: https://data.gov.uk/dataset/44b9df6e-c1d4-40e9-98eb-bb3698ecb076/risk-of-flooding-from-reservoirs-maximum-flood-extent-web-mapping-service. [last accessed February 2020]

10.3.32. Land quality issues relating to potential contamination within the underlying superficial and bedrock geologies and associated impacts to controlled waters are discussed in Chapter 12: Geology and Soils.

FUTURE BASELINE

Surface Water

10.3.33. It is expected that there will be significant changes between current and future baseline for surface water features, namely the River Wensum due to ongoing restoration work happening within the catchment led by the River Wensum Restoration Strategy (RWRS) - a partnership between the Environment Agency, Natural England and Norfolk Rivers IDB.

10.3.34. English Nature (now Natural England) commissioned a survey in 2002 to investigate issues affecting the diversity and abundance of fish stocks in the river. The survey findings indicated over abstraction, poor water quality (particularly increased phosphate and ammonia levels), increased siltation, direct loss of spawning gravels, and a reduction in the availability of off-channel nursery and adult fish habitat. As a result, plans were developed to address water resource and water quality issue, but the physical character of the river limited this improvement. The reasons for this was found to be the redundant impoundments along the reaches of the River Wensum were assessed to be adversely affecting on the morphology of the river channel, with 67% of the river backed up behind these structures. The findings concluded that the river needed a strategy to address the problem, with the main recommendations being the lowering, removal of the redundant impoundments.

10.3.35. The aim of the RWRS is not to achieve its former 'natural' condition, but to restore hydrological functioning so that it can sustain wildlife and fisheries characteristic of its chalk stream the river type. The rationale for this is set out in draft guidelines for restoration of river SSSIs, prepared jointly by Natural England and the Environment Agency. Work is currently ongoing and is set to be completed by 2027.

10.3.36. The RWRS aligns with the WFD objective for the River Wensum to achieve 'Good' status by 2027. The River Wensum's WFD failure is listed for a number of reasons on the Environment Agency's Catchment Data Explorer including surface abstraction pressures and both point and diffuse source pollution from the agricultural industry. Once the water body has achieved 'Good' status, the WFD will require this status to be maintained.

Groundwater

10.3.37. Presently, local groundwater flow directions and elevation (depth to groundwater level) are likely to be (in part) controlled by the public water supply abstraction . Should this abstraction cease then groundwater rebound could occur - this may infringe upon below ground features such as foundations (groundwater heave) and open cavities such as ponds (groundwater seepage).

10.3.38. Climate change will also impact the local groundwater regime. Wetter winters and drier summers are predicted, and this will impact baseline groundwater conditions by increasing groundwater during the winter period and reducing groundwater levels in the summer.

10.3.39. The predicted River Basin Management Plan waterbody data in Table 3 shows the 'Broadlands Rivers Chalk & Crag' aquifer to have a 'Poor' quantitative and chemical status with an ambition to being classified as 'Good' status by 2021 and 2027 respectively.

Flood Risk

10.3.40. Flood risk is expected to increase with climate change. It is unlikely that the future baseline will be significantly different to current baseline for the majority of the Scheme that is located within Flood Zone 1. Hydraulic modelling provided by the Environment Agency indicates a likely increase in flood depth of c.200mm during the 100-year event with a 65% increase in peak flow for climate change effects, and c.160mm during the 1000-year event with a 25% increase in peak flow for climate change effects. Review of the mapped outputs of the hydraulic modelling indicates minimal change to the extent of the mapped 100-year and 1000-year flood extents when climate change is considered, with flood extents largely confined by topography.

10.3.41. Peak rainfall intensity is also predicted to increase up to 40% in small catchments over the next 60 years (2080's) due to climate change in line with EA Guidance[136]. This consequently will have an impact on surface water flooding and groundwater flooding due to increased runoff, rising groundwater levels and reduced soil permeability due to ground saturation.

10.4. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

Construction

10.4.1. During construction, it is considered likely that significant effects to surface water features, groundwater features and flood risk (surface water and groundwater) could arise from:

Increased pollution of surface water and groundwater features

10.4.2. Works could pose direct and indirect risk to watercourses in the event of the spillage of fuels or other harmful substances that may migrate overland to these features and be washed downstream. This could affect the chemical and physico-chemical quality of the water environment and be toxic to freshwater species.

10.4.3. The storage of construction materials on the Scheme along with other materials such as oils, fuels and other chemicals can pose risk to groundwater, particularly from leakage or spillage of such chemicals. Mobilised suspended solids through site runoff can also impact groundwater quality.

10.4.4. Land quality issues relating to potential contamination within the underlying superficial and bedrock geologies and associated impacts to controlled waters are discussed in Chapter 12: Geology and Soils.

Increased sedimentation of surface water features

10.4.5. Watercourses may be at risk of increased sedimentation from surface water runoff migrating to a watercourse from areas of bare earth, excavations, storage of construction materials such as aggregate, and stockpiles of topsoil. Suspended sediment can reduce light penetration through the water column and can smother aquatic habitats such as fish spawning areas. Sediment-laden runoff

[136] Flood risk assessments: climate change allowances. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances published February 2016. [last accessed February 2020]

can also have a high organic content, as well as increase nitrate and phosphate levels of the watercourse.

Impacts to the hydromorphological, physico-chemical and ecological quality of surface water features

10.4.6. Temporary structures required within watercourse channels as well as other in-channel works to construct structures such as culverts or watercourse realignments are likely to cause a temporary change to flow dynamics that in turn can affect sediment transport, deposition and erosion. This in turn can have an indirect effect to the physico-chemical and ecological quality of the water feature, as well as require the temporary removal of bed substrate and channel habitats.

Groundwater seepage associated with cuttings

10.4.7. Road cuttings are proposed along the Scheme and potential dewatering activities during excavation (at construction) to allow for below ground structures (piles / foundations), road cuttings and attenuation basins may be required. Groundwater dewatering can impact groundwater levels and groundwater flows, thus impacting local groundwater receptors, hydraulically connected surface water features and ecological habitats i.e. Groundwater Dependant Terrestrial Ecosystems.

Groundwater vulnerability

10.4.8. Construction activities will require soil stripping and excavation, removing or reducing the protective cap on groundwater aquifers. Reducing the thickness off unsaturated layers increases groundwater quality vulnerability.

Increased flood risk associated with temporary works

10.4.9. Construction in the floodplain of the River Wensum, including location of construction compounds and temporary works in the river channel, could result in a loss of floodplain storage and impede flood flow conveyance that may increase flood risk elsewhere. A temporary increase in impermeable surfacing, as well as compaction of ground, could also increase the rate and volume of surface water runoff.

Groundwater flooding

10.4.10. Groundwater flooding can occur as a result of below ground structures (piles/foundations) that have the potential to create a groundwater flow barrier resulting in groundwater level rise to the site.

Table 10-4 – Elements Scoped in or Out of Further Assessment for Construction

Element	Scoped In	Scoped Out	Justification
Increased pollution risk	✓		Pollutants and sediment-laden runoff could migrate to the River Wensum, other watercourses or infiltrate to ground causing temporary or long term deterioration in water quality.
Increased sedimentation within watercourses	✓		Sediment-laden runoff from areas of bare earth, construction materials such as aggregate and stockpiles of topsoil could migrate to surface water features.
Impacts to the hydromorphological, physio-chemical and ecological quality of watercourses	✓		Works within or in close proximity to watercourses such as the installation and alteration of culverts, bridges and outfalls as well as realignment of watercourses can cause impact to the hydromorphological, physio-chemical and ecological quality of watercourses
Impacts to groundwater flows and associated water users	✓		Groundwater seepage into proposed below ground structures such as cuttings and attenuation ponds may require groundwater dewatering.
Groundwater vulnerability	✓		Soil stripping and excavation that may remove or reduce the protective cap on groundwater aquifers increases groundwater quality vulnerability.
Groundwater flooding risks	✓		Below ground structures (piles/foundations) have the potential to create a groundwater flow barrier resulting in groundwater level rise and potentially groundwater flooding.
Increased flood risk associated with temporary works	✓		Temporary works within areas of fluvial flood storage, in-channel works and changes to catchment permeability could cause a temporary increase in flood risk.

Operation

10.4.11. During operation, it is considered likely that significant effects to surface water features, groundwater features and flood risk could arise from:

Polluted surface water runoff to surface water and groundwater features

10.4.12. A broad range of potential pollutants, such as hydrocarbons (fuel and lubricants), fuel additives, metal from corrosion of vehicles, de-icer and gritting material, can accumulate on road surfaces. These can subsequently be washed off the road during rainfall events, polluting the receiving water bodies. Routine runoff from road drainage networks can result in both acute and chronic impacts on water quality and subsequently on the biodiversity of the receiving watercourses, due to both soluble (dissolved copper and dissolved zinc) and sediment bound pollutants. Uncontrolled discharge via infiltration to ground can also cause permanent deterioration of groundwater quality.

10.4.13. Land quality issues relating to potential contamination within the underlying superficial and bedrock geologies and associated impacts to controlled waters are discussed in Chapter 12: Geology and Soils.

Permanent impact to the hydromorphological and ecological quality of water features

10.4.14. Introducing structures such as culverts into a watercourse will remove natural bed substrate and bank-side habitat, as well as change flow dynamics and sediment transport through the watercourse. This in turn could increase sediment deposition or scour, as well as introduce barriers to fish migration or mammal movement. Realigning watercourses will also have an adverse impact on natural bed substrates and habitats, with further risk of scour and erosion as the watercourse re-establishes.

Permanent impacts to catchment hydrology

10.4.15. Linear structures such as highways can interrupt natural flow paths and change catchment hydrology, thereby impacting upon surface water features such as land drains and watercourses, as well as potentially posing increased flood risk.

Cutting and attenuation pond seepage

10.4.16. Dewatering activities may be required during the operational phase. The construction of embankments and associated pre-earthworks drainage could also alter local groundwater flow and levels, increasing flows in some catchments with associated reductions elsewhere. Groundwater dewatering can impact upon local groundwater receptors, hydraulically connected surface water features and ecological habitats i.e. Groundwater Dependant Terrestrial Ecosystems.

Increased flood risk associated with permanent works

10.4.17. Construction in the floodplain of the River Wensum could result in a permanent loss of floodplain storage and impede flood flow conveyance that may significantly increase flood risk elsewhere. The proposed crossing of other ordinary watercourses and overland flow paths may also cause a localised increase in flood risk to adjacent land, including risks associated with changes to flow velocity through proposed culverts.

Groundwater flooding

10.4.18. Groundwater flooding can occur as a result of below ground structures (piles/foundations) that have the potential to create a groundwater flow barrier resulting in groundwater level rise and in the worst case, causing groundwater flooding.

Increased rates and volumes of surface water runoff

10.4.19. The introduction of impermeable surface area within the study area may lead to an increase in the rate and volume of surface water runoff from the Scheme, potentially resulting in increased flood risk.

Table 10-5 - Elements Scoped in or Out of Further Assessment for Operation

Element	Scoped In	Scoped Out	Justification
Increased pollution risk	✓		Polluted surface water runoff containing silts and hydrocarbons may migrate or be discharged to surface water features or groundwater resources via the proposed highway drainage system.
Permanent impact to the hydromorphological, physio-chemical and ecological quality of water features	✓		Works within or in close proximity to water features such as the installation and alteration of culverts, bridges and outfalls as well as realignment of watercourses could affect the hydromorphological, chemical and ecological quality of watercourses.
Permanent impacts to catchment hydrology	✓		The introduction of a barrier to natural overland flow and changes to natural catchment dynamics associated with the proposed highway drainage system and proposed watercourse diversions could affect natural catchment hydrology.
Impacts to groundwater flows and associated water users	✓		Groundwater seepage into proposed below ground structures such as cuttings and attenuation ponds may require groundwater dewatering to mitigate.
Increased flood risk to the scheme and people and property elsewhere	✓		Construction in areas of flood storage and flood flow conveyance, including the crossing of watercourses and overland flow paths, could increase flood risk elsewhere.
Groundwater flooding risks	✓		Below ground structures (piles/foundations) that have the potential to create a groundwater flow barrier could result in groundwater level rise and, in the worst case, cause groundwater flooding.

Element	Scoped In	Scoped Out	Justification
Increased rates and volumes of surface water runoff	✓		The Scheme will introduce larger areas of impermeable surface into the catchment and may increase flood risk if not mitigated.

10.5. MITIGATION

CONSTRUCTION

10.5.1. A Construction Environmental Management Plan (CEMP) will need to be prepared by the appointed Contractor for the works that will include method statements for the proposed works and details of materials to be used, this will be produced following planning consent. The full CEMP should contain measures to protect both surface and groundwater quality, and other water resource aspects. A draft CEMP is expected to be included with the application documents.

10.5.2. During the construction phase, consideration is recommended to be given to:

- Potential impacts to catchment hydrology and flow within existing watercourses;
- Temporary diversions of watercourses may need to be established prior to undertaking the works to maintain existing catchments and flow regimes; and
- Bunding for areas that may generate contaminated water as a result of construction requirements and water discharged to self-contained units with treatment facilities.

10.5.3. Changes in flood risk during the construction phase will be assessed quantitively based on the hydraulic modelling approach as discussed in 'Proposed Assessment Methodology' section below (section 10.7).

10.5.4. Any qualifying works within 8m of the River Wensum within will require a Flood Risk Activities Permit (FRAP). The necessary methodology and management system will be produced in order to secure the permit before activities take place.

10.5.5. Any qualifying works within 8m of the ordinary watercourses may require a Land Drainage Consent from Norfolk County Council or Norfolk Rivers Internal Drainage Board.

10.5.6. Where groundwater interceptions are likely a groundwater management plan will need to be developed to ensure all groundwaters abstracted through construction are appropriately managed. To ensure minimal loss of groundwater quantity from the water environment, water recycling practices should be considered.

10.5.7. Presently hydrogeological data is being collected by an ongoing geo-environmental ground investigation and site-specific groundwater level monitoring data will inform whether a risk of groundwater ingress/seepage or flooding is likely during construction phase. This will be assessed further at Environmental Statement stage.

10.5.8. Land quality issues relating to potential contamination within the underlying superficial and bedrock geologies and associated impacts to controlled waters are discussed in Chapter 12: Geology and Soils.

OPERATION

10.5.9. The proposed superstructure crossing the River Wensum will be on a viaduct, with piers within the floodplain. No structures are proposed within the channel of the River Wensum or within 10m of River Wensum. This is expected to minimise impacts to the river flow and channel morphology. The design of the structure will be agreed with the relevant authorities at Environmental Statement stage.

10.5.10. The Scheme requires the construction of a maintenance access track immediately adjacent to the proposed viaduct to enable inspection of the viaduct over its design life. The track will not require crossing of the River Wensum but will need to be constructed within the floodplain of the River Wensum and cross the land drains located within this area. The access track will be constructed at grade to prevent adverse effect to floodplain storage or flood flow conveyance. The crossing of land drains will maintain hydraulic connectivity. The design of the track will be agreed within the relevant authorities at Environmental Statement stage.

10.5.11. Any new crossings of watercourses and any new watercourse channels will maintain the capacity of the channel, ensure no increased flood risk up to the 1 in 100-year event considering the potential effects of climate change, be designed in accordance with DMRB guidance, and be sensitive to ecological requirements.

10.5.12. To mitigate potential impacts during the operational phase, a robust surface water drainage system will be provided to ensure discharge from the Scheme does not increase flood risk elsewhere up to and including the 1 in 100-year event and allowing for climate change effects. Drainage systems will provide sufficient attenuation and restrict the rate and volume of discharge to those agreed with Norfolk County Council as the Lead Local Flood Authority. The Drainage Strategy at this stage of the assessment indicates that infiltration to ground and discharge to nearby watercourses will be utilised to discharge road runoff. Multi-stage proposals that maximise passive treatment through the use of Sustainable Drainage Systems (SUDS) will be considered.

10.5.13. Surface water runoff is likely to contain high levels of sediment and hydrocarbons that can pollute surface water and groundwater features through direct migration or via the surface water drainage system. A robust treatment system will therefore be required.

10.5.14. Isolated sections of the study area are identified to be at risk of surface water flooding due to natural depressions in topography and overland flow paths, typically associated with the watercourses that are crossed by the Scheme. In order to protect the Scheme, consideration will be given to maintaining these overland flow paths to mitigate the potential impact of surface water flooding on the highway and to its users.

10.5.15. Parts of the Scheme will pass through the high-risk Flood Zone 3. Any loss of fluvial flood storage or impact to flood flow conveyance will be compensated on a like-for-like basis to ensure no increased risk of flooding to the Scheme or elsewhere up to the 1 in 100-year event considering the potential effects of climate change. The Scheme will cross the River Wensum floodplain on a viaduct with no structures placed within the channel.

10.5.16. Where groundwater interceptions are likely a groundwater management plan should be developed to ensure all groundwaters abstracted through operation are appropriately managed. To ensure minimal loss of groundwater quantity from the water environment, water recycling practices should be considered.

10.6. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

10.6.1. The Scheme will look to provide ecological enhancement where considered appropriate through Biodiversity Net Gain (BNG) in accordance with the best practice principles as outlined in Chapter 9: Biodiversity. Where possible, the BNG approach will seek to enhance the environment through the use of habitat creation. Current proposals in discussion with Norfolk County Council include the integration of 'wetland habitat' to achieve these targets.

10.6.2. Sustainable Drainage Systems (SuDS) are recommended to mimic natural drainage processes to reduce the effect on quality and quantity of surface water runoff from the Scheme and provide amenity and biodiversity benefit.

10.7. PROPOSED ASSESSMENT METHODOLOGY

10.7.1. Legislation relevant to the Scheme will be presented in the ES and will consist of the following aspects:

- European Policy;
- National Policy; and
- Local Planning Policy.

10.7.2. The following policy and guidance will underpin the assessment and will be described in detail in the assessment:

- Water Framework Directive (2000/60/EC);
- Groundwater Daughter Directive (2006/118/EC);
- Flood and Water Management Act (2010);
- Environment Act (1995);
- The Water Resources Act (1991);
- Land Drainage Act (1991);
- Environmental Permitting (England and Wales) Regulations (2016);
- National Planning Policy Framework (2019) and associated Planning Practice Guidance;
- Norfolk County Council's Environmental Policy (2019);
- Non-Statutory Technical Standards for Sustainable Drainage Systems (2015);
- Environment Agency Approach to Groundwater Protection (2018);
- CIRIA Pollution Prevention Guidelines[137] ; and
- Design Manual for Roads and Bridges (LA113).

SITE WALKOVER

10.7.3. A site walkover will be completed across the study area where safe access is possible. This will inform all aspects of the ES detailed in subsequent sections below.

[137] CIRIA, Control of water pollution from linear construction projects (C649) and Control of water pollution from construction sites (C532).

CONSTRUCTION PHASE

10.7.4. The assessment of potential effects that may arise during the construction phase will be undertaken in accordance with the DMRB Volume 11 Section 3 Part 10 (LA 113).

10.7.5. The assessment of potential effects to water quality that may arise during construction will be a qualitative assessment that considers risks to the chemical and physico-chemical quality of surface water and groundwater receptors associated with pollutants typically experienced during construction. The assessment will consider the probability of pollutants entering water features, the damage that could be caused to these features, and factors that may influence the effects such as dilution, migration and conveyance potential.

10.7.6. A qualitative assessment of the potential groundwater quantity impacts of the Scheme will also be undertaken. This will require identification of groundwater receptors that could be impacted from reduced groundwater baseflow during the scheme construction. Where there is potential for hydraulic linkages between site activities and offsite groundwater receptor(s), these linkages will be described, and risks to the receptor defined. Mitigation options will be presented to enable assessment of the residual risks of on-site activities which could impact the baseline groundwater flow regime.

10.7.7. The River Wensum's floodplain is very active, therefore changes in flood risk during the construction phase will be assessed quantitatively in a standalone Flood Risk Assessment using the existing 1D hydraulic model of the River Wensum prepared by the EA in 2017. The model will be updated to a 1D-2D hydraulic model in the vicinity of the scheme (and supplemented by additional channel survey) to provide a more robust assessment of flood risk. This will inform the construction methodology and likely risk management measures to protect the works and people, property and infrastructure elsewhere during construction. Any necessary mitigation will be agreed with the Environment Agency.

10.7.8. Potential effects of the construction phase on the fluvial (river) geomorphological processes operating within the study area will be assessed in a high-level Geomorphological Appraisal of the River Wensum. This will be used to inform which mitigation measures are necessary to ensure that the Scheme does not cause significant alteration to the fluvial processes operating within the study reach during the construction phase. The assessment will also consider potential for adverse impacts on sediment entrainment or transport capability of the watercourse, as well as erosion and depositional processes. This will be done by altering Manning's n values to allow for changes in roughness, and sediment data collected using the standard Wolman pebble count that will be used in the calculations. Consultation will be undertaken with the Environment Agency and Natural England to confirm the proposed approach.

10.7.9. Any residual impacts from the construction phase will also be assessed.

10.7.10. Potential effects of the construction phase on the WFD status of the relevant water bodies will be assessed in a standalone WFD assessment.

OPERATION PHASE

10.7.11. The assessment of potential effects that may arise during the operation phase will be undertaken in accordance with the DMRB Volume 11 Section 3 Part 10 (LA 113).

10.7.12. The assessment of impacts to the water environment and flood risk will include consideration of potential risks to surface water and groundwater quality, groundwater levels and flows, GWDTEs,

hydromorphology of surface water features, flood risk to the Scheme, and increased flood elsewhere as a result of the Scheme. The ES chapter will be supported by reports appended to the ES, namely the HEWRAT (Highways England Water Risk Assessment Tool) Assessment, Flood Risk Assessment and Water Framework Directive (WFD) Assessment. Hydrological and hydromorphological impacts will be documented in the ES, and possibly in a stand-alone assessment if required.

10.7.13. The assessment of impacts to the water environment and flood risk will also include consideration of cumulative impacts.

Water Quality

10.7.14. The assessment of potential effects to water quality that may arise during operation will be informed by the HEWRAT methods outlined in LA 113 to assess potential effects to surface water and groundwater quality from routine runoff and accidental spillage.

10.7.15. HEWRAT will be used to undertake a simple assessment of the potential impact of routine runoff on the chemical quality of receiving surface waters. This will indicate if there is likely to be a risk of pollution that should be explored further or if the risks can be considered sufficiently low not to warrant any further investigation. Information regarding channel gradient, width and roughness will be estimated from topographic survey and the hydraulic model of the River Wensum, as appropriate. Sampling of baseline water quality is not proposed to inform the assessment, although where ambient copper levels can be provided by the Environment Agency as part of routine WFD monitoring this will be used to inform the assessment.

10.7.16. HEWRAT will be used to determine the potential impacts to surface water and groundwater receptors from accidental spillages predominantly due to road collisions involving the spillage of a potentially polluting substance somewhere on the length of the Scheme.

10.7.17. Appendix C of LA 113 specifies procedures for the assessment of pollution impacts from routine runoff on groundwaters. The assessment takes the form of a risk assessment using the source-pathway-receptor (S-P-R) pollutant linkage principle which is widely used and explained in Model Procedures for the Management of Contaminated Land (EA/Defra 2004). This will be undertaken if SuDS principles are likely or unlined drainage channels are proposed, or if discharge will be made to a watercourse (major or minor) that dries up in most years or has a Q95 of 1 l/s or less.

10.7.18. At this stage, discussion with statutory consultees it has not yet determined if further quantitative analysis is required. This requirement and associated methodology is to be determined at a later date once consultation has progressed.

10.7.19. Please note that contaminated land water quality risk assessment methodology is described in Chapter 9: Soils and Geology.

Hydromorphology

10.7.20. The assessment of potential impacts on the water environment will consider potential impacts to the hydromorphological quality of surface water features. This is likely to be associated with the introduction of new structures such as culverts and bridges, potential realignment of existing watercourses and potential changes to watercourse hydrology associated with the introduction of a linear barrier or diversion of natural flow caused by the proposed surface water drainage system or cuttings that could affect baseflow to the predominantly groundwater fed River Wensum. The

findings of this assessment will also contribute to the assessment of potential ecological effects assessed within Chapter 9: Biodiversity and the stand-alone WFD Assessment.

10.7.21. For the assessment of potential impacts to the River Wensum it is proposed that this assessment is qualitative and informed by desk-based study, site walkover and working closely with the Scheme ecologist. The Scheme will be located on a viaduct through the floodplain and no structures will be located within 10m of the riverbank. Therefore, a quantitative assessment of impacts to the River Wensum is not considered necessary to inform the assessment of operational phase impacts.

10.7.22. For the assessment of potential impacts to the land drains in the floodplain of the River Wensum, that will be crossed by the proposed maintenance track, a qualitative assessment is proposed that will consider the potential impacts of proposed culverts on land drain connectivity.

10.7.23. For the assessment of potential impacts to the other ordinary watercourses crossed by the scheme, a quantitative assessment is proposed that will consider the potential impacts of a proposed culvert (if this option is taken forward) on flow velocity and therefore the potential implications on downstream river hydraulics and morphology.

10.7.24. Where potential adverse effects are identified, an assessment of these will inform what mitigation measures need to be incorporated into the design and construction methods of the Scheme to remove or minimise the effect on the aquatic environment.

10.7.25. This assessment will also be undertaken in close consultation with the Environment Agency and Natural England due to the SSSI and SAC designation of the River Wensum.

Flood Risk

10.7.26. A standalone Flood Risk Assessment (FRA) will be prepared to support the ES in accordance with the National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG). The FRA will assess the potential implications of the Scheme on flood risk to people and property, as well as assess the potential risk of flooding to the Scheme. It is proposed that the following aspects will be considered:

- Potential impacts to flood flow conveyance in land drains, watercourses and floodplain crossed by the Scheme associated with the construction of new culverts, bridges and embankments and diversion of watercourses;
- Potential impacts to the Scheme from all sources of flooding, including fluvial, surface water, groundwater, drainage systems and artificial sources; and
- Potential impacts to fluvial and surface water flooding associated with an increase in impermeable surfacing and / or changes to catchment hydrology associated with the proposed surface water drainage system.

10.7.27. Detailed 1D-2D hydraulic modelling will be undertaken to inform the assessment of risk and mitigation for the River Wensum and its floodplain. Model output data will include detailed and calibrated hydraulic model flood extent outlines for the 20-year, 100-year, 100-year plus climate change and 1000-year return period events for both the construction and operation phases, in line with further consultation with the Environment Agency. The hydraulic model will also establish and quantify the need for floodplain compensation.

10.7.28. Hydraulic modelling is also proposed for the unnamed ordinary watercourse crossing between Honingham and Western Green to inform the assessment of risk and mitigation measures here. The scope of this modelling is to be agreed through the consultation process. The need for hydraulic

modelling will be discussed and agreed with the Environment Agency and Norfolk County Council once further information is available on the design of potential crossings / culverts and catchments for surface water.

10.7.29. It is proposed that a simplified approach is taken to inform the assessment of risk and mitigation for land drains and other unnamed ordinary watercourses affected by the Scheme, using hand calculations or software such as Culvert Master to inform the appropriate sizing and design of proposed diversions and watercourse crossings.

10.7.30. All assessments will take into account the potential effects of climate change. For watercourses with a catchment of greater than c.3 km², it is proposed to use the Higher Central allowance (35%) for the increase in peak flow to inform the design of the works and the Upper-End allowance (65%) to test the resilience of the design. For watercourses with a catchment of less than c.3 km², it is proposed to use the peak rainfall intensity guidance, using the Central allowance (20%) to inform the design on the works, and the Upper-End allowance (40%) to test the resilience of the design. This will be confirmed in line with consultation with the Environment Agency and Norfolk County Council.

SIGNIFICANCE CRITERIA

The assessment for this factor will be undertaken in accordance with the DMRB Volume 11, Section 3, Part 10 (LA113) and would use the assessment criteria provided below. The assessment of effect is carried out by establishing the importance of the attribute, magnitude of the potential impact and consequently determining the significance of the effect. Where the significance of the effect is described as two levels, the assessor will make a judgement of the two and choose one level of significance. This assessment would consider any level of significance of moderate or greater as significant for the assessment, and therefore would require mitigation to be proposed to minimise the magnitude of the impact.

10.8. LIMITATIONS AND ASSUMPTIONS

10.8.1. To ensure transparency within the EIA process, the following limitations and assumptions have been identified:

- This Scoping Report is based on currently available information and can be subject to change as the design of the Scheme progresses. This is of particular importance when considering potential impacts associated with the quality of surface water runoff, hydromorphology and channel hydraulics, and flood risk;
- The site walkover completed 4th December 2019 and included a site walk-over of surface water features and an inspection of the active geomorphic processes to inform a Geomorphological Appraisal. All other baseline data has been collected from freely available sources for a desk-based study.
- Drainage design information is not currently available at the time of writing and therefore potential impacts and likely mitigation are assumed based on standard design practices. It is assumed that detailed design information for the drainage elements of the Scheme will be made available for the completion of the ES. This will be essential to the detailed assessment of risks associated with water quality and increased flood risk;
- Preliminary ground investigation and subsequent groundwater monitoring data is not currently available as site works are still ongoing. It is assumed that fixed preliminary design information and winter groundwater level monitoring data will be available prior to commencement of the ES;

- Any gaps in information identified at this scoping stage will be considered and addressed along with specific mitigation measures as part of the assessments to produce the ES;
- It is assumed that data on all existing licensed and unlicensed, domestic groundwater abstractions will be made available; and

11. GEOLOGY AND SOILS

11.1. CONSULTATION

11.1.1. Table 11-1 summarises the consultation that has been undertaken in relation to the geology and soils assessment.

Table 11-1 – Consultation Undertaken to Date

Body/Organisation	Date of Consultation	Key Outcomes of Discussions
Environment Agency	06 November 2019	The Environment Agency (EA) suggested that the highway alignment does not intersect current or historical landfills, however it was noted that the Attlebridge landfill was located close to the northern part of the Scheme. It was noted that the landfill had ceased accepting waste. The EA was unaware of any remedial works carried out within the study area.
Broadland District Council	06 November 2019	Awaiting Response – response to be captured within the ES.

11.2. STUDY AREA

11.2.1. This Chapter will establish the existing geology and soil conditions underlying the Scheme and surrounding area upon which to assess the likely significant effects of the Scheme on the geology and soils. The study area includes the area within the Site and the area up to 500m from the Site, which is in general accordance with the current contaminated land guidance[138].

11.3. BASELINE CONDITIONS

SITE HISTORY

11.3.1. The earliest available mapping (from 1882-1884) shows the study area to be dominated by multiple agricultural fields, multiple roads/tracks and plantations. There are several marl and clay pits within close proximity to the Scheme that appear to have been infilled in the 1970's. The study area has remained relatively unchanged throughout the 20th Century until present.

[138] R&D Publication 66: 2008, Guidance for the Safe Development of Housing on Land Affected by Contamination.

11.3.2. Based on a preliminary assessment of unexploded ordnance, the north west of the Scheme was identified to have a 'Moderate' risk from unexploded ordnance due to the proximity to RAF Attlebridge, located to the north west of the Scheme.

GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

11.3.3. British Geological Survey (BGS)[139] mapping indicates that the superficial geology underlying the majority of the Scheme generally comprises the Sheringham Cliffs Formation. A band of Alluvium is present in the north of the Scheme in the vicinity of the A1067. A band of Head deposits is present to the south of the Alluvium, and River Terrace Deposits are present to the north of the Alluvium unit. The Lowestoft Formation is present at the southern end of the Scheme. The Happisburgh Glacigenic Formation is present in localised areas across the Scheme and wider area. The bedrock geology underlying the Scheme comprises the Lewes Nodular, Seaford, Newhaven, Culver and Portsdown Chalk Formations.

11.3.4. The Environment Agency classifies the Sheringham Cliffs Formation and River Terrace Deposits, which is assigned to permeable strata, capable of supporting water supplies at a local rather than a strategic scale, and in some cases forming an important source of base flow to rivers. The Alluvium and Head deposits are classified as Secondary B Aquifers which is assigned to lower permeability layers which may store and yield limited amounts of groundwater. The Lowestoft Formation and Happisburgh Glacigenic Formation are classified as Secondary Undifferentiated Aquifers which is a classification assigned in cases where is has not been possible to attribute either category A or B to a rock type due to variable characteristics of a rock type. The Chalk bedrock is classified as a Principal Aquifer which are layers of rock with high intergranular and/or fracture permeability, they can support water supply and/or river base flow on a strategic scale.

11.3.5. The Scheme is located within a Source Protection Zone (SPZ) 3 for total catchment, however there are no groundwater abstractions located within the Site. The closest groundwater abstraction to the Scheme is located 16m east (within the study area) where water is abstracted from the Chalk aquifer for general farming and domestic use.

11.3.6. The River Wensum and its associated flood plains cross the Scheme in the northern section. There are also multiple small unnamed water features within the study area. The River Tud runs approximately 300m south of the Scheme in an east-west orientation.

11.3.7. There are no surface water abstractions recorded within the Site. However, the closest surface water abstraction to the Scheme is located 24m south west (within the study area) and is abstracted from the River Wensum at Ringland and used for general agriculture for storage of, and direct spray irrigation. The Scheme is located within a surface water and groundwater Nitrate Vulnerable Zone (NVZ).

[139] British Geological Survey Geology of Britain (2020) http://mapapps.bgs.ac.uk/geologyofbritain/home.html?

11.4. MITIGATION

11.4.1. It is anticipated that the appropriate mitigation measures (e.g. materials management, suitable storage of fuels) during construction would be secured via the Construction Environmental Management Plan (CEMP).

11.4.2. In addition, the following is anticipated to address both construction and operational effects:

- Further UXO risk assessment;
- Ground investigation and related contamination risk assessments;
- Remediation Strategy (if required);
- Remediation (if required); and
- Permanent controlled drainage associated with the Scheme.

11.4.3. Following assessment, any additional mitigation measures will be identified in the ES where necessary, to reduce the magnitude of impacts.

11.5. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

11.5.1. Based on the baseline information and the historical and current uses of the study area, a number of receptors were identified. Based on the identified receptors likely significant effects during the construction phase include:

CONSTRUCTION IMPACTS AND EFFECTS

- Potential effect on construction workers and third-party neighbours from potential contamination within the underlying soils/groundwater (if present); and
- Potential effect to Controlled Waters.

INSIGNIFICANT EFFECTS

11.5.2. It is anticipated that any contaminants identified during the construction phase will be remediated in line with the proposed uses. It is assumed that clean cover layers (and any imported material), if required, will be validated for depth and chemical quality prior to the Scheme becoming operational. This negates the requirement for consideration of potential impacts to future users, third party neighbours, potable water supply and plants to contamination during the operational phase of the Scheme. Therefore, the potential exposure of future users, third party neighbours, potable water supply and plants to contamination during the operational phase will be insignificant and will not be assessed in the geology and soils chapter of the ES.

11.5.3. The geology and soils chapter will assess the potential effects from chemical contamination on Controlled Waters. Potential effects relating to physical contamination (i.e. sediment) and changes to groundwater flow and conveyance will be considered within Chapter 10: Road Drainage and Water Environment and Groundwater.

11.5.4. Elements scoped in and out of further assessment are presented in Table 11-2.

Table 11-2 – Elements Scoped in or Out of Further Assessment

Element	Phase	Scoped In	Scoped Out	Justification
Potential effect on construction worked and third party neighbours from potential contamination within the underlying soils / groundwater (if present)	Construction	✔		Potential for direct contact with contaminants during ground works or from the migration of contaminated dust / fibres. Potential for the inhalation of ground gases / vapours within building spaces or excavations.
Potential effect to Controlled Waters	Construction	✔		Potential for increased mobilisation of chemical contaminants. Potential for presence and migration of contaminated groundwater.
Potential impacts to future users, third party neighbours, potable water supply and plants from potential contamination within the underlying soils / groundwater.	Operational		✔	It is anticipated that contaminants found during the construction phase will be remediated in line with proposed uses. It is also assumed that clean cover layers and imported materials, if required, will be validated for depth and chemical quality prior to use of the Scheme. This negates the requirement for consideration of future site users, third party neighbours, potable water supply and plants.

11.6. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

11.6.1. The National Planning Policy Framework (NPPF) requires the Scheme to be 'suitable for use' in relation to ground contamination. Therefore, should contamination be present, the development of the Scheme would provide a beneficial effect through remediation works.

11.7. PROPOSED ASSESSMENT METHODOLOGY

LEGISLATIVE CONTEXT

11.7.1. The following legislative frameworks considered applicable to the assessment of geology and soils are summarised as follows:

- Part 2A of the Environmental Protection Act (EPA), 1990[140];
- Environment Act, 1995[141];

[140] Environmental Protection Act, 1990.
[141] Environment Act, 1995. Available at: https://www.legislation.gov.uk/ukpga/1995/25/pdfs/ukpga_19950025_en.pdf

- Control of Substances Hazardous to Human Health, 2002[142];
- Dangerous Substances Directive (Amendment), 2006;
- Groundwater Directive 2006/118/EC[143];
- Control of Asbestos Regulations, 2012[144];
- National Planning Policy Framework 2019[145];
- Contaminated Land (England) (Amendment) Regulations, 2012[146];
- Construction (Design & Management) Regulations, 2015[147];
- Environmental Damage (Prevention and Remediation) Regulations, 2015[148];
- The Environmental Permitting (England and Wales) Regulations, 2016[149]; and,
- The Water Environment (Water Framework Directive) (England and Wales) Regulations, (2000/60/EC) 2017[150].

GUIDANCE

11.7.2. The assessment will take in to account the following guidance:

- Design Manual for Roads and Bridges. LA 109 Geology and Soils, Revision 0[151]
- British Standard (BS) BS8576 (2013) Guidance on Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds[152];
- Construction Industry Research and Information Association (CIRIA) C552 (2001) Contaminated Land Risk Assessment. A Guide to Good Practice[153];
- CIRIA C532 (2001) Control of Pollution from Construction Sites[154];

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[142] Control of Substances Hazardous to Human Health (2002). Available at: http://www.legislation.gov.uk/uksi/2002/2677/pdfs/uksi_20022677_en.pdf
[143] Groundwater Directive 2006/118/EC. Available at: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:372:0019:0031:EN:PDF
[144] Control of Asbestos Regulations, 2012. Available at: http://www.legislation.gov.uk/uksi/2012/632/pdfs/uksi_20120632_en.pdf
[145] National Planning Policy Framework (NPPF), 2019. Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2
[146] Contaminated Land (England) (Amendment) Regulations, 2012. Available at: http://www.legislation.gov.uk/uksi/2012/263/pdfs/uksi_20120263_en.pdf
[147] Construction (Design & Management) Regulations, 2015. Available at: http://www.legislation.gov.uk/uksi/2015/51/pdfs/uksi_20150051_en.pdf
[148] Environmental Damage (Prevention and Remediation) Regulations, 2015. Available at: https://www.legislation.gov.uk/uksi/2015/810/pdfs/uksi_20150810_en.pdf
[149] The Environmental Permitting (England and Wales) Regulations, 2016. Available at: http://www.legislation.gov.uk/uksi/2016/1154/pdfs/uksi_20161154_en.pdf
[150] Available at: http://www.legislation.gov.uk/uksi/2017/407/pdfs/uksi_20170407_en.pdf
[151] Design Manual for Roads and Bridges. LA 109 Geology and Soils (formerly DMRB Volume 11, Section3, Park 11 & Part 6) Revision 0.
[152] British Standards Institute (2013). Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs).
[153] Rudland, D J, Lancefield, R M, Mayell, P N (2001). Contaminated Land Risk Assessment. A Guide to Good Practice (C552). Construction Industry Research and Information Association (CIRIA).
[154] Masters-Williams, H et al. 2001. Control of Pollution from Construction Sites. CIRIA C53.

- Environment Agency (2004) Model Procedures for the Management of Contaminated Land (CLR11) [155];
- CIRIA C665 (2007) Assessing Risks Posed by Hazardous Gases to Buildings[156];
- CIRIA C681 (2009) Unexploded Ordnance - A Guide for the Construction Industry[157];
- CIRIA C682 (2009) The VOCs Handbook[158];
- Department for Environment Food & Rural Affairs (DEFRA) (2012) Contaminated Land Statutory Guidance[159];
- CIRIA C733 (2014) Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks[160];
- BS5930 (2015) Code of Practice for ground investigations[161];
- BS 8485: 2015+A1 (2019) Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings[162];
- BS 10175:2011+A2 (2017) Investigation of Potentially Contaminated Sites – Code of Practice[163]; and
- EA (2017) Groundwater Protection Technical Guidance[164].

ASSESSMENT METHODOLOGY

11.7.3. The Environment Agency's guidance, CLR11 (2004)[165], advocates the use of a conceptual risk model (conceptual site model). The basis of this approach comprises three elements: a source, a pathway and a receptor. Without each of these, there can be no contamination risk. Therefore, the presence of measurable concentrations of contaminants within the ground and subsurface does not automatically imply that a contamination risk exists, since the contamination must be defined in terms of pollutant linkages and unacceptable risk of harm. The nature and importance of both pathways and receptors, which are relevant to a particular site, will vary according to the intended use of the site, its characteristics and its surroundings. The potential for harm to occur requires three conditions to be satisfied:

[155] Environment Agency (2004). Model Procedures for the Management of Land Contamination (CLR11). Available at: https://webarchive.nationalarchives.gov.uk/20140328160926/http:/cdn.environment-agency.gov.uk/scho0804bibr-e-e.pdf
[156] Wilson, S et al. Assessing Risks Posed by Hazardous Gases to Buildings (C665). CIRIA.
[157] Stone, K et al. 2009 Unexploded Ordnance - A Guide for the Construction Industry (C681). CIRIA
[158] Baker, K. et al. (2009). The VOCs Handbook (C682). CIRIA.
[159] Department for Environment Food & Rural Affairs (1990). Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/223705/pb13735cont-land-guidance.pdf
[160] Nathanail, C P, et al. (2014). Asbestos in soil and made ground: a guide to understanding and managing risks (C733). CIRIA.
[161] British Standards Institute (2015). 5930:2015: Code of Practice for ground investigations.
[162] British Standards Institute (2019). BS 8485: 2015+A1: Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings
[163] British Standards Institute (2017). BS 10175:2011+A2: Investigation of Potentially Contaminated Sites – Code of Practice.
[164] Environment Agency (2017). Ground Water Protection Technical Guidance. Available at: https://www.gov.uk/government/publications/groundwater-protection-technical-guidance
[165] Environment Agency (2004). Model Procedures for the Management of Land Contamination (CLR11). Available at: https://webarchive.nationalarchives.gov.uk/20140328160926/http:/cdn.environment-agency.gov.uk/scho0804bibr-e-e.pdf

- The presence of substances (potential contaminants/pollutants) that may cause harm (the 'Source' of pollution;
- The presence of a receptor that may be harmed (e.g. the water environment or humans, building, fauna or flora) (the 'Receptor'); and
- The existence of a linkage between the source and receptor ('the Pathway').

11.7.4. CLR11 will be used as a technical framework in the understanding of how contamination issues that may arise could be managed.

11.7.5. The Conceptual Site Model will be used to identify and assess the potential effects on the identified sensitive receptors (including human health, controlled waters, buildings and services) and outline mitigation measures to manage the risks identified in the assessment. The assessment will be prepared in accordance with the legislation and guidance referenced above.

11.7.6. The potential effect of the Scheme on geology and soils, and/or the effect of geology and soils on the Scheme, will be assessed during the construction and operational phases. The significance level attributed to each effect will be assessment on the magnitude of impact due to the Scheme and the value / sensitivity of the affected receptor / receiving environment to change.

MAGNITUDE CRITERIA

11.7.7. Risk, probability and consequence inform the magnitude of change (CIRIA C552 guidance[153]). The magnitude of change will be assessed on a scale of major, moderate, minor, negligible and no change.

RECEPTOR VALUE / SENSITIVITY

11.7.8. The value / sensitivity of the affected receptor will be assessed on a scale of very high, high, medium, low and negligible according to CIRIA C552 guidance[153].

OVERALL SIGNIFICANCE CRITERIA

11.7.9. The effects will be defined according to Table 3.8.1 of the DMRB guidance LA 104. The impacts will be described as beneficial or adverse. An effect will be considered significant if assessed as moderate or above.

11.8. LIMITATIONS AND ASSUMPTIONS

11.8.1. To ensure transparency within the EIA process, the following limitations and assumptions have been identified:

- The assessment relies on available data, and best endeavours have been made to ensure that the data is accurate and up to date, however the accuracy of third-party information cannot be confirmed.
- At the time of writing the preliminary ground investigation works are incomplete

12. MATERIAL ASSETS AND WASTE

12.1. CONSULTATION

12.1.1. To date, no statutory consultation has been undertaken for the Scheme for the completion of this chapter.

12.1.2. Defra have been previously consulted generally on Materials and Waste EIA Scoping chapters, regarding the availability of regional Construction, Demolition Excavation (CDE) arisings. Defra responded that such data is only available at national level for England.

12.1.3. Statutory consultation with the Waste Planning Authority will be undertaken during Environmental Assessment at the ES stage, to ensure that any local context and future plans for materials and waste management in the region are understood and taken into account. All other information and data on materials and waste will be acquired through publicly available sources and will require no additional consultation.

12.2. STUDY AREA

12.2.1. The primary study area comprises the extent of the works within the Site (refer to Appendix C – Site Layout Plan).

12.2.2. The secondary study area extends to the availability of construction and recovered material resources and the capacity of waste management facilities within the UK and the East of England region (Bedfordshire, Cambridgeshire, Essex, Hertfordshire, Norfolk and Suffolk).

12.2.3. The study areas have been chosen using professional judgement based on experience of similar projects, as they provide a useful and proportionate geographical extent in which the assessment of effects from material and waste can be undertaken.

12.3. BASELINE CONDITIONS

12.3.1. This section describes baseline material consumption and waste disposal for the current land use and provides regional / national information and data in the context of which the ES assessment will be undertaken.

12.3.2. The current land use consists of agricultural fields intersected by small areas of woodland, hedgerows, drainage channels from the River Wensum, and single lane carriageways.

12.3.3. The most up to date sources of information have been used to collate data for material resource availability, landfill capacity and waste recovery. Indication of the most recent year from which data has been acquired has been provided throughout.

MATERIAL RESOURCES

Materials Currently Required

12.3.4. The current land use requires minimal consumption of construction materials. Therefore, the current use of resources is deemed negligible. The do-minimum scenario (no scheme pursued) would be unlikely to change this scenario.

UK and Regional Perspective: Availability of Construction Materials

12.3.5. Table 12-1[166,167,168,169] provides a summary of the availability of the main construction materials in East of England (Bedfordshire, Cambridgeshire, Essex, Hertfordshire, Norfolk and Suffolk) and the UK, as required to deliver typical highways schemes. The overview provides a context in which the assessment of impacts and significant effects from material consumption from the Scheme can be undertaken.

Table 12-1 – Construction materials availability in the East of England and the UK

Material Type	East of England	UK
Sand and gravel *	11.5 million tonnes (Mt) (2018)	58.3Mt (2018)
Permitted crushed rock *	0.4 Mt	144.5Mt
Concrete blocks #	1.8 million square meters (Mm2) (Midlands) (2018)	6.8Mm2 (2018)
Primary aggregate *	12.6Mt	203Mt
Recycled and secondary aggregate *	(no data)	74Mt
Ready-mix concrete *	1.4 million cubic meters (Mm3)	25.9Mm3
Steel +	(no data)	8Mt (2016)
Asphalt *	2.4Mt	27.3Mt
# stocks + production * sales Data availability: 2017 unless otherwise stated		

12.3.6. The Norfolk County Council interactive map of Mineral Safeguarding Areas[170] indicates that the Scheme passes through both silica sand, and sand and gravel deposits. However, these deposits extend beyond the study area, and thus the Scheme does not sterilise these resources. Further consideration and consultation with Norfolk County Council on the importance of these resources and impact of the Scheme will be reported in the Geology and Soils chapter of the ES.

[166] Department for Business, Energy & Industrial Strategy, Monthly Bulletin of Building Materials and Components - August 2018. [link]
[167] East of England Aggregates Working Party Annual Monitoring Report (2017) [link]
[168] Mineral Products Association, Profile of the UK Mineral Products Industry, 2018 Edition [link]
[169] House of Commons Library UK Steel Industry: Statistics and Policy (2018) [link]
[170] Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010-2026 (adopted September 2011) [Link]

12.3.7. Furthermore, there are no known peat resources[171] or active peat extractions[172] within the primary study area.

12.3.8. By comparison with other UK regions, the East of England has – in general – a slightly lower than average availability of some construction materials, for example; sales of permitted crushed rock. However, the availability of construction materials typically required for highways construction schemes in the East of England and across the UK, indicates that stocks / production / sales remain buoyant.

12.3.9. The East of England is noted to have set a regional recycled content target for aggregate (31%) that is higher than the average for England (25%)[173].

12.3.10. Taking into account the above information, the sensitivity of materials required for the Scheme is, on balance, assessed to be low.

SITE ARISINGS

Site Arisings Currently Generated

12.3.11. The current land use within the primary study area is expected to generate negligible volumes of site arisings, limited to potential earthworks on agricultural land. The do-minimum option (no scheme pursued) would be unlikely to change this scenario.

UK and Regional Perspective: Transfer, Recovery and Recycling

12.3.12. Defra data (within Table 12-2 below) shows that within England, the recovery rate for non-hazardous construction and demolition wastes have remained above 90% since 2010. This exceeds the EU target of 70%, which the UK must meet by 2020[174].

Table 12-2 - Non-hazardous construction and demolition waste recovery in England

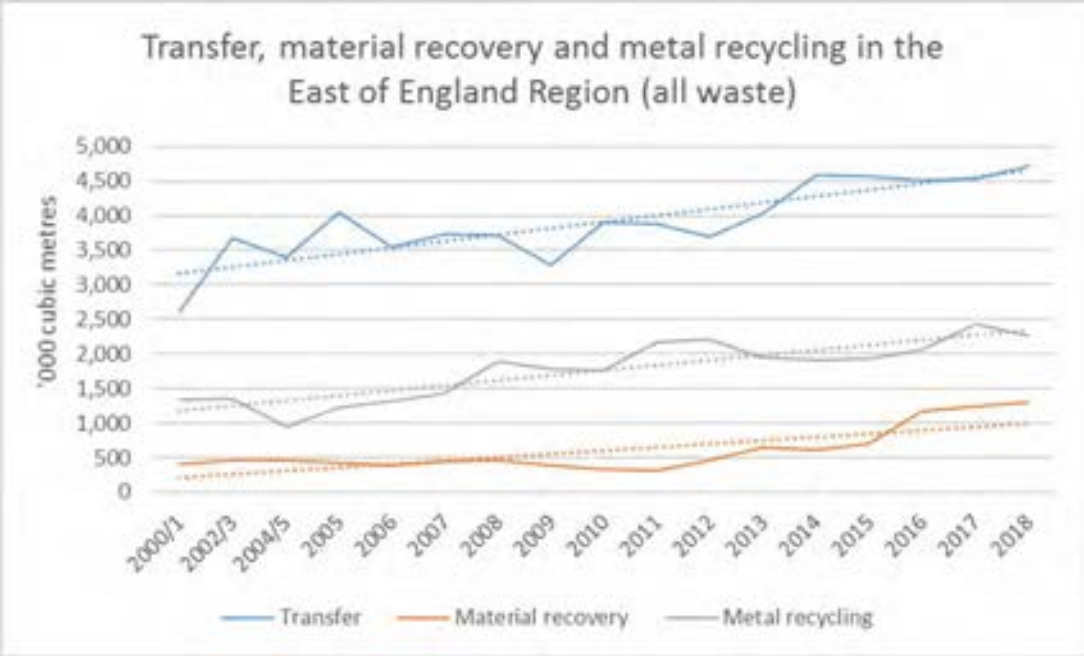
Year	Generation (Mt)	Recovery (Mt)	Recovery rate (%)
2010	53.6	49.4	92.2%
2011	54.9	50.8	92.5%
2012	50.5	46.4	92.0%
2013	51.7	47.6	92.0%
2014	55.9	51.7	92.4%

[171] Natural England MAGIC mapping website [link]
[172] DEFRA, Basis of the UK BAP target for the reduction in use of peat in horticulture – SP0573 (2009) [link]
[173] Department for Communities and Local Government (2009). National and regional guidelines for aggregates provision in England 2005-2020 [link]
[174] Defra (2019) UK Statistics on Waste [link]

Year	Generation (Mt)	Recovery (Mt)	Recovery rate (%)
2015	57.7	53.3	92.3%
2016	59.6	55.0	92.1%

12.3.13. No regional data for CDE production or recovery rates are currently available for East of England. Instead, data in Figure 12-1 has been collated to show that rates of waste recovery in the region have risen steadily over the past 18 years[175]. Metal recycling shows a slight decline in recent years; however, the trend continues to rise. Data are provided for all waste types in the East of England and hence will include but are not specific to CDE wastes.

Figure 12-1 - Transfer, materials recovery and metal recycling in the East of England (2000/1 - 2018)



12.3.14. Whilst trends for transfer, recovery and metal recycling in the East of England display different characteristics, data indicate that there is likely to be regional infrastructure and capacity for the transfer and recovery for CDE wastes from the Scheme. Construction and demolition recovery trends across England (Table 12-3) and data in confirm this assertion[176].

[175] Environment Agency, Waste Data Interrogator (2018) Waste Management Information 2018: East of England [link]
[176] Environment Agency, Waste Data Interrogator (2018) Waste Management Information 2018: England [link]

Table 12-3 – Permitted waste recovery management sites in East of England (2018)

Waste recovery facility type	Number of sites
Incineration	14
Transfer	356
Treatment	388
Metal recovery	281
Use of waste	3
Total	1,042

12.3.15. The availability of materials recovery infrastructure in the East of England, and across England, suggests that there is strong potential to divert waste from landfill site arisings generated by the Scheme, if they are not already used on-site or another local project. The importance (positive value) of this infrastructure indicates there is potential to maximise the re-use / recycling value of site arisings, and hence also has the potential to materially influence the assessment of materials and waste.

WASTE GENERATION AND DISPOSAL

Waste Currently Generated and Disposed Of

12.3.16. The current land use (arable land) within the primary study area does not generate significant quantities of waste. Therefore, the anticipated magnitude of impact associated with disposing of waste is deemed negligible in the context of available regional capacity.

12.3.17. The do-minimum option would not change impacts associated with the generation and disposal of site arisings and waste.

Regional Perspective: Remaining Landfill Capacity

12.3.18. Environment Agency data[177] confirms that at the end of 2018, there were 50 landfill sites in the East of England recorded as having 49.7 million cubic meters (Mm3) of remaining capacity, as presented inTable 12-4. The table also shows the change in capacity from 2017 to 2018.

[177] Environment Agency, Remaining landfill capacity, England (2018) [link]

Table 12-4 – Remaining landfill capacity in East of England

Landfill type	Capacity in 2017(m3)	Remaining capacity m3 (2018)	2017 to 2018 capacity comparison (Millio̊n m3)
Hazardous (merchant and restricted)	0	0	0
Inert	18,459,260	18,928,162	+0.5
Non-hazardous (including stable hazardous waste cells)	33,201,573	30,803,161	-2.4
Total	51,660,833	49,731,392	-1.9

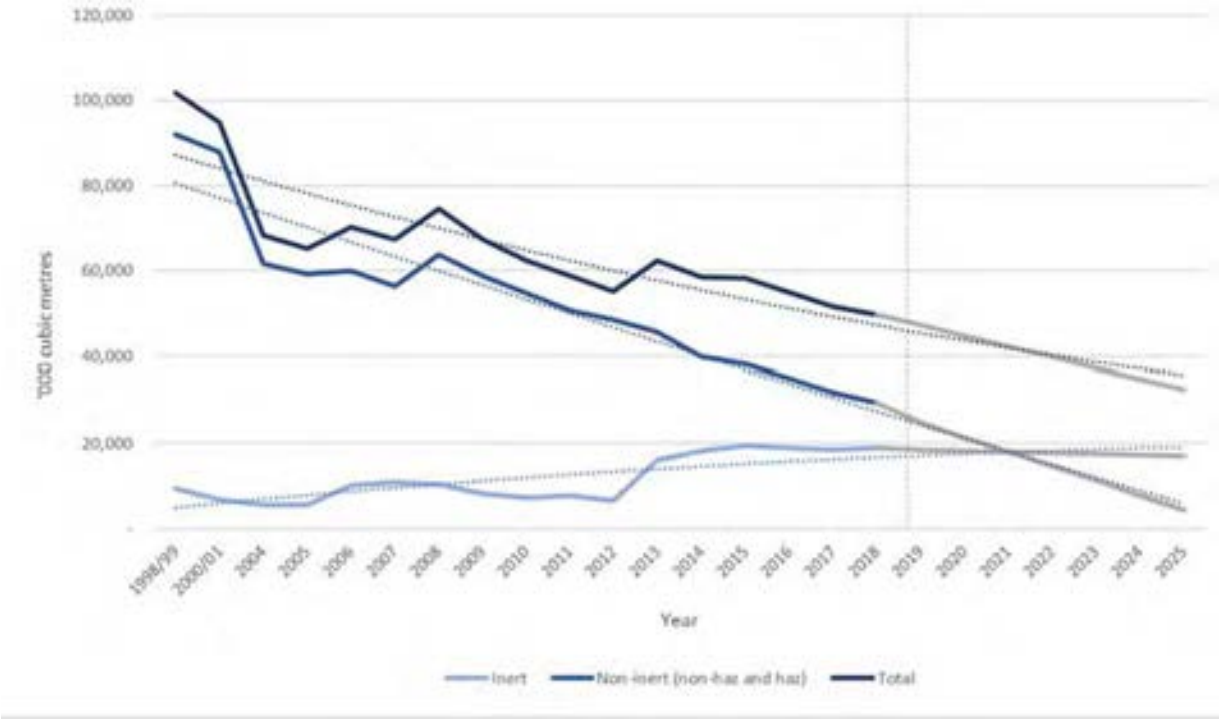
12.3.19. As the data shows, no hazardous waste landfill sites are present within the East of England region. The Norfolk Minerals and Waste Development Framework states that since the ban on co-disposal of hazardous waste with non-hazardous waste to landfill in July 2004, and since much of Norfolk is hydrogeologically unsuitable for hazardous waste landfill sites, there are no such facilities in the Norfolk area.

12.3.20. Further to this, the Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010-2026[178] specifies that proposals for new inert waste landfill void space will not be acceptable unless there is a clear need for additional void space. Any new proposals will need to demonstrate that they will have advantages for one or more of; amenity, landscape, wildlife or similar.

12.3.21. Baseline regional capacity[179] is detailed in Figure 12-2. Simple statistical forecasting (using the Microsoft Excel forecasting function) has been used to demonstrate long term void capacity to the year of planned Scheme completion (early 2025) in the absence of future provision.

[178] Norfolk County Council (2010) Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010-2026 [Link]
[179] Environment Agency, Waste Data Interrogator (2018) Waste Management Information 2018: East of England [link]

Figure 12-2 – Remaining Landfill Capacity in the East of England



12.3.22. Baseline data indicates that in the absence of future provision, inert, non-inert and total landfill capacity is likely to become an increasingly sensitive receptor throughout the duration of the construction phase, and first full year of operation. Figure 12-2 shows that waste capacity in the East Midlands is forecast to reduce by as much as 7% (inert) 82% (non-inert), and 31% (total) from 2019 to 2025, in the absences of future provision.

12.4. MITIGATION

12.4.1. No primary or tertiary mitigations for the Scheme have been identified or committed to at this time. As such, specific design measures to avoid and mitigate adverse impacts from material resources consumption and site arisings, and the generation and disposal of waste, will be identified and adopted during the assessment process and as the Scheme design develops.

12.4.2. Examples of potential design, (secondary) mitigation and enhancement measures are noted in Table 12-5.

Table 12-5 – Potential design, mitigation and enhancement measures

Element	Description	Timing / Process
Materials	Identification and specification of material resources that can be acquired responsibly, in accordance with BES 6001 Responsible Sourcing of Construction Products (British Research Establishment (BRE), 2014).	Design and construction

Element	Description	Timing / Process
	Design for resource optimisation: simplifying layout and form, using standard sizes, balancing cut and fill, maximising the use of renewable materials, and materials with recycled or secondary content, and setting net importation as a scheme goal.	Design
	Design for off-site construction: maximising the use of pre-fabricated structures and components, encouraging a process of assembly rather than construction.	Design
	Design for the future: considering how materials can be designed to be more easily adapted over an asset lifetime, and how deconstructability and demountability of elements can be maximised at end-of-first-life.	Design
	Identifying opportunities to minimise both the export and import of material resources.	Design and construction
	As part of a Construction Environmental Management Plan (CEMP), implement a Materials Management Plan in accordance with the CL:AIRE Definition of Waste: Code of Practice.	Construction
Waste	Engage early with contractors to identify additional enhancement and mitigation measures (for example, waste exemption licenses), and to identify opportunities to reduce waste through collaboration and regional synergies.	Design and Procurement
	Design for recovery and reuse: identifying, securing and using material resources at their highest value, whether they already exist on site, or are sourced from other schemes.	Design
	Ensure arisings are properly characterised before or during design, to maximise the potential for highest value reuse.	Design
	Forecast and identify the volume and type of woodland and other vegetative arisings that will be generated and establish opportunities for high-value re-use and recycling, both on and off-site.	Design and construction
	Working to the Proximity Principle, ensuring arisings generated are handled, stored, managed and re-used or recycled as close as possible to the point of origin.	Design and construction
	Identify areas for stockpiling and storing wastes that will minimise quality degradation and leachate, and will minimise damage and loss.	Design and construction
	As part of a CEMP, and once the scheme design is finalised, capture information and data on site arisings recovered and diverted from landfill through development of a Design Site Waste Management Plan.	Design

12.5. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

12.5.1. The following construction and operational phase effects are potentially significant and will be considered within the ES:

- The consumption of materials could have a potentially significant adverse effect on the environment through the depletion of natural resources; and
- The generation and disposal of waste generated by the Scheme. The potential for significant effects from waste disposal is commensurate with a reduction in regional landfill void capacity; landfill capacity is considered a sensitive receptor in the UK.

12.5.2. Table 12-6 provides a summary of the anticipated materials and waste for the Scheme which have the potential to generate significant environmental effects. The quantity of materials imported, arisings generated for re-use or recovery, and waste for disposal to landfill will be identified as the Scheme progresses.

Table 12-6 – Potential significant effects from material and waste

Project Activity	Material use and potential to generate significant effects	Potential waste arisings and potential to generate significant effects
Site remediation / preparation	Bulk construction material resources for the compound and storage areas are likely to be imported and expected to comprise: Asphalt and aggregate for base and sub-base; Timber for formwork & temporary fencing; and Steel or other metals for reinforcement, structures, signage, lighting and safety barriers Any impacts associated with material resource consumption would be adverse, permanent and direct and could – in combination with other construction phases - give rise to significant adverse effects.	Information given in the Interpretative Environmental Desk Study Report, suggests that risks of contamination are medium to low. Any impacts associated with waste disposal to landfill would be adverse, permanent and direct, and could – in combination with other construction phases - give rise to significant adverse effects.
Demolition	No potential significant effects have been identified with regards to material resource consumption required during the demolition phase.	The potential demolition of highway and associated assets is likely to result in a small volume of arisings, a proportion of which (after the potential for reuse and recycling has been maximised) may need to be disposed of. Wastes generated during demolition are likely to include: broken out concrete, and road surface planings; hazardous or contaminated material found on or beneath the Scheme;

Project Activity	Material use and potential to generate significant effects	Potential waste arisings and potential to generate significant effects
		wood and metal from boundary fences; and Other demolition wastes. Where diverting site arisings from landfill is not possible, the impacts associated with disposing of waste would be adverse, permanent and direct, and therefore could – in combination with other construction phases - give rise to significant adverse effects.
Site construction	Bulk construction material resources to be imported for the Scheme are likely to comprise: aggregate for sub-base; asphalt for road surfacing; concrete for structures (such as bridges), kerbing and drainage; earthworks for embankments; plastic for drainage; top or subsoil (dependent on cut and fill balance); timber for formwork; and steel or other metals for reinforcement, structures, signage, lighting and safety barriers Any impacts associated with material resource consumption would be adverse, permanent and direct and could – in combination with other construction phases - give rise to significant adverse effects.	Waste arisings generated during construction may include: surplus or damaged materials (asphalt, aggregate, concrete, metals, plastics); timber from used formwork; general construction waste (packaging); and earthworks Any impacts associated with waste disposal to landfill would be adverse, permanent and direct, and could – in combination with other construction phases - give rise to significant adverse effects.
Operation and maintenance	In the first year of operation, minor amendments and changes to the Scheme assets may be required. Depending on the extent of these changes, the potential to consume material resources (including recovered site arisings), and to produce and dispose of waste may be required. The extent of changes within the first year of operation is not currently known, but professional judgement would indicate that there are unlikely to be significant environmental effects. Similarly, beyond the first year of operation, it is predicted that there will be no significant adverse effects. Operational effects have therefore been scoped out of further assessment.	

FUTURE BASELINE

Material resources

12.5.3. In the future baseline, it is considered that the land use would remain arable farmland. Therefore, the future consumption of construction and other materials (including recovered site arisings) within the proposed primary study area, is considered **negligible**.

12.5.4. The do-minimum option would be unlikely to change the current consumption of materials.

Waste

12.5.5. In the future baseline it is considered that the land use would remain arable farmland. Therefore, the future generation and disposal of waste within the primary study area is assessed as **negligible**.

12.5.6. The do-minimum option would be unlikely to change the generation and disposal of waste within the primary study area.

Table 12-7 shows the elements of materials and waste which will be scoped in and out of the ES assessment.

Table 12-7 – Elements Scoped in or Out of Further Assessment

Element	Phase	Scoped In	Scoped Out	Justification
Material resource consumption and waste generation and disposal	Site preparation and Remediation	✔		As the Ground Risk and Remediation assessment has not been undertaken at the time of writing this report, it is unknown whether site preparation and remediation will be required. Therefore, in the event that it is required, it will be scoped in. In the case where it is potential for direct physical impacts through the consumption of construction materials, and disposal of inert and non-inert waste in preparation for the Scheme. In combination with other construction phases, this could give rise to significant adverse environmental effects.
Material resource consumption and waste generation and disposal	Demolition	✔		Potential for direct physical impacts through the disposal of inert and non-inert waste from demolition, in preparation for the Scheme. In combination with other construction phases, this could give rise to significant environmental effects.
Material resource consumption and waste generation and disposal	Construction	✔		Potential for direct physical impacts based on the materials forecast for use, and site arisings and waste generated / disposed of. In combination with other construction phases, this could give rise to significant adverse environmental effects.
Material resource	Operation		✔	The quantity of material resources required, and waste generated during the

Element	Phase	Scoped In	Scoped Out	Justification
consumption and waste generation and disposal				operational phase (for example routine maintenance and repairs) is – using professional judgement - considered negligible, and is not expected to result in significant adverse effects.

12.6. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

12.6.1. Opportunities for enhancing the environment from materials and waste management are integrated into Table 12-5. Some potential examples to be considered include:

- Responsible acquirement of material resources in accordance with BES 6001 Responsible Sourcing of Construction Products (British Research Establishment (BRE), 2014);
- Design for recover and re-use – identify opportunities to reduce waste through collaboration and regional synergies.
- use of surplus recycled or recovered materials in community projects e.g, utilising recycled mulch from tree felling on adjacent community facilities; or
- recycling suitable material for construction of noise and landscape bunding outside of the highway boundary where need has been previously identified (where land availability allows) to improve environmental outcomes for a wider range of receptors.

12.7. PROPOSED ASSESSMENT METHODOLOGY

CONSTRUCTION PHASE

12.7.1. The Standard that will be used to inform the assessment process is DMRB LA110 Material assets and Waste (formerly Interim Advice Notice 153/11[180], as updated by Major Projects Instructions 57/2017). Professional judgement will be used in the application of the standard, to ensure it responds to previous legal advice on other comparable environmental assessment documentation, and hence offers a 'best fit' solution to the assessment process.

12.7.2. LA110 aligns with the Environmental Impact Assessment Directive (2011/92/EU)[181] which provides a framework for assessing and managing the effects associated with the use of material assets and disposal/recovery of waste, by promoting;

1. Reduction in overall impacts and improvements in the efficiency of resource use; and

2. Prevention and/or reduction of the adverse effects associated with the generation and management of waste.

12.7.3. In accordance with the requirements set out in LA110, assessments should be a quantitative exercise that aim to identify the following:

[180] Interim Advice Notice 153/11 Guidance on the Environmental Assessment of Material Resources [Link]
[181] Directive 2011/92/EU of the European Parliament of the Council of 13 December 2011 on the assessment of the effects of certain public and private project on the environment Text with EEA relevance [Link]

For materials:

- Types and quantities of materials required to construct the project;
- Information on materials that contain secondary / recycled content;
- Information on any known sustainability credentials of materials to be consumed;
- The type and volume of materials that will be recovered from off-site sources for use on the project;
- The cut and fill balance; and
- Details of on-site storage and stockpiling arrangements, and any supporting logistical details.

For waste:

- The amount of waste (by weight) that will be recovered and diverted from landfill either on site or off site (i.e. for use on other projects);
- Types and quantities of waste arising from the project (demolition, excavation arisings and remediation) requiring disposal to landfill;
- Details of on-site storage and segregation arrangement for waste and any supporting logistical arrangements;
- Potential for generation of hazardous waste (type and quantity);
- The impacts that will arise from the issues identified in relation to materials and waste;
- A conclusion about the magnitude and nature of the impacts; and
- The identification of measures to mitigate the identified impacts.

MATERIALS

12.7.4. An assessment of the effects of consuming materials required during the construction phases will be undertaken by considering the origins and sources of materials, including their general availability (production, stock, sales) and the proportion of recovered (reused or recycled) materials they contain (including other sustainability features). Materials forecast to be consumed during operation of the Scheme are considered (using professional judgement) negligible, and hence scoped out.

12.7.5. The reuse of excavated and other arisings (that meet waste exemption criteria) will be evaluated as part of the assessment of materials, to determine whether the adverse impacts associated with the consumption of primary resources can be reduced.

12.7.6. To determine the significance of (and any residual) effects associated with material resource consumption, the next steps for the ES will comprise:

- The review and analysis of a material type and quantities required for the Scheme;
- The review and analysis of the cut and fill balance of the Scheme; and
- The review and analysis of embedded and proposed mitigation measures.

LANDFILL CAPACITY

12.7.7. An assessment of the remaining landfill capacity in the East of England will be used to determine the impacts and effects of waste generated during the construction phase of the Scheme. Waste generated during operation of the Scheme is considered negligible, and hence scoped out.

12.7.8. The assessment shall consider the type and volume of waste to be generated by the Scheme and determine the potential impact on remaining landfill capacity in the region; this will be completed for inert and non-inert (non-hazardous and hazardous) waste types. Wherever waste is recovered

(diverted from landfill) the influence of this action will be taken into account in the assessment of significance of effect.

12.7.9. To determine the significance of (and any residual) effects associated with waste generation and disposal, the next steps for the environmental assessment process will comprise a review and analysis of:

- Anticipated waste (and arising) types and volumes to be generated;
- Anticipated on-site waste storage arrangements;
- Anticipated pre-treatment, treatment, re-use, recycling, recovery and / or landfill disposal of arisings and waste; and
- Embedded and additional mitigation measures.

OPERATION PHASE

12.7.10. For reasons explained in Table 12-7, operation has been scoped out of the assessment. No assessment methodology is therefore required.

12.8. SIGNIFICANCE CRITERIA

12.8.1. LA110i provides a range of significance criteria for the assessment of effects from material assets and waste disposal (Table 12-8).

Table 12-8 – Significance Criteria

Significance	Materials	Waste
Very large	No criteria: use criteria for large categories.	>1% reduction or alteration in national capacity of landfill, as a result of accommodating waste from a project; or Construction of new (permanent) waste infrastructure is required to accommodate waste from a project.
Large	Project achieves <70% overall material recovery / recycling (by weight) of non-hazardous Construction and Demolition Waste (CDW) to substitute use of primary materials; Aggregates required to be imported to site comprise <1% re-used / recycled content; and Project sterilises ≥1 mineral safeguarding site and/or peat resource.	>1% reduction in the regional capacity of landfill as a result of accommodating waste from a project; and 50% of project waste for disposal outside of the region.
Moderate	Project achieves less than 70% overall material recovery / recycling (by weight) of non-hazardous CDW to substitute use of primary materials; and Aggregates required to be imported to site comprise re-used/recycled content below the relevant regional percentage target.	>1% reduction or alteration in the regional capacity of landfill as a result of accommodating waste from a project; and 1-50% of project waste for disposal outside of the region.

Significance	Materials	Waste
Slight	Project achieves 70-99% overall material recovery / recycling (by weight) of non-hazardous CDW to substitute use of primary materials; and Aggregates required to be imported to site comprise re-used/recycled content in line with the relevant regional percentage target.	≤1% reduction or alteration in the regional capacity of landfill; and Waste infrastructure has sufficient capacity to accommodate waste from a project, without compromising integrity of the receiving infrastructure (design life or capacity) within the region.
Neutral	Project achieves >99% overall material recovery / recycling (by weight) of non-hazardous Construction Demolition Waste (CDW) to substitute use of primary materials; and Aggregates required to be imported to site comprise >99% re-used / recycled content.	No reduction or alteration in the capacity of waste infrastructure within the region.
Notes	Recycled aggregate targets 2005 – 2020[182] The higher of the targets set for recycled aggregate (national average or regional) shall be applied to the Scheme. Where a project is located in more than one region, the target from the region where the majority of the materials are to be sourced, shall apply.	

Region	Recycled content target (alternative materials)	Total aggregate provision (million tonnes)
East	31%	382
England (average)	25%	434 (3908 Total)

12.8.2. The descriptions provided in Table 12-9 will be used to define whether effects identified as a result of material consumption or waste disposal from the Scheme, are significant or not.

Table 12-9 – Descriptions for significance of effect

Significance Criteria	Materials Significance of Effect	Waste Significance of Effect
Neutral	Not significant	Not significant
Slight	Not significant	Not significant
Moderate	Significant	Significant

[182] Department for Communities and Local Government. National and regional guidelines for aggregates provision in England 2005-2020 (2009) [link]

Significance Criteria	Materials Significance of Effect	Waste Significance of Effect
Large	Significant	Significant
Very Large	Significant	Significant

12.9. LIMITATIONS AND ASSUMPTIONS

12.9.1. Data for material resource availability, landfill capacity and waste recovery is only updated periodically by Defra and the Environment Agency. The most up-to-date sources of available information have been used at the time of writing.

MATERIALS

- The assessment of material resources will be based upon the validity of the collated information, regarding the materials that are expected to be consumed during the 'in scope' lifecycle phases of the Scheme.
- Baseline data and information for the assessment will use the most recent available data, however this is typically only available to 2018 (unless stated otherwise).
- A lifecycle assessment (including embodied carbon and water) of materials will not be included in the ES as the effort and resources required are deemed disproportionate to the benefit they would offer the assessment of significance of effect.

WASTE

- The assessment of impacts and effects on landfill void capacity will be based upon the validity of the collated information, regarding the waste generated and disposed by the Scheme.
- UK landfill operators can claim commercial confidentiality for their data at the time of submission; data for sites with a commercial confidentiality in place are therefore unavailable for the analyses presented in this Chapter. It is not anticipated that any lack of data in this context will materially affect the results of the assessment.
- Defra has been previously consulted to determine whether generation and recovery rates for CDE arisings were available by region. Defra confirmed that it does not publish CDE figures at a regional level, and only national (England) data are accessible through the publicly available Waste Data Interrogator Database; the database is held and operated by the Environment Agency. It was quoted that: "The methodology used to generate these figures is complex, in order to take into account, the inherent double-counting and data gaps that are present within waste system data, and it would not be feasible to reproduce these on a regional basis."
- Until such a time that CDE generation and recovery rates by region are available, transfer (non-civic), recovery and metal recycling data (available through the Waste Data Interrogator Database) will be used as the closest possible proxy.

13. CLIMATE

13.1. INTRODUCTION

13.1.1. The requirement to consider a project's impact on and vulnerability to climate change results from the 2014 amendment to the EIA Directive (2014/52). The Directive has been fully transposed into UK law in the EIA Regulations. The Directive requires: "A description of the likely significant effects of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change".

13.1.2. As such this Chapter considers the impacts and effects of the Scheme in terms of;

- The contribution to climate change: the greenhouse gas (GHG) emissions assessment; and
- The assessment of the vulnerability of the Scheme to climate change: climate change resilience and adaptation.

13.1.3. Therefore, this chapter has been divided into two sections.

GREENHOUSE GASES

13.1.4. This Chapter presents the methods and scope of the assessment that will examine the Scheme's GHG emissions, to be presented in the ES. In addition, baseline information, potential mitigation measures, and potential residual effects are reported.

13.1.5. The approach to the assessment aligns with the following policy and guidance:

- Highways England (2019) Design Manual for Roads and Bridges (DMRB) LA 114 Climate[183];
- IEMA (2017) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance[184]; and
- Norfolk County Council (2019) Norfolk Council Council's Environmental Policy[185].

13.2. CONSULTATION

13.2.1. No formal consultation has been undertaken to date in relation to the GHG emissions, however discussions with the Norfolk County Council Sustainability Manager have been held to discuss the councils latest Environmental Policy which includes targets related to resource efficiency and carbon reduction. A key aspiration captured within the policy is for the council to collectively achieve 'net

[183] Highways England (2019) DMRB LA 114 Climate http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/LA%20114%20Climate-web.pdf [Accessed 15/01/2020].
[184] IEMA (2017) IEMA Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance. Available at https://www.iema.net/assets/newbuild/documents/IEMA%20GHG%20in%20EIA%20Guidance%20Document%20V4.pdf [Accessed 14/01/2020].
[185]Norfolk County Council (2019) Norfolk Council Council's Environmental Policy https://www.norfolk.gov.uk/-/media/norfolk/downloads/what-we-do-and-how-we-work/policy-performance-and-partnerships/policies-and-strategies/environment/norfolk-county-council-environmental-policy.pdf?la=en

zero' carbon emissions on estates by 2030, but within wider areas, work towards 'carbon neutrality' also by 2030.

13.3. STUDY AREA

13.3.1. The GHG assessment is not restricted by geographical area but instead includes any increase or decrease in emissions as a result of the Scheme, wherever that may be. This includes:

- Construction emissions from the Site but also related to the transport of materials to and from the site and their manufacture (this may be distant from the Scheme location); and
- Operational emissions (increase or reduction) which result from the end-use of the Scheme and any shifts in transport modes/patterns which may occur. Such emissions include those for traffic using the Scheme as well as the surrounding regional road network to gain access.

13.4. BASELINE CONDITIONS

EXISTING BASELINE

13.4.1. In the baseline (Do Minimum) scenario, GHG emissions occur constantly and widely as a result of human and natural activity including energy consumption (fuel, power), industrial processes, land use and land use change. The GHG assessment will only consider instances in which the Scheme results in additional or avoided emissions in comparison to the baseline scenario and its assumed evolution. The baseline conditions therefore focus on those emissions sources subject to change between the baseline scenario and the Scheme. However, emissions from 2017 within Norwich, Norfolk, and nationally are presented in Table 13-1 for context[186].

Table 13-1 – Emissions sources (2017) for Norwich, Norfolk, and nationally.

Emissions Sources	Norwich ($ktCO_2$)	Norfolk ($ktCO_2$)	National ($ktCO_2$)
Industry and Commercial Electricity	98.3	622.4	46,415
Industry and Commercial Gas	88.5	673.9	34,466
Large Industrial Installations	-	10.5	1751.2
Industrial and Commercial Other Fuels	18.9	333.3	17,169.9
Agriculture	0.3	63.2	4,452
Industry and Commercial Total	**206.3**	**1,703.3**	**104,254.5**
Domestic Electricity	51.7	446.6	27,546.9
Domestic Gas	123.2	617.3	59,875.6

[186] Department for Business, Energy and Industrial Strategy (2019) UK local and regional CO_2 emissions, https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-to-2017

Emissions Sources	Norwich ($ktCO_2$)	Norfolk ($ktCO_2$)	National ($ktCO_2$)
Domestic 'Other Fuels'	8.6	292.8	10,678.9
Domestic Total	183.5	1,356.8	98,101.3
Road Transport (A roads)	64.6	1,060.5	56,185.5
Road Transport (Minor roads)	55.8	769.2	37,977.9
Transport Other	10.4	129.3	2,094.5
Transport Total	**130.8**	**1,959**	**96,258**
Grand Total	**520.3**	**5,019**	**298,613.8**
Population ('000s, mid-year estimate)	140.4	898.4	66,040.2
Per Capita Emissions (t)	3.7	5.6	4.5

13.4.2. The 'do minimum' (baseline) scenario involves no construction activities and therefore the construction baseline is zero emissions.

13.4.3. The operation and management of the existing assets under the baseline scenario are likely to require a small number of components (for example, light bulbs and signage) as well as some bulk material (cement, concrete, sand and gravel) for minor works and repairs of the highway and ancillary infrastructure. These materials will have embodied emissions associated with them, and the installation of these materials will result in emissions due to the transport of these materials, and plant use. These baseline emissions are expected to be small, and as such will not be quantified.

FUTURE BASELINE

13.4.4. The future baseline scenario involves no construction activities and therefore the construction baseline is zero emissions.

13.4.5. The total end-user operational GHG emissions from traffic flows in the 'do minimum' scenario is modelled in accordance with the Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 14 Climate; LA114. The modelling includes the total GHG emissions for vehicles covered by the traffic model, covering the road network in the area of the Scheme and its surroundings. At present, this data for the end-user emissions is not available for inclusion but this data will be reported in the next stage of climate assessment in the ES.

13.5. MITIGATION

CONSTRUCTION STAGE

13.5.1. The magnitude of GHG emissions associated with the construction phase of the Scheme can be minimised by the following preliminary mitigation and enhancement measures:

- Detailed design optimisation to reflect the carbon reduction hierarchy (BSI, 2016)[187];
- Minimising the quantities of materials required to construct the Scheme;
- Maximising the use of construction materials and products with recycled or secondary and low carbon content, from renewable sources, and offering sustainability benefit;
- Using locally-sourced materials where available and practicable to minimise the distance materials are transported from source to site;
- Using more efficient construction plant and delivery vehicles, and/or those powered by electricity from alternative/lower carbon fuels; and.
- Using innovative construction methods to reduce plant use.

13.5.2. Mitigation measures will be developed further in the ES.

OPERATIONAL STAGE

13.5.3. The magnitude of GHG emissions associated with the operational phase of the Scheme can be minimised by, amongst others:

- Designing, specifying and constructing the Scheme with a view to maximising the operational lifespan and minimising the need for maintenance and refurbishment (and all associated emissions);
- Designing, specifying and constructing the Scheme with a view to maximising the potential for reuse and recycling of materials/elements at the end-of-life stage;
- Specifying high efficiency mechanical and electrical equipment such as lighting and telecoms; and; and
- Operating, maintaining and refurbishing the Scheme using best-practice efficient approaches and equipment.

13.6. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

13.7. The potential sources of GHG emissions associated with the Scheme are identified in Table 13-2.

Table 13-2 – Key Emissions Sources During the Scheme Lifespan

Lifecycle stage (as per PAS 2080[188])		Potential sources of emissions (not exhaustive)
Construction	Product stage (manufacture and transport of raw materials to suppliers) A1-3	Embodied emissions associated with extraction and manufacturing of the required raw materials.
	Transport of materials to site A4	Emissions from fuel and electricity used in vehicles transporting materials to site.
	Plant and equipment use during construction A5	Emissions from fuel and electricity used in plant and equipment on site.

[187] BSI. (2016). PAS 2080: Carbon Management in Infrastructure
[188] BSI (2016) PAS 2080 Carbon Management in Infrastructure

Lifecycle stage (as per PAS 2080[188])		Potential sources of emissions (not exhaustive)
	Transport of waste A5	Emissions from fuel/energy used in vehicles transporting materials to away from site.
	Disposal of waste A5	Emissions from the final disposal of waste materials.
	Land use, land use change and forestry A5	Change in emissions associated with the clearance and disposal of biomass due to the scheme.
Operation	Operation B1	Electricity used for lighting.
	Maintenance, repair, replacement, refurbishment B2-5	Embodied emissions, and emissions from transport and plant associated with maintenance, repair, replacement, and refurbishment.
	Land use, land use change and forestry B8	Change in emissions associated with the existence of the Scheme hindering or promoting the sequestration of carbon dioxide into biomass.
	End user emissions (regional traffic flows) – traffic B9/D	Vehicles using highways infrastructure affected by the scheme.
End of life	Decommissioning process C1	Emissions from decommissioning work (i.e. fuel/electricity)
	Transport and disposal of materials C2-4	Emission sources as fuel/energy consumption from the transport of materials to disposal sites or recovery.

13.7.1. The impacts of GHG emissions relates to their contribution to global warming and climate change. These impacts are global and cumulative in nature, with every tonne of GHG contributing to impacts on natural and human systems. GHG emissions result in the same global effects wherever and whenever they occur and, therefore, the sensitivity of different human and natural receptors is not considered. The magnitude of emissions associated with the Scheme will not be quantified until the ES is produced, and as such the impact of the scheme on the climate is not currently known.

SCOPE

13.7.2. Based on the emissions sources identified in Table 13-2, and using guidance from the Institute of Environmental Management and Assessment (IEMA)189, professional judgement has been used to determine which sources to scope in for further consideration in the ES. A summary of this proposed scope is presented in Table 13-3.

[189] IEMA (2017) Assessing Greenhouse Gas Emissions and Evaluating their Significance https://www.iema.net/assets/newbuild/documents/IEMA%20GHG%20in%20EIA%20Guidance%20Document%20V4.pdf

Table 13-3 – Elements Scoped in or Out of Further Assessment

Element	Phase	Scoped In	Scoped Out	Justification
Product stage (manufacture and transport of raw materials to suppliers) A1-3	Construction	✔		Raw materials required for the Scheme will result in embodied emissions and have the potential to be large.
Transport of materials to site A4	Construction	✔		Construction stage emissions from fuel / energy consumption due to the delivery of material to site have the potential to be large.
Plant and equipment use during construction A5	Construction	✔		Fuel / energy consumption of plant and equipment used during construction would generate GHG emissions.
Replacement and refurbishment B2-5	Operation	✔		The replacement and refurbishment of the Scheme would release a potentially large magnitude of emissions.
End-user emissions (regional traffic flows) - traffic B9/D	Operation	✔		Changes to regional traffic flows are expected and this has the potential to result in a large change in GHG emissions.
Disposal of waste A5	Construction		✔	Emissions from the disposal of waste are unlikely to be large, due to a large proportion of construction waste being inert.
Land use, land use change and forestry A5	Construction		✔	Emissions from the disposal of biomass are not expected to be large.
Electricity used for lighting B1	Operation		✔	There will be 10 lighting columns at the lead up to the A47. This is not considered to be a large emission source.
Maintenance B2-5	Operation		✔	Maintenance associated with the Scheme is not considered to be a large emissions source as only a small amount will be additional to the maintenance that already takes place within the region.
Repair B2-5	Operation		✔	The Scheme is designed to be maintained rather than repaired, therefore subsequent repair emissions sources are not considered to be large.

Element	Phase	Scoped In	Scoped Out	Justification
Land use, land use change and forestry B8	Operation		✔	The reduction in carbon sequestration due to the Scheme is not considered to be large.
Decommissioning process C1	End of Life		✔	Expected timescales for decommissioning are so far into the future that there is insufficient certainty about the likelihood, type or scale of emissions activity to determine their likely magnitude, even if they take place at all. As such these emissions sources will not be considered.

13.8. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

13.8.1. Refer to the measures identified in 13.14.1.

13.9. PROPOSED ASSESSMENT METHODOLOGY

13.9.1. The assessment approach considers the likely magnitude of GHG emissions (or avoided emissions) in comparison to the baseline scenario without the Scheme. It considers emissions throughout the lifecycle of the Scheme including:

- Construction stage; e.g. embodied emissions associated with materials, transportation of materials to site and waste/arisings from site, and the construction process; and
- Operation; e.g. operation of lighting and controls, maintenance and replacement of original materials, as well as emissions (or avoided emissions) from end-user vehicles.

13.9.2. For all lifecycle stages and sub-stages of the Scheme, the assessment will include the following:

- Collection of available data/information on the scale of GHG emitting activities (e.g. tonnes concrete, litres of fuel, kWh electricity) for the baseline scenario and for the Scheme. In each case this will cover the whole study period; and
- Calculation of the GHG emissions by applying a suitable emissions factor (tCO2e per unit of emissions generating activity).

EMISSIONS CALCULATIONS

13.9.3. Emissions calculations for all sources other than end-user emissions (traffic), will be completed within an industry recognised carbon calculation tool which focuses on emissions throughout the Scheme lifecycle. For this assessment, Highways England's carbon tool will be used and, where required, this will be supplemented with best practice methods. Traffic emissions will be assessed in accordance with the DMRB Volume 11, Section 3, Part 14; LA114 – Climate, and will be quantified using WebTAG data from the Department of Transport. This considers the proportions of the vehicle types, fuel types, forecast fuel consumption parameters and emission factors.. Values will be reported as tonnes of carbon dioxide equivalents (tCO2e).

SIGNIFICANCE CRITERIA

13.9.4. There are currently no agreed thresholds for what level of GHG emissions is considered significant in an EIA context. In line with the National Networks National Policy Statement (NN NPS)[190], significance of GHG impacts is assessed with the best practice technique of comparing estimated GHG emissions arising from the Scheme with the respective UK carbon budget (Table 13-4), which have been set by the UK Government covering 2018 to 2032. As such the magnitude of emissions, in conjunction with guidance from IEMA[191] will inform professional judgement of significance.

Table 13-4 – National Carbon Budgets set by the Government

Carbon Budget Period	UK Carbon Budget
Third: 2018-2022	2,544 MtCO2e
Fourth: 2023-2027	1,950 MtCO2e
Fifth: 2028-2032	1,725 MtCO2e

13.10. LIMITATIONS AND ASSUMPTIONS

13.10.1. The following limitations and assumptions have been identified:

- The assessment is expected to take place before the detailed design is finalised and a contractor is on site, and as such there will be some uncertainty regarding the types and quantities of materials to be used in construction. Where data is unavailable, worst-case reasonable assumptions will be used to fill in gaps;
- The assessment of significance will be based, in part, on professional judgement;
- The assessment is reliant on traffic modelling data, therefore any uncertainty in this data will affect the assessment; and
- Some small emissions sources have been excluded as emissions from these sources are not considered likely to be large and therefore not material to the assessment.

[190] The NN NPS has been used for context and is not directly relevant policy.
[191] IEMA (2017) Assessing Greenhouse Gas Emissions and Evaluating their Significance https://www.iema.net/assets/newbuild/documents/IEMA%20GHG%20in%20EIA%20Guidance%20Document%20V4.pdf

13.10.2. This section presents an assessment of the vulnerability of the Scheme to the impacts of climate change, and scopes relevant climate change vulnerabilities in for future assessment.

13.10.3. The approach to the assessment aligns with the following UK and international guidance:

- Highways England (2019) Design Manual for Roads and Bridges (DMRB) LA 114 Climate[192];
- IEMA (2015) Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation[193];
- European Commission (2013) Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment[194];
- European Commission (2016) Climate change and major projects[195];
- European Commission Non-Paper Guidelines for Project Managers: Making vulnerable investments climate resilient[196]; and
- Norfolk County Council's Environmental Policy (2019)[197].

13.11. CONSULTATION

13.11.1. There has been no consultation undertaken to date in relation to climate resilience. No consultation is proposed at this stage to support the ES. Consultation undertaken in relation to flood risk has been identified in Chapter 10 – Road Drainage and the Water Environment.

13.12. STUDY AREA

13.12.1. The study area for the climate resilience assessment is defined by the Site (refer to Appendix C). The assessment will be informed by information on historic and projected change in climate variables.

[192] Highways England (2019) DMRB LA 114 Climate http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/LA%20114%20Climate-web.pdf [Accessed 15/01/2020].
[193] IEMA (2015) IEMA EIA Guide to Climate Change Resilience and Adaptation. Available at https://www.iema.net/assets/templates/documents/iema_guidance_documents_eia_climate_change_resilience_and_adaptation%20(1).pdf [Accessed 08/01/2020].
[194] European Commission (2013) Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment
[195] European Commission (2016) Climate changes and major projects https://publications.europa.eu/en/publication-detail/-/publication/5535c968-7a41-11e6-b076-01aa75ed71a1/language-en [Accessed 08/01/2020].
[196] European Commission (2016) Non-paper Guidelines for Project Managers: Making vulnerable investments climate resilient.
[197] Norfolk County Council (2019) Norfolk County Council's Environmental Policy.

13.13. BASELINE CONDITIONS

13.13.1. Historic climate data has been extracted for this region using Met Office Regional climate profiles[198] and weather station data. Future projected climate data has been interpreted from UK Climate Projection 2018 data.

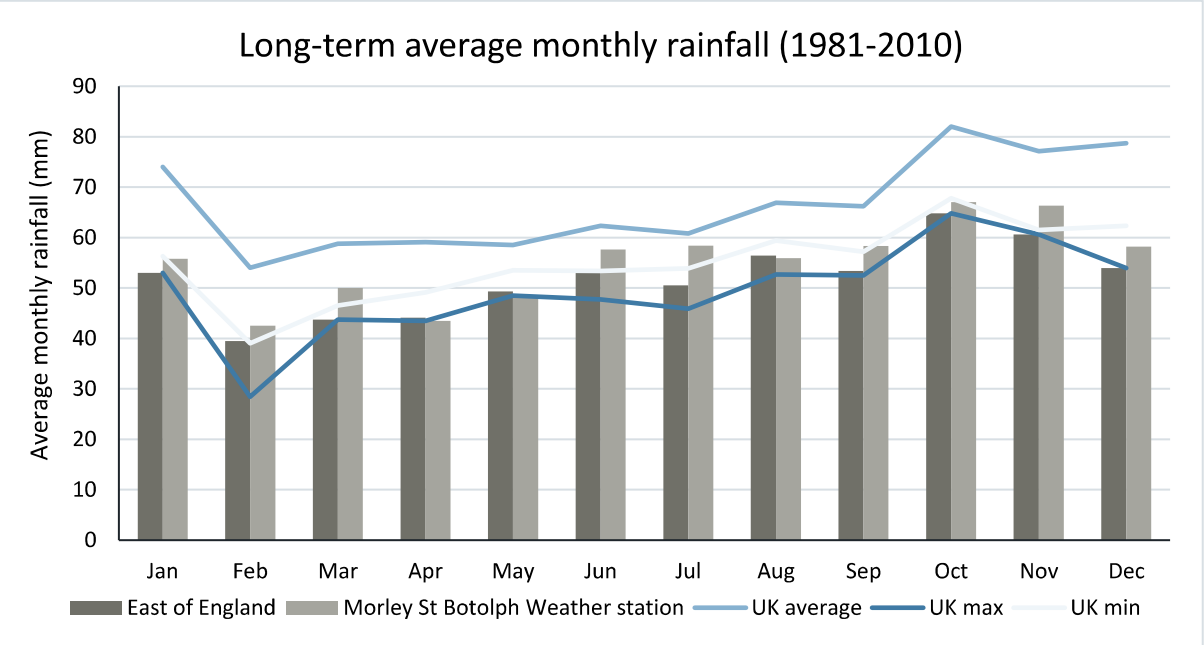
EXISTING BASELINE

Precipitation

13.13.2. The East of England is characterised as having minimal rainfall in comparison to the rest of the UK.

13.13.3. Figure 13-1 - Long Term Average Mean Monthly Rainfall for the East of England region and Morley St Botolph Weather Station, in comparison to the rest of the UK shows the long-term average monthly rainfall for the East of England Region and Morley St Botolph Weather station[199] (approximately 11 miles south east of the scheme) between 1981 and 2010. It shows that the region is drier than most parts of the UK throughout the year, however rainfall in the area of the weather station is slightly higher than the average for the East of England.

Figure 13-1 - Long Term Average Mean Monthly Rainfall for the East of England region and Morley St Botolph Weather Station, in comparison to the rest of the UK



[198] Met Office (2018) East England: Climate https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/regional-climates/eastern-england_-climate---met-office.pdf . [Accessed 08/01/2020].
[199] Met Office UK Climate Averages https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/u12dzxjyc [Accessed 08/01/2020].

Extreme Precipitation

13.13.4. Whilst the region is drier than the UK average, it does experience extreme rainfall events. Table 13-5 shows the average number of days in summer and winter in the region (in the period 1981 – 2010) where rainfall exceeded 10mm per day (a measure of extreme rainfall)[200].

Table 13-5 - Long Term Average of Total Number of Days where Rainfall Exceeded 10mm for the Baseline Period (1981-2010)

Period	Average number of days rainfall > 10mm (1981-2010)
Summer	1.4
Winter	<1 day
Annual	1.2

13.13.5. Periods of prolonged rainfall are often associated with Atlantic depressions or with convection[201]. The Atlantic lows are more vigorous in autumn and winter. In summer, convection caused by solar surface heating sometimes forms shower clouds and a large proportion of rain falls from showers and thunderstorms at this time of year. Rainfall caused this way is normally more intense than winter rainfall which tends to be more frontal with falls occurring over longer periods. Some noteworthy extreme rainfall, drought and storm events include:

- June 2019 – the UK experienced a spell of very wet weather in mid-June as a low pressure system and associated fronts brought widespread and slow moving heavy rainfall. In Eastern England, approximately 60mm of rain fell in three days. This is the average rainfall expected for the month of June[202].
- 2010 to March 2012 - Much of central, eastern and southern England and Wales experienced a prolonged period of below average rainfall due to a sequence of dry months from winter 2009/10 to March 2012, particularly in the spring, autumn and winter seasons. For England and Wales, this was one of the ten most significant droughts of one to two years duration in the last 100 years[203].

[200] Jenkins, G.J., Perry, M.C., and Prior, M.J. (2008). The climate of the United Kingdom and recent trends. Met Office Hadley Centre, Exeter, UK.
[201] Met Office https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/regional-climates/eastern-england_-climate---met-office.pdf [Accessed 08/01/2020].
[202] Met Office (2019) Wet weather June 2019 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2019/2019_006_rainfall_lincolnshire.pdf [Accessed 08/01/2020].
[203] Met Office (2019) England and Wales drought 2010 to 2012 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2012/england-and-wales-drought-2010-to-2012---met-office.pdf [Accessed 08/01/2020].

Snow and ice

13.13.6. Snowfall is closely linked with temperature, with falls rarely occurring if the temperature is higher than 4 °C. For snow to lie for any length of time, the temperature normally must be lower than this. Over most of the area, snowfall is normally confined to the months from November to April, but upland areas may have brief falls in October and May. Snow rarely lies outside the period from December to March. The region has experienced snow events in:

- February to March 2018 - the most significant spell of snow and low temperatures for the UK overall since December 2010[204].
- March 2013 - winds from the east or north, drawing bitterly cold air from northern Europe and Siberia[205].
- December 2010 – Two spells of snowfall lasting around a month[206].

Temperature

Figure 13-2 shows the long-term average mean monthly temperature for the East of England Region and Morley St Botolph Weather station[207] (approximately 11 miles south east of the scheme) between 1981 and 2010. It shows that the region is warmer than the UK average, though the area within Morley St Botolph Weather station is slightly cooler than the average for the region.

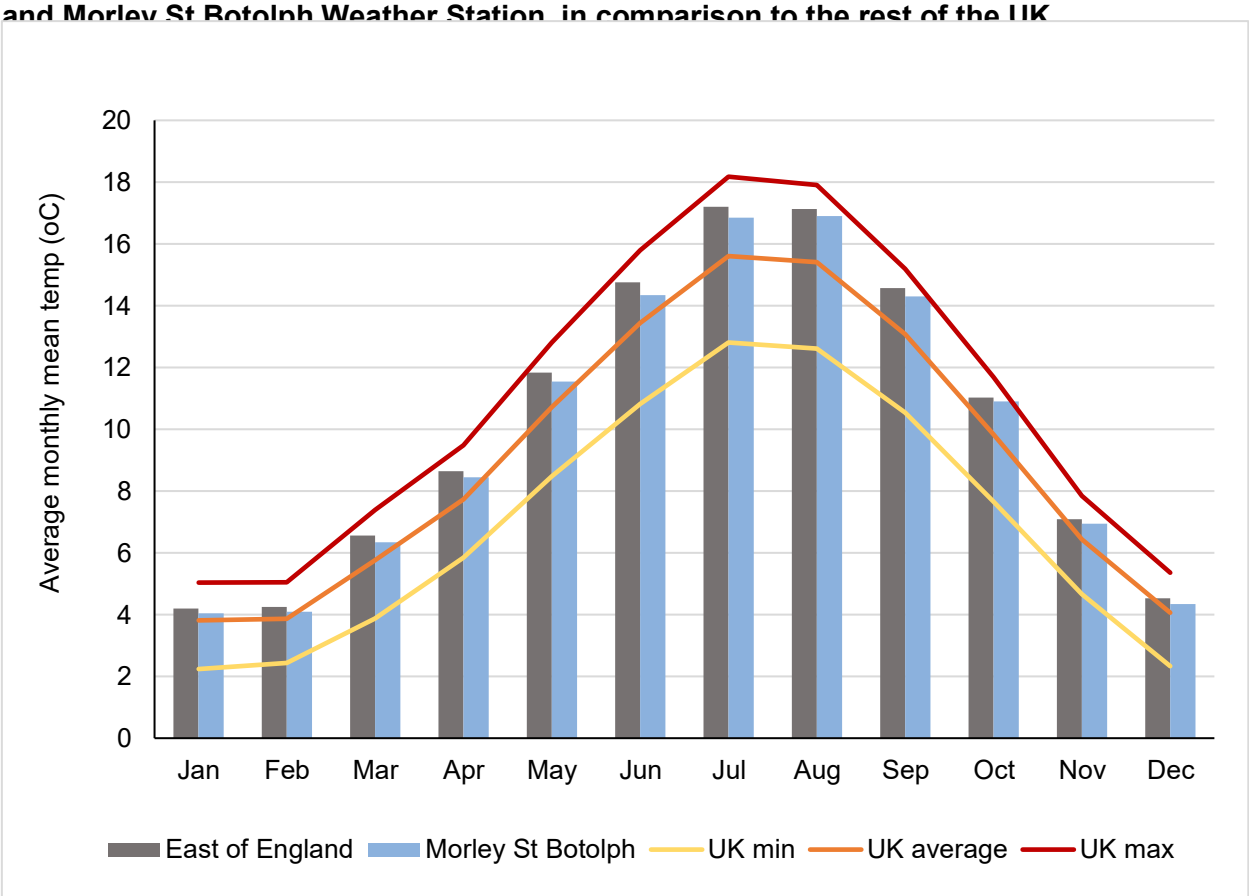
[204] Met Office (2019) Snow and low temperature February to March 2018 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2018/snow-and-low-temperatures-february-to-march-2018---met-office.pdf [Accessed 08/01/2020].

[205] Met Office (2019) Snow and low temperatures late March 2013 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2013/snow-and-low-temperatures-late-march-2013---met-office.pdf [Accessed 08/01/2020].

[206] Met Office (2019) Snow and low temperatures, December 2010 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2010/snow-and-low-temperatures-december-2010---met-office.pdf [Accessed 08/01/2020].

[207] Met Office UK Climate Averages https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/u12dzxjyc [Accessed 08/01/2020].

Figure 13-2 – Long Term Average Mean Monthly Temperature for the East of England region and Morley St Botolph Weather Station, in comparison to the rest of the UK



Extreme Temperature

13.13.7. The region experiences extreme temperatures. Table 13-6 shows the average maximum and minimum summer (June, July and August) and winter (December, January and February) temperatures recorded.

Table 13-6 - Summer and Winter Mean Maximum Temperatures in East England (1981 - 2010)

Period	Mean Maximum Temperature (°C)	Mean Minimum Temperature (°C)
Summer	21.3	11.4
Winter	7.3	1.4

13.13.8. The hottest day in the UK on record was experienced during record heatwave conditions in July 2019 with temperatures widely exceeding 30°C and reaching a record 38.7°C in Cambridge[208] (approximately 50 miles south west of the Scheme). This led to national disruption to transport infrastructure with temperatures causing traffic lights to fail and vehicles to breakdown[209].

Wind

13.13.9. Eastern England is one of the more sheltered parts of the UK, since the windiest areas are to the north and west, closer to the track of Atlantic storms. The strongest winds are associated with the passage of deep depressions across or close to the UK. The frequency of depressions is greatest during the winter months so this is when the strongest winds normally occur.

13.13.10. A day of gale is defined as a day on which the wind speed attains a mean value of 34 knots or more over any period of 10 minutes. Notable gales affecting the east of England include:

- March 2019 'Storm Gareth' - The UK experienced a turbulent week of weather in March 2019 as a succession of Atlantic low pressure systems brought strong winds and heavy rain, driven by a powerful jet stream. This spell included storm Gareth, the seventh named storm of the 2018/2019 winter. The East of England experienced maximum gusts of 40 to 50Kt (46 to 58 mph)[210].
- October 2013 –due to a fast-moving, vigorous Atlantic depression, bringing both very strong winds and heavy rain. The East of England experienced maximum gusts around 70 to 80Kt (80 to 92 mph)[211].

FUTURE BASELINE

13.13.11. The UK Climate Projections 2018 (UKCP18) provide data on projected change in climate variables for the UK. Probabilistic projections for the 25km grid square where the Scheme is located have been used (Figure 13.3). The UKCP18 are the most up-to-date projections of climate change for the UK. UKCP18 includes probabilistic projections of a range of climate variables for different emissions scenarios (RCPs) and for a range of time slices to the end of the 21st Century. The probabilistic projections mean that rather than a single 'best-guess' of the impact of climate change, they provide a range of outcomes based on an 'ensemble' of multiple climate model runs. This better represents the uncertainty of climate prediction science. To help demonstrate consideration of uncertainty inherent within climate modelling, projections for the 10th, 50th (central) and 90th percentiles are stated, where possible.

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[208] Met Office (2019) Record breaking heat-wave July 2019 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2019/2019_007_july_heatwave.pdf [Accessed 10/01/2020]

[209] Bucks Free Press (2019) Traffic lights stop working and bin lorries break down as temperatures soar https://www.bucksfreepress.co.uk/news/17795863.traffic-lights-stop-working-bin-lorries-break-temperatures-soar/ [Accessed 10/01/2020]

[210] Met Office (2019) stormy and very wet spell, March 2019 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2019/2019_004_stormy_spell.pdf [Accessed 10/01/2020]

[211] Met Office (2013) Autumn Storm, October 2013 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2013/autumn-storm-october-2013---met-office.pdf [Accessed 10/01/2020]

13.13.12. Climate projections are provided for the emissions scenario (termed Representative Concentration Pathway (RCP)) 8.5 (RCP8.5). This is a high emissions scenario which combines assumptions about high population and relatively slow income growth with modest rates of technological change and energy intensity improvements, leading in the long term to high energy demand and GHG emissions in absence of climate change policies. The National Policy Statement for National Networks212 paragraph 4.41 states that a high emissions scenario should be used to assess the vulnerability of transport infrastructure which has safety-critical elements and an asset life of 60 years or more. Furthermore, EIA relies on the assessment of the worst-case scenario.

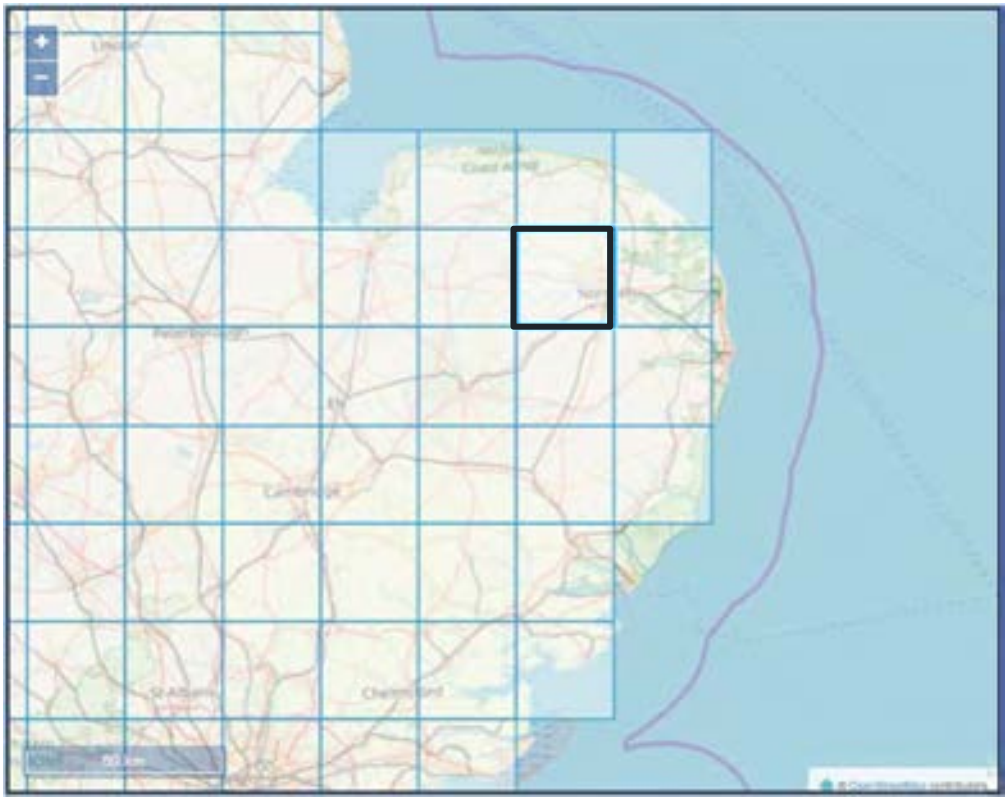
13.13.13. The future baseline has been presented for the 2060s and 2080s to identify the anticipated climate conditions over the life of the Scheme elements:

- Road elements (pavements, including roundabout): 20-40 years;
- Bridge elements (including viaduct, overpass and underpass bridges): 120 years;
- Ancillary works (including provision for non-motorised users: 20-40 years

13.13.14. Probabilistic projections are presented for the 25km grid square where the Scheme is located (Figure 13-3 - 25km grid square used for the probabilistic projections).

[212] National Policy Statement for National Networks, Department for Transport, December 2014 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf

Figure 13-3 - 25km grid square used for the probabilistic projections



Precipitation

13.13.15. Climate change is projected to lead to wetter winters and drier summers although natural variation, including extreme events such as storms and heat waves, will continue to punctuate these trends. The projected changes to average summer (June, July and August) and winter (December, January and February) rainfall for the 2060s and 2080s are summarised in **Table 13-7** below.

Table 13-7 - Projected Change in Mean Summer and Winter Precipitation (%) for the 2060s and 2080s, RCP8.5

Season / Timeslice		Percentile Change		
		10th	50th	90th
Summer	2060s	-52%	-25%	2%
	2080s	-63%	-33%	-1%
Winter	2060s	-2%	11%	25%
	2080s	0	16%	35%

13.13.16. The 10th and 90th percentile provide the lower and upper estimates of precipitation change. For example, for the summer in the 2060s, precipitation is very unlikely to decrease by more than 52% or increase by more than 2%. The central estimate predicts that there will be a decrease in summer rainfall by approximately 25% for the 2060s and a further decrease of 33% for the 2080s. In contrast, winter precipitation is predicted to increase by 11% for the 2060s and 16% for the 2080s (central estimate).

Extreme Precipitation

13.13.17. Climate change means that more rainfall will fall during 'intense' events, particularly in winter. Projections for extreme precipitation are only available at the 2.2km scale from UKCP18 for the time periods of 2021-2040 and 2061-2080. Projections for summer and winter are presented in **Table 13-8** for the 50th percentile.

Table 13-8 - Projected Change in Mean Extreme Summer and Winter Precipitation (%) for the 2060s and 2080s, RCP8.5

Season / Timeslice		50th Percentile
Summer	2021-2040	-4%
	2061-2080	-37%
Winter	2021-2040	7%
	2061-2080	25%

Temperature

13.13.18. Climate change is projected to lead to hotter summers and warmer winters. Table 13-9 summarises the UKCP18 projections for changes in mean temperature for the 25km grid square where the Scheme is located (Figure 14-3) in the 2060s and 2080s under RCP 8.5.

Table 13-9 - Projected Change in Mean Summer and Winter Temperature (°C) for the 2060s and 2080s RCP8.5

Season / Timeslice		Temperature Change (0C)		
		10th	50th	90th
Summer	2060s	1.1	2.9	4.7
	2080s	2.0	4.3	6.8
Winter	2060s	0.7	2.1	3.6
	2080s	1.1	3.1	5.1

13.13.19. The 10th and 90th percentile provide the lower and upper estimates of warming. For example, for the summer in the 2060s, temperature increase is very unlikely to be less than a 1.1°C increase, or more than a 4.7°C increase. The central estimate predicts that there will be an increase in summer temperature by approximately 2.9°C for the 2060s and a further increase by 4.3°C for the 2080s. Winter temperature is also predicted to increase, by 2.1°C for the 2060s and 3.1°C for the 2080s.

Extreme Temperature

13.13.20. **Table 13-10** summarises the UKCP18 projections for changes in maximum and minimum temperature for summer and winter in the 2060s and 2080s in the RCP 8.5 emissions scenario. Note, the values below represent mean maximum and minimum temperature changes therefore, individual days may exceed these values.

Table 13-10 – Projected Change in Maximum and Minimum Mean Summer and Winter Temperatures (°C) for the 2060s and 2080s RCP 8.5.

Season / Timeslice		Temperature Change					
		Maximum (0C)			Minimum (0C)		
		10th	50th	90th	10th	50th	90th
Summer	2060s	1.1	3.2	5.5	1.2	2.6	4.3
	2080s	1.9	4.8	8.0	1.9	4.0	6.4
Winter	2060s	0.8	2.0	3.4	0.6	2.1	3.8
	2080s	1.2	3.0	4.9	1.0	3.1	5.5

Snow and Ice

13.13.21. Snowfall is closely linked with temperature, with falls rarely occurring if the temperature is higher than 4°C. For snow to lie for any length of time, the temperature normally has to be lower than this. With regards to future changes, rising winter temperatures are likely to reduce the amount of precipitation that falls as snow in winter. UKCP18 does not have data on snowfall, although UKCP09 projects a reduction of mean snowfall, the number of days when snow falls and heavy snow events by the end of the 21st century. UKCP09 does not provide projections for the nearer-term for snow. While there is less certainty in the magnitude of projected change, there is confidence in the negative sign of the change (i.e. snow fall is generally expected to decrease compared with the baseline[213]. Projections indicate substantial reductions in snowfall days for all regions in winter[214].

Wind

13.13.22. UKCP18 depicts a wide spread of future changes in mean surface wind speed, however, there is large uncertainty in projected changes in circulation over the UK and natural climate variability contributes much of this uncertainty[215]. It is therefore difficult to represent regional wind extreme winds and gusts within regional climate models[216].

13.13.23. Central estimates of change in mean wind speed for the 2060s are small in all ensemble runs (<0.2ms-1). A wind speed of 0.2 ms−1 (approximately 0.4 knots) is small compared with the typical magnitude of summer mean wind speed of about 3.6–5.1ms-1 (7–10 knots) over much of

[213] Jylhä, K., Fronzek, S., Tuomenvirta, H., Carter, T. R. and Ruosteenoja, K. (2008). Changes in frost, snow and Baltic sea ice by the end of the twenty-first century based on climate model projections for Europe. Climatic Change, 86: 441–462.
[214] Brown, S., Boorman, P. and Murphy, J. (2010) Interpretation and use of future snow projections from the 11-member Met Office regional climate model ensemble. In: UKCP09 technical note. Hadley Centre, Exeter, UK, Met Office. 25pp.
[215] Brown, S., Boorman, P., McDonald, R., and Murphy. J. (2012) Interpretation for use of surface wind speed projections from the 11-member Met Office Regional Climate Model ensemble. Post-launch technical documentation for UKCP09. Met Office Hadley Centre, Exeter, UK. Crown copyright.
[216] Bengtsson, L., K. Hodges, and E. Roeckner, 2006: Storm tracks and climate change. Journal of Climate, 19, 3518-3543.

England[217]. Seasonal changes at individual locations across the UK lie within the range of –15% to +10%.

13.13.24. With regards to storms, the analysis presented here is a summary of expected changes in storm patterns under a changing climate. A storm is defined by the Met Office as a wind event measuring 10 or higher on the Beaufort scale (equivalent to a wind speed of 24.5m/s or 55mph).

13.13.25. Thunderstorms are most likely to occur from May to September, reaching their peak in July and August, but are less frequent than in areas further south, and the north of the region can expect only five to eight days with thunder each year. The heaviest rainfall events in the UK are often associated with these summer thunderstorms.

13.13.26. With regard to future projections of storms, studies suggest that climate-driven storm changes are less distinct in the Northern than Southern hemisphere[218]. However, such is the wide range of inter-model variation, robust projections of changes in storm track are not yet possible and there is low confidence in the direction of future changes in the frequency, duration or intensity of storms affecting the UK.

Solar Radiation

13.13.27. A recent (regional) study[219] suggests that the East of England is likely to see an increase in annual solar radiation by the 2060s of 5.1watts per square meter (Wm-2) and by the 2080s of 6.5Wm-2 (central estimate), under a high emissions scenario.

13.13.28. All regions of the UK are likely to have increased cloud cover (although there is large uncertainty around future projections of cloud cover) and therefore slightly less solar radiation during the winter.

Relative Humidity

13.13.29. Climate change is projected to increase humidity within the UK. Summer and winter humidity in the study area is predicted to increase by 13% and 20% for the 2060s and 2080s respectively for the summer and by 14% and 22% for the 2060s and 2080s respectively for the winter (central estimates).

13.14. MITIGATION

13.14.1. Design, mitigation and enhancement measures to reduce vulnerability to impacts of climate change during construction and operation of the Scheme include:

CONSTRUCTION

- Ensure site compound drainage has sufficient capacity to cope with heavy rainfall events;

[217] Jenkins, G.J., Perry, M.C., and Prior, M.J. (2008). The climate of the United Kingdom and recent trends. Met Office Hadley Centre, Exeter, UK.

[218] Slingo, J., Belcher, S., Scaife, A., McCarthy, M., Saulter, A., McBeath, K., Jenkins, A., Huntingford, C., Marsh, T., Hannaford, J. and Parry, S. (2014) The recent storms and floods in the UK, Met Office, Exeter, 29pp.

[219] Burnett, D., Barbour, E. and Harrison, G.P. (2014) The UK solar energy resource and the impact of climate change. Renewable Energy, 71, 333-343.

- Cover spoil and material heaps during periods of high rainfall or high winds;
- Spray spoil and material heaps during dry periods to reduce dust;
- Regularly inspect materials stockpiles and structures with additional inspections during and following extreme weather events (e.g. floods, heatwaves, storms);
- Provide adequate rest, shade and PPE (e.g. hats and sunscreen) for workforce during periods of high temperature and high solar radiation;
- Adjust programme of activities or schedule daily working time to account for weather conditions; and
- Build additional contingency into the programme.

OPERATION

- Consider projections of extreme temperature when specifying materials e.g. use harder binders in asphalt, alter concrete mix. Re-consider choice of materials when repair or replacement is necessary based on projected temperatures;
- Ensure drainage infrastructure has sufficient capacity to cope with projected rainfall (average and extreme);
- Consider projections of extreme temperature when designing bridges, particularly the effect of high temperatures on expansion;
- Consider changes in precipitation and temperature when designing structures and earthworks;
- Regular inspection of drainage infrastructure, materials and structures to identify any deterioration. Additional inspection of earthworks and structures following extreme weather events (e.g. floods, heatwaves, drought, storm). Bring forward repair/replacement if necessary;
- More frequent vegetation management on verges; and
- Back-up power source for electrical equipment and signalling; and appropriate hazard and warning signage along the roadside.

13.15. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

13.15.1. Climate variables for the construction and operation phases to consider in further detail at the ES have been identified using a vulnerability assessment. The vulnerability of a project to climate change is a function of:

- The typical sensitivity of receptors to climate variables – based on literature review and expert judgement and rated as high, medium or low; and
- The exposure of receptors to projected change in climate variables – based on the baseline information presented above and rated as high, medium or low.

13.15.2. The vulnerability of receptors to climate variables is determined from the combination of the sensitivity and exposure ratings, using the matrix shown in Table 13-11. At this point, climate variables in the construction and operation phase to which the Scheme is likely to have a Low vulnerability to, are scoped out of further assessment. Climate variables in the construction and operation phase to which the Scheme is likely to have a medium or high vulnerability to are taken forward for further assessment at the next stage.

13.15.3. This is a qualitative assessment informed by expert opinion and supporting literature.

Table 13-11 – Vulnerability matrix

SENSITIVITY	EXPOSURE		
	Low	Medium	High
Low	Low vulnerability	Low vulnerability	Low vulnerability
Medium	Low vulnerability	Medium vulnerability	Medium vulnerability
High	Low vulnerability	Medium vulnerability	High vulnerability

SENSITIVITY

13.15.4. **Precipitation –** roads are sensitive to changes in average rainfall and extreme rainfall events. Flooding (pluvial or fluvial) may lead roads and footways being impassable and causing dangerous driving conditions. For example, in Gloucestershire in 2007, 78mm of rainfall over a 12-hour period causing rapid and intense flash flooding. The M5 came to a standstill with around 10,000 motorists stuck overnight[220]. Flooding may also cause damage to paved surfaces, leading to deterioration of materials and increased maintenance requirements. Extreme rainfall events may also lead to destabilisation of soils and earthworks, potentially leading to disruption. Roads and footways are also sensitive to low rainfall or drought. Prolonged dry periods may lead to drying out and cracking of earthworks and soils and greater amounts of dust.

13.15.5. **Temperature –** roads and footways are sensitive to extreme temperatures. High temperatures may cause damage to paved surfaces, including potential melting and deformation, for example, a heatwave in 2018 caused roads in Berkshire to melt[221]. An increase in solar radiation can also cause more rapid deterioration of materials and associated infrastructure such as signage.

13.15.6. **Wind –** high winds and storms can affect the stability of above-ground infrastructure and hasten material degradation due to wind-driven rain infiltration. Road and footway users may also be sensitive to high winds and associated infrastructure such as signage or signals could also be damaged by high winds or lightning strike.

13.15.7. **Soils –** roads and footways are sensitive to changes in soil moisture and stability. Soil stability can be reduced as a result of extreme rainfall or prolonged periods of rainfall which can lead to waterlogging, as well as extreme temperatures and drought which can causes soils to dry out and crack. Earthworks and embankments associated with roads and footways are particularly sensitive to changes in soil stability. Water availability can cause a number of impacts to water quality and soils. For example, greater water volumes can increase the mobilisation of pollutants in soils whilst water scarcity can increase the accumulation of chemicals and pollutants which may cause increased salinity and acidification.

[220] Gloucestershire Live (2017) The story of Gloucestershire's floods, 10 years on https://www.gloucestershirelive.co.uk/news/gloucester-news/story-gloucestershires-floods-10-years-217275 [accessed 15/01/2020].
[221] Telegraph (2018) Bin lorry gets stuck in road as heatwave melts surface https://www.telegraph.co.uk/news/2018/07/06/bin-lorry-gets-stuck-road-heatwave-melts-surface/ [accessed 15/01/2020].

13.15.8. Given the inland location of the Scheme, variables associated with sea level and sea temperature are not included in the assessment.

13.15.9. Based on the information described above, literature review and expert opinion, Table 13-12 outlines the climate sensitivity of the Scheme's main components.

Table 13-12 – Sensitivity assessment

CLIMATE VARIABLE		SENSITIVITY OF SCHEME COMPONENTS		
		Road (including roundabout)	Bridges (including viaduct, overpass and underpass bridges)	Ancillary works (including provision for non-motorised users)
Precipitation	Changes in annual average	Medium	Medium	Low
	Drought	Medium	Low	Low
	Extreme precipitation events	High	High	Medium
Temperature	Change in annual average	Low	Low	Low
	Extreme temperature events	High	High	Medium
	Solar radiation	Low	Low	Low
Wind	Gales and high winds	Medium	High	Low
	Storms	Low	High	Low
Relative humidity	Changes in annual average	Low	Low	Low
	Evaporation	Low	Low	Low
Water quality and Soils	Soil moisture	Medium	Medium	Medium
	Salinity/pH	Low	Low	Low
	Runoff	Low	Low	Low
	Soil stability	Medium	Medium	Medium

Exposure

13.15.10. Based on the design life of the Scheme elements and future climate projections presented in Table 13-13 and Table 13-14 summarises the exposure of the Scheme to change in climate variables.

Table 13-13 - Exposure assessment, road elements and ancillary works (based on the 2060 climate projections in line with a 20-40 year design life)

CLIMATE VARIABLE		EXPOSURE
Precipitation	Change in annual average	Medium
	Drought (summer)	Medium
	Extreme precipitation events (flooding) (winter)	Medium
Temperature	Changes in annual average	Medium
	Extreme temperature events	Medium
	Solar radiation	Low
Wind	Gales and extreme wind events	Medium
	Storms (hail, lightning)	Medium
Relative humidity	Changes in annual average	Low
	Evaporation	Low
Water quality and soils	Soil moisture	Medium
	Salinity/pH	Low
	Runoff	Medium
	Soil stability	Medium

Table 13-14 - Exposure assessment, structures (based on the 2080 climate projections in line with a 120 year design life for bridges)

CLIMATE VARIABLE		EXPOSURE
Precipitation	Change in annual average	Medium
	Drought (summer)	Medium
	Extreme precipitation events (flooding) (winter)	High
Temperature	Changes in annual average	Medium
	Extreme temperature events	High
	Solar radiation	Low
Wind	Gales and extreme wind events	Medium
	Storms (hail, lightning)	Medium
Relative humidity	Changes in annual average	Medium
	Evaporation	Medium

Water quality and soils	Soil moisture	Medium
	Salinity/pH	Low
	Runoff	Medium
	Soil stability	Medium

13.15.11. The sensitivity and exposure analyses are combined to provide an overall assessment of vulnerability of the Scheme. High and Medium vulnerabilities are considered to be the residual effects which we will assessed in more detail at the next stage of the assessment. Table 13-15, Table 13-16 and Table 13-17 present the assessment of vulnerability for the road, bridge and footway elements of the Scheme.

Table 13-15 – Vulnerability assessment, road element (including roundabout)

VARIABLE		SENSITIVITY	EXPOSURE	VULNERABILITY
Precipitation	Change in annual average	Medium	Medium	Medium vulnerability
	Drought	Medium	Medium	Medium vulnerability
	Extreme precipitation events	High	Medium	High vulnerability
Temperature	Change in annual average	Low	Medium	Low vulnerability
	Extreme temperature events	High	Medium	High vulnerability
Wind	Gales and extreme wind events	Medium	Medium	Medium vulnerability
	Storms (snow, lightning, hail)	Low	Medium	Low vulnerability
Water quality and soils	Soil moisture	Medium	Medium	Medium vulnerability
	Runoff	Low	Medium	Low vulnerability
	Soil stability	Medium	Medium	Medium vulnerability

Table 13-16 – Vulnerability assessment, bridge element (including viaduct, overpass and underpass bridges)

VARIABLE		SENSITIVITY	EXPOSURE	VULNERABILITY
Precipitation	Change in annual average	Medium	Medium	Medium vulnerability
	Drought	Low	Medium	Low vulnerability
	Extreme precipitation events	High	High	High vulnerability
Temperature	Change in annual average	Low	Medium	Low vulnerability
	Extreme temperature events	Medium	High	Medium vulnerability
Wind	Gales and extreme wind events	High	Medium	Medium vulnerability
	Storms (snow, lightning, hail)	High	Medium	Medium vulnerability
Relative humidity	Changes in annual average	Low	Medium	Low vulnerability
	Evaporation	Low	Medium	Low vulnerability
Water quality and soils	Soil moisture	Medium	Medium	Medium vulnerability
	Runoff	Low	Medium	Low vulnerability

VARIABLE		SENSITIVITY	EXPOSURE	VULNERABILITY
	Soil stability	Medium	Medium	Medium vulnerability

Table 13-17 - Vulnerability assessment, ancillary works (including provision for non-motorised users)

VARIABLE		SENSITIVITY	EXPOSURE	VULNERABILITY
Precipitation	Change in annual average	Low	Medium	Low vulnerability
		Low	Medium	Low vulnerability
	Extreme precipitation events	Medium	Medium	Medium vulnerability
Temperature	Change in annual average	Low	Medium	Low vulnerability
	Extreme temperature events	Medium	Medium	Medium vulnerability
Wind	Gales and extreme wind events	Low	Medium	Low vulnerability
	Storms (snow, lightning, hail)	Low	Medium	Low vulnerability
Water quality and soils	Soil moisture	Medium	Medium	Medium vulnerability
	Runoff	Low	Medium	Low vulnerability
	Soil stability	Medium	Medium	Medium vulnerability

13.15.12. Following the vulnerability assessment, Table 13-18 identifies the climate variables that have been scoped into and out of further assessment. The table refers to both construction and operation.

Table 13-18 - Elements Scoped in or Out of Further Assessment

Element	Climate Variable		Scoped In	Scoped Out
Road, Bridges and ancillary works	Sea	Sea level rise Storm surge and storm tide Surface temperature Currents and waves		✔
Road and bridges	Precipitation	Changes in annual average	✔	
Ancillary works				✔
Road		Drought	✔	
Bridges and ancillary works				✔
Road, Bridges and ancillary works		Extreme precipitation events	✔	

Element	Climate Variable		Scoped In	Scoped Out
	Temperature	Changes in annual average		✔
		Extreme temperature events	✔	
		Solar radiation		✔
Road and bridges	Wind	Gales and extreme wind events	✔	
Ancillary works				✔
Bridges		Storms (hail, lightning)	✔	
Road and Ancillary works				✔
Road, Bridges and ancillary works	Relative humidity	Changes in annual average Evaporation		✔
	Water quality and soils	Soil moisture	✔	
		Salinity/pH		✔
		Runoff		✔
		Soil stability	✔	

13.15.13. The main Scheme elements to be scoped in and out of further assessment in the ES have been identified from a high-level vulnerability assessment. At the ES stage, a more detailed assessment will be undertaken for the following receptors:

Construction

- Site compound;
- Materials;
- Plant and equipment; and
- Workforce.

Operation

- Road;
- Bridges;
- Ancillary works;
- Drainage;
- Landscaping and vegetation;
- Signage;
- Earthworks (embankments); and
- End users.

13.16. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

13.16.1. No further measures have been identified at this stage, other than those identified in section 13.14 – Mitigation.

13.17. PROPOSED ASSESSMENT METHODOLOGY

13.17.1. In the ES the significance of effects of changes in (scoped in) climate variables on receptors will be identified during construction and operation phases. The significance of effects is determined by considering the consequence and the likelihood of potential impacts associated with changes in climate variables on scheme receptors occurring. Likelihood and consequence are qualitatively assessed using the descriptions in **Table 13-19** and Table 13-20. These descriptions have been informed by relevant guidance (refer to 13.1.2) and using professional judgement.

13.17.2. The assessment of likelihood and consequence (and therefore significance) takes embedded mitigation into account. Embedded mitigation is identified through consultation with the project design team.

Table 13-19 – Likelihood definitions

Measure of likelihood	Description
Very high	The event occurs multiple times during the lifetime of the project e.g. approximately annually
High	The event occurs several times during the lifetime of the project e.g. approximately once every five years
Medium	The event occurs limited times during the lifetime of the project e.g. approximately once every 15 years
Low	The event occurs occasionally during the lifetime of the project e.g. once in 60 years.
Very low	The event can occur once during the lifetime of the

Table 13-20 – Consequence of definitions

Measure of consequence	Description
Negligible	No infrastructure damage, minimal adverse effects on health, safety and the environment or financial loss. Little change to service and disruption lasting less than 1 day.
Minor adverse	Localised infrastructure disruption or loss of service. No permanent damage, minor restoration work required: disruption lasting less than 1 day. Small financial losses and/or slight adverse health or environmental effects.
Moderate adverse	Limited infrastructure damage and loss of service with damage recoverable by maintenance or minor repair. Disruption lasting more than 1 day but less than 1 week. Moderate financial losses. Adverse effects on health and/or the environment.
Large adverse	Extensive infrastructure damage and severe loss of service. Disruption lasting more than 1 week. Early renewal of infrastructure 50-90%.

Measure of consequence	Description
	Permanent physical injuries and/or fatalities. Major financial loss. Significant effect on the environment, requiring remediation.
Very large adverse	Permanent damage and complete loss of service. Disruption lasting more than 1 week. Early renewal of infrastructure >90%. Severe health effects and/or fatalities. Extreme financial loss. Very significant loss to the environment requiring remediation and restoration.

SIGNIFICANCE CRITERIA

13.17.3. The likelihood and consequence are combined to assess the significance of effects on receptors, as detailed within DMRB guidance.. The assessment is qualitative and based on expert judgment based on knowledge of similar schemes, engagement with the wider Project Team and a review of relevant literature.

13.18. LIMITATIONS AND ASSUMPTIONS

13.18.1. To ensure transparency within the EIA process, the following limitations and assumptions have been identified:

- The UKCP18 projections have been used to infer future changes in a range of climate variables that may affect the vulnerability of the Scheme to climate change. At the time of writing, these represent the most up-to-date representation of future climate in the UK. However, the UKCP18 data currently available does not provide data for drought, snow and ice or wind.
- There are inherent uncertainties associated with climate projections. As they are projections, they cannot be considered as predictions of the future. It is possible that future climate will differ from the future baseline climate against which the resilience of the Scheme has been assessed, depending on global emissions over the next century. A 'high' emissions scenario (RCP 8.5) using the 2080s timeslice (2070 – 2099 - the longest temporal scale available through UKCP18) has been used to develop the baseline against which resilience has been assessed. This is consistent with the precautionary principle (i.e. 'worst case' scenario).
- Any further research, analysis or decision-making should take account of the accuracies and uncertainties associated with climate projections. It is also important to note that the analysis is based on selected observational data, the results of climate model ensembles and a selected range of existing climate change research and literature available at the time of assessment. Any future decision-making based on this analysis should consider the range of literature, evidence and research available at that time and any changes to this.

14. POPULATION AND HUMAN HEALTH

14.1. CONSULTATION

14.1.1. No consultation has been undertaken for the Scheme to date for the completion of this scoping chapter. Consultation with the Norfolk County Council and Broadland District Council may be required for the ES.

14.2. STUDY AREA

14.2.1. The study areas for the Population and Human Health assessment follows guidance set out within Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 6, LA 112 Population and Human Health[222]. These are detailed below according to each different receptor groups:

LAND USE AND ACCESSIBILITY

Private property and housing

- Land parcels of private properties and housing allocation that lie within, or immediately adjacent to the Site, or those which have a direct means of access within the Site.

Community land and assets

- Community facilities, recreational facilities (including open spaces) that lie within 500m of the Site, or those which have a direct means of access within the Site.

Development land and businesses

- Land parcels of employment allocation and businesses that lie within, or immediately adjacent to the Site, or those which have a direct means of access within the Site.

Agricultural land holdings

- Agricultural land holdings which manage or own land parcels of agricultural land that lie within the Site, or those which have a direct means of access within the Site.

Walkers, cyclists and horse-riders (WCH)

- Public rights of way (PRoW) and non-designated routes within 500m of the Scheme.

HUMAN HEALTH

14.2.2. The study area for human health has been based on the smallest denomination boundary for the Scheme where possible. The Scheme is located within the ward of Great Witchingham and therefore it is the community that is most likely to be impacted by the Scheme.

[222] Highways England, LA 112 Population and Human Health, Design Manual for Roads and Bridges, Volume 11, Section 2, Part 6 (Oct 2019)

14.2.3. However, indirect impacts are still likely to be felt in the wider area and a number of relevant datasets are only available at a district level. Various area profiles have been used for these assessments and they are provided below:

- National: England;
- Region: East of England;
- County: Norfolk County Council;
- Local Authority / District Council: Broadland District Council; and
- Ward: Great Witchingham

14.3. BASELINE CONDITIONS

14.3.1. This section provides an overview of the baseline conditions for the Scheme.

LAND USE AND ACCESSIBILITY

Private property and housing

14.3.2. Private property is residential land that does not accommodate public space or any other community facility or asset or land allocated within planning policy for residential development. Commercial property is considered under Development Land and Businesses.

14.3.3. Three farm properties and direct access of two additional private properties near Green Farm are located within the Site off Weston Road. Properties at Old Hall Cottages and direct access of the associated private properties and farm properties off the A1067 Fakenham Road are located directly adjacent to the edge of the Site.

14.3.4. The properties above are some, not all, of the dwellings affected. More detail will be provided within the ES with a thorough assessment being completed based on the traffic, noise and air data/modelling.

14.3.5. There are no housing land allocations located within or directly adjacent to the Site[223,224,225].

Community land and assets

14.3.6. The Scheme is located in a predominantly rural area between the A47 and A1067 Fakenham Road. Nearby communities include; Honingham, Weston Green, Ringland, Weston Longville and Taverham.

14.3.7. Community facilities identified within the study area include two churches, a community centre, a village hall, a public house, an allotment, an open space, a shooting ground, two golf clubs and two paintball centres.

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[223] Broadland District Council, Site Allocations DPD 2016. Available at: https://www.broadland.gov.uk/downloads/download/162/site_allocations_dpd (Accessed: 13 January 2020)
[224] Broadland District Council, Site Allocations DPD 2016. Available at: https://www.broadland.gov.uk/downloads/download/162/site_allocations_dpd (Accessed: 13 January 2020)
[225] Broadland District Council, Draft Greater Norwich Local Plan (GNLP). Available at: https://www.gnlp.org.uk/key-documents-evidence/ (Accessed: 06 April 2020)

14.3.8. There is no Registered Common Land located within or adjacent to the Site.

Development land and businesses

14.3.9. There are no employment land allocations or existing businesses (except agricultural land holdings) located within or adjacent to the Site. Agricultural land holdings are considered separately.

Agricultural land holdings

14.3.10. The majority of agricultural land within the Site is classified as Grade 2, Grade 3, Grade 4 and non-agricultural land[226]. The majority of land is a mixture of arable and grazing land, with some commercially managed woodland. Approximately 25 fields would be crossed by the Scheme. The number of land parcels and agricultural land holdings as registered under the Land Registry will be confirmed in the ES.

14.3.11. Wood Farm, Green Farm, Field Farm and Low Farm are located adjacent or in proximity to the Site. In addition to these agricultural land holdings, there are also a number of others (seven listings on the land registry) identified with land within the study area, which are likely to be affected by the Scheme. The impact upon land owners and tenants operating this land will be assessed within the ES.

Walking, Cycling and Horse Riding (WCH)

14.3.12. There are two footpaths and two restricted byways located within the Site which have been identified using the Norfolk interactive map[227] and Google maps. An additional five footpaths and two restricted byways are located within the study area. Locations of the identified PRoW are provided in Appendix B-1.

14.3.13. There are no bus stops located within the Site. However, four bus stops are located within the study area.

14.3.14. There are no bridleways, cycle routes, long distance routes or bus stops located within the study area.

HUMAN HEALTH

Age breakdown

14.3.15. The Scheme is located within Broadland District Council. According to Public Health England (PHE)[228], the male and female age profile for Broadland is older than the regional and national averages. In particular, the proportion of the population aged between 65-69, 70-74 and 75-79 is

[226] Natural England, MAGIC Map. Available at: https://magic.defra.gov.uk/ (Accessed: 19 February 2020)
[227] Norfolk County Council, Map and Statement of Public Rights of Way in Norfolk. Available at: https://www.norfolk.gov.uk/out-and-about-in-norfolk/public-rights-of-way/map-and-statement-of-public-rights-of-way-in-norfolk (Accessed: 14 January 2020)
[228] Public Health England, Local Authority Health Profiles – Broadland. Available at: https://fingertips.phe.org.uk/profile/health-profiles/data#page/12/gid/1938132696/pat/6/par/E12000006/ati/201/are/E07000144 (Accessed: 13 January 2020)

higher than the regional and national averages for these age groups. Those aged between 0-4, 20-24, 25-29, 30-34 and 35-39 form a smaller proportion of the population when compared to the regional and national averages.

Life expectancy

14.3.16. Life expectancy at birth for both males and females are higher in Broadland than both the regional and national averages. The Scheme falls within the ward of Great Witchingham which has a higher life expectancy at birth for both males and females when compared to the national average[229].

Indices of deprivation

14.3.17. In terms of overall deprivation, the ward of Great Witchingham is more deprived when compared to the county average. However, it is less deprived when comparing with the regional and national averages[230].

14.3.18. With regards to income deprivation, child poverty and older people in deprivation, the ward of Great Witchingham is less deprived than the county average, and significantly less deprived when compared to the regional and national averages[229]

Public health profile

14.3.19. The summary of health indicators provided by PHE shows the health of people in Broadland is generally better when compared with the national average. It is noted that some of the health indicators are better than the national averages, some are similar, and one health indicator is worse than the national average[257]. The indicators are listed as follows:

- Health indicators which are better when compared to the national averages include:
  - life expectancy at birth for males and females;
  - under 75 mortality rate from all causes, cardiovascular diseases and cancer;
  - emergency hospital admissions for intentional self-harm;
  - cancer diagnosed at early stage;
  - hospital admission rate for alcohol-related conditions;
  - smoking prevalence in adults;
  - teenage conception rate;
  - infant mortality rate;
  - Prevalence of obesity (Year 6);
  - children in low income families;
  - GCSE attainment;
  - hospital admissions for violence (including sexual violence);

[229] Public Health England, Local Health – Great Witchingham. Available at: http://www.localhealth.org.uk/GC_preport.php?lang=en&s=165&view=map15&id_rep=r03&selId0=3222&nivgeo=ward_2018 (Accessed: 13 January 2020)
[230] Public Health England, Local Health – Great Witchingham. Available at: http://www.localhealth.org.uk/GC_preport.php?lang=en&s=165&view=map15&id_rep=r03&selId0=3222&nivgeo=ward_2018 (Accessed: 13 January 2020)

- new sexually transmitted infections diagnoses; and
- tuberculosis incidence.

- Health indicators which are similar when compared to national averages include:
  - suicide rate;
  - hip fractures in people aged 65 and over;
  - killed and seriously injured (KSI) on roads;
  - estimated dementia diagnosis rate for people aged 65 and over;
  - hospital admission rate for alcohol-specific conditions for people aged under 18;
  - physically active adults;
  - adults classified as overweight or obese;
  - smoking during pregnancy;
  - breastfeeding initiation;
  - smoking prevalence in adults in routine and manual occupations;
  - percentage of people aged 16-64 in employment; and
  - excess winter deaths index.
- Health indicator which is worse when compared to national average:
  - estimated diabetes diagnosis rate.

Qualifications and employment

14.3.20. The ward of Great Witchingham has a similar percentage attainment of 5 GCSEs (ranging between A*-C, including English and Maths) when compared with regional data, and a higher percentage when compared with the county and national averages[257].

14.3.21. The Scheme covers the local authority of Broadland District Council. A greater proportion of the population hold qualifications when compares with the regional and national averages, in particular those with a level National Vocational Qualification (NVQ) 1 and above, 2 and above, and 3 and above[231].

14.3.22. Employment levels in Broadland are slightly higher than the regional and national averages[258].

Air quality, noise, landscape and visual, and road drainage and the water environment

14.3.23. Baseline conditions for air quality, noise, and road drainage and the water environment are outlined in Chapter 5 - Air Quality, Chapter 6 - Noise and Vibration, Chapter 8 - Landscape and Visual, and Chapter 10 - Road Drainage and the Water Environment of this EIA Scoping Report.

[231] NOMIS, Labour Market Profile – Broadland. Available at: https://www.nomisweb.co.uk/reports/lmp/la/1946157233/report.aspx (Accessed: 13 January 2020)

14.4. MITIGATION

CONSTRUCTION

14.4.1. Relevant mitigation measures will be identified in the ES. Likely mitigation measures to be implemented during the construction phase are as follows:

- Where possible, land will be returned to former use and quality once construction works have been completed;
- Alternative accesses will be provided where practicable to limit severance of agricultural land holdings. Further requirements of agricultural land holdings will be determined through consultation and assessment and be mitigated as appropriate;
- Where practicable, access to residential and commercial properties will remain open, and alternatives provided where necessary;
- Where possible, acquisition of land would be managed through negotiations with stakeholders to mitigate impact and landowners will be compensated where necessary, pursuant to the Compensation Code;
- Should PRoW be obstructed, appropriate diversions will be implemented where possible during construction to minimise effects on accessibility and severance for WCH in travelling between community land and assets. Where appropriate diversions are not available, temporary closures may be required;
- Any PRoW, footway or carriageway diversions or closures undertaken during constriction will be clearly advertised prior to commencement of works. Clear signage will be provided to show temporary diversion routes for the affected PRoW, footways or carriageways;
- Design of the diverted routes for WCH will take into account vulnerable user groups to ensure accessibility is maintained for users with limited mobility where practicable;
- Best practice measures, a Construction Environmental Management Plan (CEMP) and a Construction Traffic Management Plan will be implemented to avoid conflict with WCH, as well as residents of nearby dwellings and nearby businesses, and ensure impacts from construction dust, noise and traffic are managed appropriately;
- Contractors will liaise with residents and user groups, where necessary, prior to works to ensure contractors act considerately in relation to local residents and businesses, particularly for any works that may be programmed to take place at night. Any out of hours construction work will be agreed with the local authority in advance; and
- Health related mitigation measures are presented in Chapter 5 Air Quality, Chapter 6 Noise and Vibration, Chapter 8 Landscape and Visual, and Chapter 10 Road Drainage and the Water Environment of this EIA Scoping Report.

OPERATION

14.4.2. Relevant mitigation measures will be identified in the ES. Likely mitigation measures to be implemented during the operation phase are as follows:

- Permanent closure of PRoW would be avoided where practicable. Permanent closure measures would be carried out in consultation with the local highway authority and other interested stakeholders;
- Ancillary works including provision for a non-motorised user crossing bridge have been proposed to minimise effect on WCH; and

- Health related mitigation measures are presented in Chapter 5 Air Quality, Chapter 6 Noise and Vibration, Chapter 8 Landscape and Visual and Chapter 10 Road Drainage and the Water Environment of this EIA Scoping Report.

14.5. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

PRIVATE PROPERTY AND HOUSING

Construction

14.5.1. There is potential for permanent significant adverse effects on private residential farm properties, where potential land take and demolition are required. Potential temporary significant adverse effects on residential properties is also anticipated, where potential direct access may be disrupted during construction.

14.5.2. Given that no secured housing allocations are located within or adjacent to the Site, it is anticipated that there would be no impact on land for housing development.

Operation

14.5.3. No further effects on private property and housing are anticipated during operation.

COMMUNITY LAND AND ASSETS

Construction

14.5.4. No direct effects on community land and assets are anticipated during construction.

14.5.5. There is potential for a temporary significant adverse effect on community land and assets during construction where access routes are temporarily closed or diverted. The implementation of signed PRoW and non-designated routes diversion and a Construction Traffic Management Plan would potentially reduce the level of effect.

Operation

14.5.6. There is potential for a permanent significant beneficial effect on community land and assets during operation, where the Scheme will provide a new access route between the north and south of outer Norwich.

DEVELOPMENT LAND AND BUSINESSES

Construction

14.5.7. There is potential negligible effect on businesses (except agricultural land holdings which are considered separately) during construction due to no existing businesses or development land allocation or their direct access routes being located within the Site.

Operation

14.5.8. No effects are anticipated on businesses (except agricultural land holdings which are considered separately) during operation, as there is no anticipated land take required from businesses.

AGRICULTURAL LAND HOLDINGS

Construction

14.5.9. There is potential for temporary and permanent significant adverse effects on agricultural land holdings during construction, where land take is required or where accesses are affected and potentially causing severance which could affect the viability of the agricultural land holdings.

Operation

14.5.10. There is potential for permanent significant adverse effects on agricultural land holdings during operation, where agricultural land holdings are severed by the scheme alignment.

WCH

Construction

14.5.11. There is potential for temporary and permanent significant adverse effects on WCH, where temporary and/or permanent closures and diversions of the identified WCH routes are required. These include two restricted byways (Honingham RB1 and Attlebridge RB4), as well as a footpath (Ringland FP1). Journey length and user experience of the identified routes also have the potential to be temporarily affected.

Operation

14.5.12. There is potential for temporary and permanent significant adverse effects on WCH, where permanent closures and diversions of the identified WCH routes are required during operation. Journey length and user experience of the identified routes also have the potential to be permanently affected. The implementation of proposed provision of wildlife and pedestrian crossing bridges as part of the ancillary works has the potential to reduce the level of effect.

HUMAN HEALTH

Construction

14.5.13. There is potential for temporary negative human health outcomes during construction. This is due to potential increase in air and noise pollution (from both construction dust and noise, and potential additional congestion caused by diversions). There is also potential for temporary adverse effects to arise from obstruction and disruption of PRoW due to potential closures and diversions, which could alter people's ability to follow healthy pursuits and partake in physical activity. There is potential for permanent adverse effects on visual amenity and water quality, which may have a negative human health outcome during construction and operation.

Operation

14.5.14. There is potential for negative human health outcomes due to permanent PRoW diversions, which may increase journey time and discourage WCH journeys and therefore reducing levels of physical activity. The implementation of proposed provision of pedestrian crossing bridge has the potential to lessen health impacts associated with reduced physical activity levels. There is potential for negative human health outcomes during operation due to new roadside air quality and noise emissions from vehicles.

14.5.15. Table 14-1 summarised elements to be scoped in and scoped out of further assessment.

Table 14-1 - Elements Scoped in or Out of Further Assessment

Element	Phase	Scoped In	Scoped Out	Justification
Private property and housing	Construction	✔		Potential for permanent adverse effects due to potential land take and demolition from private property and land owned by private land owners, based on the highway alignment.
	Operation		✔	No further effects anticipated during operation
Community land and assets	Construction	✔		Potential for temporary adverse effects due to potential obstruction and disruption to community land and assets during construction, based on the highway alignment.
	Operation	✔		Potential for permanent beneficial effects due to access improvement to community land and assets, based on the proposal of a pedestrian crossing bridge and road crossing bridges along the highway alignment.
Development land and assets	Construction	✔		Potential for negligible effect as no existing businesses (except farm businesses) or development land allocation located within the Site.
	Operation		✔	Given that no land take will be required from businesses (excluding agricultural land holdings), it is understood at this stage that the Scheme would have no direct impact on development land and assets. This will be confirmed within the ES.
Agricultural land and holdings	Construction and operation	✔		Potential for permanent adverse effects due to potential land take from agricultural land, based on the highway alignment.
WCH	Construction	✔		Potential for temporary adverse effects due to potential obstruction and disruption on PRoW and potential increase journey length, based on the highway alignment.
	Operation	✔		Potential permanent adverse effects due to potential PRoW diversion, based on the proposed highway alignment. However, there is a proposed pedestrian crossing bridge which may reduce the level of effect.
Human health	Construction	✔		Potential temporary negative health outcomes associated with potential increased air and noise pollution and reduced opportunities for WCH due to construction works.
	Operation	✔		Potential negative health outcomes associated with reduced physical activity due to PRoW diversion which may discourage WCH journeys, based on the highway alignment. However, there is proposed pedestrian crossing bridge which may lessen this health impact.

Element	Phase	Scoped In	Scoped Out	Justification
				Potential negative health outcomes associated with exposure to potential new roadside emissions from vehicles based on the highway alignment, visual effects and water pollution.

14.6. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

14.6.1. Opportunities for enhancement of WCH facilities are being considered, including new and upgraded routes, provision of road crossing bridges, and wildlife and pedestrian bridges. Furthermore, an existing pedestrian bridge over the River Wensum is likely to be maintained.

14.7. PROPOSED ASSESSMENT METHODOLOGY

LEGISLATIVE AND POLICY FRAMEWORK

14.7.1. The following legislation, policy and guidance will be applied to the Population and Human Health assessment:

- Directive and legislation:
  - Countryside and Rights of Way Act 2000[232];
  - Equality Act 2010[233]; and
  - Localism Act 2011[234].
- National Policy:
  - National Policy Statement for National Networks[235];
  - National Planning Policy Framework 2019[236];
  - Planning Practice Guidance 2014[237,238];

[232] Countryside and Rights of Way Act, 2000, Chapter 37, Available at: http://www.legislation.gov.uk/ukpga/2000/37/enacted (Accessed:14 January 2020)
[233] Equality Act, 2010, Chapter 15, Available at: http://www.legislation.gov.uk/ukpga/2010/15/contents (Accessed: 14 January 2020)
[234] Localism Act, 2011, Chapter 20, Available at: http://www.legislation.gov.uk/ukpga/2011/20/contents (Accessed: 14 January 2020)
[235] Department for Transport, National Policy Statement for National Networks (December 2014)
[236] Department for Communities and Local Government, Revised National Planning Policy Framework (February 2019)
[237] Ministry of Housing, Communities & Local Government, Planning Practice Guidance – Open space, sports and recreation facilities, public rights of way and local green space (2014) Available at: https://www.gov.uk/guidance/open-space-sports-and-recreation-facilities-public-rights-of-way-and-local-green-space (Accessed: 14 January 2020)
[238] Ministry of Housing, Communities & Local Government, Planning Practice Guidance - Health and wellbeing (2014) Available at: https://www.gov.uk/guidance/health-and-wellbeing (Accessed: 14 January 2020)

- Fair Society, Health Lives, The Marmot Review 10 Years On 2020[239]; and
- Public Health Outcomes Framework 2019.

- Local Policy:
  - Norfolk County Council's Environmental Policy[240];
  - Norfolk Transport Plan 2011 - 2026[241];
  - Norfolk Access Improvement Plan (NAIP) 2019 – 2029[242];
  - Joint Core Strategy for Broadland, Norwich and South Norfolk Development Plan Document (DPD)[243];
  - Development Management DPD 2015[244];
  - Site Allocations DPD 2016[245]; and
  - Growth Triangle Area Action Plan[246].
- Guidance:
  - DMRB Volume 11, Section 2, Part 4 LA 104 (Environmental Assessment and Monitoring)[247]; and
  - DMRB Volume 11, Section 3, Part 6 LA 112 (Population and Human Health)[250].

[239] The institute of Health and Equality Fair Society Healthy Lives (Marmot Review 10 Years On) Available at: http://www.instituteofhealthequity.org/resources-reports/marmot-review-10-years-on (Accessed: 28 February 2020)
[240] Norfolk County Council, Environmental policy. Available at: https://www.norfolk.gov.uk/what-we-do-and-how-we-work/policy-performance-and-partnerships/policies-and-strategies/natural-environment-policies/environmental-policy (Accessed: 14 January 2020)
[241] Norfolk County Council, Norfolk Local Transport Plan 2011-2026. Available at: https://www.norfolk.gov.uk/what-we-do-and-how-we-work/policy-performance-and-partnerships/policies-and-strategies/roads-and-travel-policies/local-transport-plan (Accessed: 14 January 2020)
[242] Norfolk County Council, Norfolk Access Improvement Plan (NAIP) 2019 – 2029. Available at: https://www.norfolk.gov.uk/out-and-about-in-norfolk/public-rights-of-way/norfolk-access-improvement-plan (Accessed: 14 January 2020)
[243] Broadland District Council, Joint Core Strategy. Available at: https://www.broadland.gov.uk/downloads/download/159/current_local_plan_-_joint_core_strategy (Accessed: 14 January 2020)
[244] Broadland District Council, Development Management Development Plan Document (DPD) 2015. Available at: https://www.broadland.gov.uk/downloads/download/161/development_management_dpd (Accessed: 13 January 2020)
[245] Broadland District Council, Site Allocations DPD 2016. Available at: https://www.broadland.gov.uk/downloads/download/162/site_allocations_dpd (Accessed: 13 January 2020)
[246] Broadland District Council, Growth Triangle Area Action Plan. Available at: https://www.broadland.gov.uk/downloads/download/163/growth_triangle_area_action_plan (Accessed: 14 January 2020)
[247] Highways England, LA 104 Environmental assessment and monitoring, Volume 11, Section 2, Part 4 (Jul 2019)

SIGNIFICANCE CRITERIA

14.7.2. The approach and methodologies to be used for the Population and Human Health assessment are set out below.

14.7.3. The Land use and accessibility assessment will be undertaken in accordance with guidance within DMRB Volume 11, Section 3, Part 6 LA 112[248]. Sensitivity criteria and magnitude of impact will be assigned according to Table 3.11 and Table 3.12 in the LA 112 guidance respectively. Level of significance will be assigned according to Table 3.8.1 in DMRB Volume 11, Section 2, Part 4 LA 104[262]. Significant effects comprise effect which are assigned as moderate, large or very large. The remaining effects will be categorised as non-significant.

LAND USE AND ACCESSIBILITY

Private property and housing

14.7.4. The assessment will identify disruption to access, the extent and level of private property and housing land lost to the Scheme, taking account where relevant, of compensation to be provided in mitigation.

Community land and assets

14.7.5. The assessment will identify community land and community facilities and the level of use. The assessment will set out the impact on community land used by the public, taking account where relevant, of exchange land to be provided in mitigation. Assessment of severance and accessibility to community facilities will be undertaken.

Development land and businesses

14.7.6. The assessment will identify the disruption to access, extent of development land and business lost to the Scheme. The assessment will set out the impact on development land and business owners, taking account where relevant, of exchange land or other form of compensation to be provided in mitigation.

Agricultural land holdings

14.7.7. The assessment will identify the extent of agricultural land lost to the Scheme, the frequency and type of use and impacts on severance and accessibility. The assessment will set out the impact on agricultural landowners, taking account where relevant, of exchange land or other form of compensation to be provided in mitigation.

WCH

14.7.8. The assessment will identify likely routes taken by pedestrians, equestrians and cyclists. The assessment will set out the impact on WCH receptors according to change in journey length.

[248] Highways England, LA 112 Population and Human Health, Volume 11, Section 3, Part 6. (January 2020)

HUMAN HEALTH

14.7.9. Effects of the Scheme on Human Health are considered in a qualitative assessment with evidence provided to support the conclusions made. Changes to health determinants as a result of the Scheme will be identified using available information about the Scheme and from other ES topics. Health determinants likely to be affected by the scheme, and included in the assessment of Human Health include;

- Air quality;
- Noise;
- Water quality;
- Landscape amenity;
- Accessibility to community, social and employment facilities; and
- Opportunities for physical activity.

14.7.10. The sensitivity of the population will be determined using professional judgement applied to the health profile presented in the baseline, and reported as low, medium, or high. A health receptors' sensitivity is based on their ability to experience a potential impact without incurring a substantial change to their health status. Information used to determine receptor value includes the following:

- Level of deprivation and/or isolation;
- Accessibility;
- Availability of local services and/or assets, and availability of alternatives;
- Use of routes by WCH, particularly vulnerable travellers, for journeys (either utility or recreational); and
- Importance of land for business or employment uses.

14.7.11. Likely health outcomes resulting from the Scheme will be reported on using guidance in the DMRB, Volume 11, LA112 (Table 3.32).

14.8. LIMITATIONS AND ASSUMPTIONS

14.8.1. To ensure transparency within the EIA process, the following limitations and assumptions have been identified:

- There is limited information on landowners, business land parcels, privately-owned woodland and agricultural land at this stage. These will be further assessed in the ES to identify potential effects on private property and agricultural land holdings;
- The assessment would rely, in part, on data provided by third parties (e.g. OS Mapping, Local Authorities, NOMIS, PHE) which are the most up-to-date, available at the time of the assessment. No significant changes or limitations in these datasets have been identified that would affect the robustness of the assessment for EIA purpose;
- The assessment impact on users of community facilities would be based on desktop study. No consultation would be undertaken to verify user levels;
- The assessment would identify population impacts down to the lowest defined population group available according to Office for National Statistics (ONS) survey outputs (lower super output areas). Further granularity of data is not available. No significant changes or limitations in these datasets have been identified that would affect the robustness of the assessment for EIA purposes;

- Vulnerable groups, including those with protected characteristics as defined by the Equality Act 2010, would be assumed to be present throughout the study area, additionally where specific areas have been identified as deprived, these areas will be emphasised; and
- Any limitations found or assumptions used in the final assessment will be highlighted within the ES.

15. ARBORICULTURE

15.1. INTRODUCTION

15.1.1. This scoping report method statement will inform the process of developing a technical appendix which provides an assessment of the potential impacts of the Scheme on arboricultural receptors.

15.1.2. This appendix should be read in conjunction with:

- Landscape and Visual effects (Chapter 8); and
- Biodiversity (Chapter 9).

15.2. CONSULTATION

15.2.1. Consultation with relevant parties relating to statutory tree protection (i.e. Norfolk County Council Tree Officer) will continue to be undertaken during the production of the ES.

Table 15-1 – Consultation undertaken to date

Body/Organisation	Date of Consultation	Key Outcomes of Discussions
Norfolk County Council Arboricultural Officer	01 May 2020	Initial discussion on presentation of arboricultural survey data; principles of compensation for loss of trees (including ancient and veteran); and approach to ongoing consultation.

15.3. STUDY AREA

15.3.1. Access to the site will be from public and private land.

- The arboricultural study area is defined as the Site plus a buffer zone. This buffer ensures that the root protection areas of arboricultural features, which are outside the footprint of the Scheme, are protected from construction activities.
- Desk Study Area: 100 metres from the Site to record ancient woodland, ancient and veteran trees, and notable trees, 15 metres to record all other Arboricultural features where data is available;
- Field Study Area: 15 metres from the Site, or up to 100 metres for ancient woodland, ancient and veteran trees, and notable trees identified either via desk study or visually during site visit; and
- The work scope for the study area will remain the same. It may be subject to re-survey and refinement later in the project lifecycle due to changes in the Site boundary, and therefore additional work may be required.

15.4. BASELINE CONDITIONS

15.4.1. The baseline conditions described for arboriculture are derived from the following sources:

- Desk Study Sources:

- Woodland Trust Ancient Tree Inventory[249];
- Multi Agency Geographical Information for the Countryside[250] (MAGIC) maps; and
- Data request to Norfolk County Council regarding the presence of TPO, Conservation Areas and other Statutory Tree Protection.

- Field Survey Sources:
  - Walkover surveys and;

15.5. MITIGATION

15.5.1. Mitigation and enhancements will be provided around an Arboricultural Method Statement and a Tree Protection Plan in accordance with Biodiversity Net Gain (BNG) criteria (DEFRA 2.0)[251].

15.5.2. Tree removals will be mitigated by replacement planting and habitat creation to enhance biodiversity, where possible and appropriate, with arboriculturist recommendations contributing to landscape design.

15.6. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

15.6.1. The gathering of arboricultural survey data identifies and categorise trees according to the established approach provided by British Standard BS5837:2012 (see *Proposed Field Assessment Methodology*, below). The data will subsequently enable the preparation of arboricultural impact assessment, tree protection plans, and arboricultural method statements.

15.6.2. The information quantifies the number of arboricultural features and assigns the tree or feature to one of four categories. The four categories present a hierarchy of value, with A category trees the highest category.

15.6.3. Within the highest A category, the British Standard does not elevate ancient, veteran and notable trees above other A category features. However, Standing Advice from the Government agencies, Natural England and the Forestry Commission, places an expectation for retention of ancient and veteran trees. The Standing Advice states, "*Compensation measures are always a last resort because ancient woodland and veteran trees and their habitats are irreplaceable*".

15.6.4. The potential impacts considered in the appendix are:

Construction Phase

- Adverse impact resulting from fragmentation of ancient woodlands, an irreplaceable habitat;

[249] Ancient Tree Inventory (2019) Tree Search. Available at: https://ati.woodlandtrust.org.uk/ (Accessed: 22 January 2019)
[250] Natural England (2019) Interactive mapping at your fingertips. Available at https://magic.defra.gov.uk (Accessed: 22 January 2019)
[251] Natural England Natural England (2019). The Biodiversity Metric 2.0 – auditing and accounting for biodiversity. User Guide. Natural England Joint Publication JP029.

- Adverse impact resulting from the permanent loss of significant areas or numbers of irreplaceable habitats (which includes ancient woodlands, ancient and veteran trees);
- A suitable compensation strategy for the loss of irreplaceable habitats may not be achievable;
- The removal of a significant number of arboricultural receptors of high, medium and low value (to include other woodlands and individual trees) to facilitate construction may result in an overall major adverse impact; and
- Damage to soil and tree roots / canopies of retained trees results in deterioration of condition and reduce retention span.

Operational Phase

- The removal of a significant number of arboricultural receptors of high, medium and low value to facilitate construction likely to result in an overall net loss in tree canopy cover;
- Increased exposure to windthrow;
- Damaged tree roots / canopies of retained trees resulting from the construction phase leading to reduced value of arboricultural receptors;
- Likely long-term impacts associated with tree pests and diseases, including Chalara dieback of ash (Hymenoscyphus fraxineus);
- Climate change impacts resulting in changes to future local environmental conditions; and
- Regrowth of retained arboricultural receptors results in encroachment of tree roots and canopy across Highways England boundary.

15.6.5. Evidently, whilst the tree is categorised there is no approved methodology to translate this category into significance of arboricultural effects. For this reason, the impact of the Scheme on arboricultural features will simply quantify, by category, those trees which will be physically or environmentally affected. In the absence of any approved methodology, it is not appropriate to further extrapolate those categorisations to descriptors of significance. Therefore, a table showing elements scoped in and scoped out of further assessment has not been included.

15.7. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

15.7.1. Tree planting will be incorporated into the Scheme to provide landscaping and ecological mitigation. Prescriptions for biodiversity enhancement will also be explored in existing woodlands. Arboriculture and forestry expertise will feed into the proposals and management methods to maximise the effectiveness of these contributions to the arboricultural environment. However, this compensation or enhancement relates to the contribution of trees for landscape, habitat and biodiversity and not in relation to their intrinsic arboricultural value.

15.7.2. Proposals developed purely on arboricultural value (and the policy of tree renewal and replacement) is best contemplated over large spatial scales, such as county-wide. Hence, reference to arboricultural enhancement opportunities, at the scale of the Scheme, is not appropriate.

15.8. PROPOSED ASSESSMENT METHODOLOGY

15.8.1. The method of assessment is a non-intrusive walkover survey of qualifying arboricultural features, with potential to be affected by the Scheme, referenced in *Study Area*, above.

15.8.2. Qualifying features will be inspected and classified by a suitably qualified and experienced arboriculturist in accordance with British Standard BS5837:2012 '*Trees in Relation to Design, Demolition and Construction - Recommendations*'. Qualifying trees are defined as individual trees with a stem diameter of at least 75mm, measured at 1.5m above ground level. Where trees form groups, either aerodynamically through mutual support or by forming a screen or other such feature, they will be recorded as groups or woodlands. This approach is detailed within paragraph 4.4.2.3 of BS 5837.

15.8.3. Each arboricultural feature identified will be assessed in transparent, understandable and systematic manner as set out in Tables 1 and 2 of the British Standard. The trees will be assigned a category based on their current condition and status:

- Category A – trees of high arboricultural quality.
- Category B – trees of moderate arboricultural quality.
- Category C – trees of low arboricultural quality.
- Category U – unsuitable for retention - trees in such a condition that they cannot realistically be retained in the context of the current land use for longer than 10 years.

15.8.4. All qualifying trees will be inspected from ground level using the Visual Tree Assessment (VTA) method. This is a non-invasive method for ascertaining the physiological and structural condition of trees and may require the use of an acoustic mallet and small probe. The VTA will be undertaken on the above ground portion of the trees. No aerial inspection, internal sampling or excavation will be undertaken nor will any laboratory testing carried out. Binoculars may be used to inspect the upper parts of the tree canopy from ground level if required.

PROPOSED ANALYSIS OF FIELD AND DESK DATA

15.8.5. Data regarding ancient, veteran and notable trees will be derived from two sources: the Ancient Tree Inventory (ATI, maintained by the Woodland Trust, referenced in *Baseline* Conditions, above) and field survey data derived by the arboricultural consultant.

15.8.6. The ATI contains information volunteered to the Woodland Trust. The voluntary provision of information is inevitably incomplete. The competency of inputs to the ATI is not guaranteed. The ATI is a valuable tool to support field survey by a qualified arboricultural consultant.

15.8.7. The ATI has provided evidence for the existence of numerous ancient and veteran trees within the Site boundary. The information on these trees includes a grid reference but the voluntary provision of the data does not ensure topographical precision. Matching trees to field survey cannot be guaranteed.

15.8.8. The consistent application of qualifying criteria, by an experienced arboricultural consultant, potentially identifies trees, not included in the ATI. Equally, it is possible that the consultant will not support the inclusion of trees within the ATI.

15.8.9. An analysis of ancient, veteran, and notable trees has been scoped into the arboricultural reporting and will be provided within the ES. This will include a tabular comparison of field and ATI data. Only the consultant's field-based identification of qualifying trees will be mapped, representing the primacy of the data.

15.9. LIMITATIONS AND ASSUMPTIONS

15.9.1. The following limitations and assumptions have been identified:

- Arboricultural receptors may be valued for their arboricultural, landscape or conservation benefits and can include high, moderate and low value trees, linear and non-linear tree groups, wooded areas and hedges;
- Arboricultural features are afforded statutory protection when a Tree Preservation Order is placed on individual trees or tree groups or when trees are located within a conservation area. They may also carry non-statutory designations such as ancient woodland and ancient or veteran trees;
- Arboricultural features are a material consideration within the planning system with local authorities placed under a general duty to make provision for the preservation or planting of trees;
- Arboricultural features which are of high or moderate value are likely to be of sufficient quality and value for them to warrant incorporation into the Scheme wherever this can be achieved;
- It is assumed that topographical survey data will be available in electronic format prior to the start of the arboriculture survey to ensure the accuracy of tree locations;
- Although the BS 5837 survey will refer to the structural and physiological condition of trees, it is not a tree hazard assessment and should not be used as such; and
- The arboriculture report will be independent of the ecological assessment of trees, particularly the potential for trees and tree groups to provide habitat for protected species.

16. MAJOR ACCIDENTS AND DISASTERS

16.1. INTRODUCTION

16.1.1. The requirement for a Major Accidents and Disasters (MAD) assessment is new to EIA practice in the UK being introduced via the EIA Regulations 2017[252].

16.1.2. The EIA Regulations 2017 require that the ES includes: '*A description of the expected significant adverse effects of the development on the environment deriving from the vulnerability of the development to risks of major accidents and/or disasters which are relevant to the project concerned. Relevant information available and obtained through risk assessments pursuant to EU legislation such as Directive 2012/18/EU of the European Parliament and of the Council(c) or Council Directive 2009/71/Euratom(d) or UK environmental assessments may be used for this purpose provided that the requirements of this Directive are met. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.*'

16.1.3. This purpose of this MAD section of this Scoping Report is to:

- Identify the MAD topics and types that are proposed to be the subject of the environmental assessment – those topics that are "scoped in";
- Eliminate those MAD topics and types not requiring further consideration, and which would therefore not be taken further in the environmental assessment – those topics that are "scoped out"; and
- Define the approach to, and methodologies for, identifying potential MAD events and their assessment.

16.1.4. The definition of key terms used in this section are given in Table 16-1.

[252] Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (SI 2017 No. 572).

16.1.5. These definitions have been developed by reference to the definitions used in EU and UK legislation and guidance relevant to major accidents and/or disasters[253,254,255,256,257,258,259,260,261,262,263] as well as professional judgement in the context of the Scheme.

Table 16-1 – Key terms and definitions relevant to this section of this section of the Scoping Report

Term	Definition
(Major) Accident	In the context of the Scheme, an event that threatens immediate or delayed serious damage to human health, welfare and/or the environment and requires the use of resources beyond those of the Applicant or its contractors to respond to the event. Serious damage includes the loss of life or permanent injury and/or permanent or long-lasting damage to an environmental receptor that cannot be restored through minor clean-up and restoration efforts. The significance of this effect will take into account the extent, severity and duration of harm and the sensitivity of the receptor.
Consultation zone	The Health & Safety Executive (HSE) sets a Consultation Distance (CD) around major hazard sites and major accident hazard pipelines after assessing the risks and likely effects of major accidents at the major hazard. The area enclosed within the CD is referred to as the consultation zone. The Planning Authority is notified of this CD and has a statutory duty to consult HSE on certain proposed developments within the zone the CD forms.
Disaster	In the context of the Scheme, a naturally occurring phenomenon such as an extreme weather event (for example storm, flood, temperature) or ground-related hazard events (for example subsidence, landslide, earthquake) with the

[253] Civil Contingencies Act 2004 (c36).
[254] HM Government (2013) Emergency Response and Recovery – Non-statutory guidance accompanying the Civil Contingencies Act 2004, Cabinet Office, 28 October 2013.
[255] The Seveso III Directive (Directive 2012/18/EU).
[256] Control of Major Accident Hazards Regulations 2015 (SI 2015 No. 483) (COMAH).
[257] Health and Safety Executive (2015) The Control of Major Accident Hazards Regulations 2015: Guidance on Regulations, L111, Third Edition, June 2015.
[258] "All Measures Necessary - Environmental Aspects", COMAH CA, accessed 3/3/18 at https://www.sepa.org.uk/media/219152/d130416_all-measures-necessary-guidance.pdf.
[259] SEPA (2016a) CDOIF guideline "Environmental Risk Tolerability for COMAH Establishments" v2, accessed 3/3/18 from http://www.sepa.org.uk/media/219154/cdoif_guideline__environmental_risk_assessment_v2.pdf.
[260] Major Accident Off-Site Emergency Plan (Management of Waste from Extractive Industries) (England and Wales) Regulations 2009.
[261] Department of Environment, Food and Rural Affairs (2011) Guidance: Major Accident Off-Site Emergency Plan (Management of Waste from Extractive Industries) (England and Wales) Regulations 2009. Mining Waste Directive: Article 6 Category "A" Waste Facilities. Department of Environment, Food and Rural Affairs, August 2011.
[262] International Federation of Red Cross and Red Crescent Societies, What is a Disaster? (http://www.ifrc.org/en/what-we-do/disaster-management/about-disasters/what-is-a-disaster/)
[263] Oxford English Dictionary

Term	Definition
	potential to cause an event or situation that meets the definition of a Major Accident as defined above.
External Influencing Factor	A factor which occurs beyond the Scheme redline boundary that may present a risk to the Scheme, e.g. if an external disaster occurred (e.g. earthquake, COMAH site major accident) it would increase the risk of serious damage to an environmental receptor associated with the Scheme.
Hazard	Anything with the potential to cause harm, including ill-health and injury, damage to property or the environment; or a combination of these
Internal Influencing Factor	A factor which occurs within the Scheme redline boundary that may present a risk to the Scheme.
Risk	The likelihood of an impact occurring combined with effect or consequence(s) of the impact on a receptor if it does occur.
Risk Event	An identified, unplanned event, which is considered relevant to the Scheme and has the potential to be a Major Accident and/or Disaster subject to assessment of its potential to result in a significant adverse effect on an environmental receptor.
Vulnerability	In the context of the 2014 EU Directive, the term refers to the 'exposure and resilience' of the Scheme to the risk of a major accident and/or disaster. Vulnerability is influenced by sensitivity, adaptive capacity and magnitude of impact.

16.2. CONSULTATION

16.2.1. Specific consultation has been undertaken with the HSE to date in support of the Scheme regarding the major hazards pipeline (summarised Table 16-2).

Table 16-2 – Summary of consultation undertaken to date

Body / Organisation	Individual / statutory body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
Health & Safety Executive (HSE)	Land Use Planning (LUP) Unit	24/10/2019	HSE advise to utilise the free enquiry on HSE's Planning Advice Web App to determine whether or not the associated land parcel is affected by HSE consultation zones. HSE confirmed that there are HSE Consultation zones for a Major Accident Hazard Pipeline that affect the proposed development. Details of the Major Accident Pipelines and their associated HSE were provided, and it was noted that WSP

Body / Organisation	Individual / statutory body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
			would need to contact the pipeline operator for the exact layout of the pipelines, as well as to ensure if the pipeline has been modified in this area. If so, HSE would be willing to reassess the risks from the pipeline (additional costs may apply), relative to the proposed development, if specific details are supplied.
HSE	LUP Unit	03/01/2020 – Ref: D1164: Consultation Zones - HP Feeder 3 Felthorpe - Hardingham, Norfolk	HSE summarised the information required to be submitted to obtain formal pre-application advice for the Scheme.
HSE	LUP Unit	08/01/2019 – HSE LUP Web app	Advice: HSL-200108111934-715; HSL-200108130151-715; HSL-200108130654-715 and HSL-200108131321-715 The proposed development site which you have identified currently lies within the consultation distance (CD) of at least one major hazard site and/or major accident hazard pipeline; HSE needs to be consulted on any developments on this site. The pipeline operator will also need to be contacted as they may have additional constraints on development near their pipeline (7450_1709 National Grid Gas PLC).

16.3. STUDY AREA

16.3.1. The extent of the scoping study area was a 2.5km radius around the Scheme footprint. Within the study area, accident and disaster groups and categories were considered both within and outside the Site, along with potential external influencing factors, such as:

- Natural Hazard categories, e.g.
  - Geophysical;
  - Hydrology;
  - Climatological and metrological;
  - Biological;
- Technological or manmade hazard categories, e.g.
  - Societal;

- Industrial and Urban accidents;

- Transport accidents;
- Utility failures;
- Malicious attacks; and
- Engineering failures and accidents.

16.3.2. Schedule 4 of the EIA Regulations 2017 advises the information to be included in the ES. As such, the scoping study has considered the following receptors:

- Members of the public and local communities;
- Infrastructure and the built environment;
- The natural environment, including ecosystems, land and soil quality, air quality, surface and groundwater resources and landscape;
- The historic environment, including archaeology and built heritage; and
- The interaction between the factors above.

16.3.3. The study has been based primarily on information held by the Applicant and information developed as part of the Scoping Report by the WSP project team.

16.4. BASELINE CONDITIONS

16.4.1. The baseline relevant to this topic comprises:

- Features external to the Scheme that contribute a potential source of hazard to the Scheme;
- Sensitive environmental receptors at risk of significant effect; and
- Current (without the Scheme) major accident and disaster risks for the existing locality.

16.4.2. Areas of the Scheme are within the Consultation Distance (CD) for a Major Accident Hazard pipeline operated by National Grid.

16.4.3. There is a potential for natural cavities, such as sinkholes and solution pipes, given the nature of the local geology (Chalk Group) underlying the Scheme.

16.4.4. The Scheme is located in a Flood Zone 3 classified as an area with a high probability of flooding (greater than a 1 in 100 (1%) risk of fluvial flooding in any year). The high flood risk stems from the presence of the River Wensum which runs across the northern end of the scheme and has a large catchment area.

16.5. MITIGATION

16.5.1. The Applicant has committed to constructing and managing the Scheme in accordance with, inter alia:

- Environmental, Health & Safety Management systems;
- Supplier management environmental, health & safety standards (e.g. Construction Skills Certification Scheme);
- Risk management systems; and
- Construction and Environmental Management systems (including CEMP, a draft of which will be included with the ES).

16.6. DESCRIPTION OF POTENTIAL VULNERABILITY TO MAJOR ACCIDENT AND DISASTER RISKS

16.6.1. An initial review of the accident and disaster categories (16.3.1) identified in the study area has been undertaken to inform the scoping process. This is summarised in Table 16-3 to show the potential vulnerability of the Scheme to the risk of a Major Accident and/or Disaster type. The ES will provide greater assessment and justification for the topic areas scoped in and out of the EIA, although at this scoping stage it is envisaged that hazards related to the Major Accident Hazard pipeline is the only likely category scoped in to the assessment.

Table 16-3 – MAD Types Scoped in or Out of Further Assessment

MAD group - categories	Phase	Scoped In	Scoped Out	Justification
Natural Hazards - Geophysical	Construction and Operation	✔		Chalk mining, sinkholes and dissolution features present a general risk for the Scheme. The design shall consider the associated risks and incorporate appropriate mitigation measures.
Natural Hazards - Hydrology	Construction and Operation		✔	Parts of the Scheme are located within Flood Zone 3 which makes the infrastructure potentially vulnerable to the risk of fluvial flooding. This will be further assessed as part of the flood risk assessment within the ES and used to inform the design and will remain on the design risk register until design mitigation measures are finalised. As such should not need a separate MA&D assessment.
Natural Hazards – Climatological and metrological	Construction and Operation		✔	The Scheme is not vulnerable due to location or proposed use.
Natural Hazards - Biological	Construction		✔	Standard control measures would be implemented by the appointed contractor during construction to protect workers from disease epidemics (Weil's Disease) and diseased animal/ plants.
Technological or manmade hazards - Societal	Construction and Operation		✔	Despite some likely objection, the Scheme is not considered highly controversial and should not lead to high profile public demonstrations.
Technological or manmade hazards - Industrial/Urban Accidents	Construction and Operation	✔		Parts of site overlap with Major Accident Hazard (MAH) pipeline which makes the Scheme potentially vulnerable to the risk of a major fire/explosion. Increased societal risk

MAD group - categories	Phase	Scoped In	Scoped Out	Justification
				due to the presence of transient road users and road maintenance personnel during operation that did not previously exist within the MAH Consultation Zone. These risks require further consideration in the ES.
Technological or manmade hazards – Transport accidents	Construction and Operation		✔	The Scheme is not vulnerable due to location or proposed use.
Technological or manmade hazards – Pollution accidents	Construction and Operation		✔	The Scheme is not vulnerable due to location or use.
Technological or manmade hazards – Utility failures	Construction		✔	The Scheme not vulnerable due to location or proposed use.
Technological or manmade hazards – Malicious attacks	Construction		✔	The Scheme is unlikely to be the target for malicious attacks.
Technological or manmade hazards – Engineering failures and accidents	Construction and Operation		✔	The Scheme is not vulnerable due to structures (new viaduct and smaller bridges) designed to modern safety standard. Allowances have been made for future climate change predictions that could result in flooding. Only 11kva lines along Ringland Lane are being removed (no pylons). The appointed Principal Contractor will carry out surveys for harmful substances (e.g. asbestos) and develop detailed Risk Assessments and Method Statements (RAMS) prior to any demolition works.

16.7. PROPOSED ASSESSMENT METHODOLOGY

16.7.1. The applicable legislative framework covering the design, construction, operation of the Scheme is summarised as follows, and further details presented in Appendix E:

- Health and Safety at Work etc. Act 1974 (HASWA)[264]; and
- Construction (Design and Management) Regulations 2015 (CDM)[265]; and

[264] Health and Safety at Work etc. Act 1974 (c. 37).
[265] Construction (Design and Management) Regulations 2015 (SI 2015 No. 15).

- Pipeline Safety Regulations[266].

16.7.2. There is no published guidance for the application of the legal requirements to the assessment of MA&D. However, selected relevant guidance for risk assessment methodologies is summarised as follows:

- Defra (2011) 'Guidelines for Environmental Risk Assessment and Management[267];
- Chemical and Downstream Oil Industries Forum, (2013), Guideline – Environmental Risk Tolerability for COMAH Establishments[286].
- The International Standards Organization's ISO 31000: 2009 Risk Management – principles and guidelines[268].

16.7.3. Additionally, the following have been consulted to support the identification of potential MA&D:

- The Cabinet Office National Risk Register of Civil Emergencies (2017 Edition)[269]. This document is the unclassified version of the National Risk Register and it identifies the main types of civil emergencies that could affect the UK in the next five years. It is recognised, however, that this document does not provide an all-encompassing list of all potential accidents and disasters and its timescales are short term.
- The International Federation of Red Cross & Red Crescent Societies Early Warning, Early Action (2008)[270]. This guidance looks to other countries including those in warmer climates, thereby identifying risks that the UK may encounter in the future in light of climate change and global warming.

16.7.4. The International Disaster Database[271]. This online source (http://www.emdat.be/) contains data covering over 22,000 mass disasters in the world since 1900 to the present day and aims to "rationalise decision making for disaster preparedness, as well as provide an objective base for vulnerability assessment and priority setting".

16.7.5. A three-tiered process will be used to scope MA&Ds in/out for detailed assessment in the ES:

- Firstly, low likelihood and low consequence events are scoped out as these events are unlikely to result in significant adverse effects as they do not fall into the definition of a MA&D. Highly likely and low consequence events are also scoped out as they will not lead to significant adverse effects. Furthermore, high likelihood and high consequence events are also scoped out, as it is assumed that existing legislation (Appendix E) and regulatory controls[266] would not permit the Scheme to be progressed under these circumstances.

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[266] The Pipelines Safety Regulations 1996 (SI 1996 No. 825).
[267] Defra (2011), Guidelines for Environmental Risk Assessment and Management: Green Leaves III, Cranfield University and Department for Environment, Food and Rural Affairs, November 2011.
[268] The International Standards Organization's ISO 31000: 2009 Risk Management – principles and guidelines.
[269] Cabinet Office, National Risk Register of Civil Emergencies, 2017 Edition.
[270] International Federation of Red Cross and Red Crescent Societies, What is a Disaster? (http://www.ifrc.org/en/what-we-do/disaster-management/about-disasters/what-is-a-disaster/)
[271] The International Disaster Database (http://www.emdat.be/).

- The second component is in accordance with emerging EIA practice, whereby occupational health and safety (H&S) is scoped out of this topic (other health issues are covered in relevant topic sections of air quality and noise and vibration, and flood risk and the water environment. As such, human health impacts are "in combination" impacts and are considered under the Cumulative Effects heading) as it is covered by detailed H&S legislation[238],[272],[273],[274].
- The third component is the formation of the Initial Long List of all possible MADs. This is reviewed to rule out any potential accidents and disasters that are considered highly unlikely to occur due to the location of the Scheme, based on information provided by the environmental topic teams and use of information sources related to accidents and disasters [289, 296271,275,276]. Those MADs that cannot be screened out will form the In Scope MADs which will require further detailed assessment in the ES.

16.7.6. The process for those In Scope MADs for detailed assessment in the ES will include:

- identifying risk events;
- screening these risk events;
- defining the likely worst-case consequences (impact);
- assessing the likelihood; and then
- determining MA&D status and if relevant, ALARP status of the proposed mitigation measures.

16.8. LIMITATIONS AND ASSUMPTIONS

16.8.1. The following limitations and assumptions have been identified:

- The design of the Scheme will take into consideration the relevant potential mitigation measures set out in National Policy Statement for National Networks (NPSNN).
- The design of the road network will be subject to relevant Hazard Identification (HAZID)/road safety studies and actions identified integrated into the final design to reduce risks to as low as reasonably practicable (ALARP).
- The construction stage(s) of the Scheme will be managed through the implementation of the Construction Phase Plan (required under the CDM Regulations 2015) and CEMP, a draft of which will be included with the ES.
- The Scheme is being designed and its implementation guided by other industry standards and codes, many of which are mandatory. These require infrastructure and systems to be designed so that risks to people and the environment are either eliminated or reduced to levels that are ALARP.
- It is considered highly unlikely that the Scheme would be demolished after its design life as it is likely to have become an integral part of the infrastructure in the area, therefore the demolition of the Scheme is scoped out.

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[272] Management of Health & Safety at Work Regulations 1999.
[273] The Workplace (Health, Safety and Welfare) Regulations 1992.
[274] The Dangerous Substances and Explosive Atmospheres Regulations 2002.
[275] British Geological Survey Geo Index Onshore (http://mapapps2.bgs.ac.uk/geoindex/home.html).
[276] Prevention Web Europe: Tsunamis Hazard Map (https://www.preventionweb.net/english/professional/maps/v.php?id=3831).

16.8.2. Environmental effects associated with unplanned events that do not meet the definition of a major accident and/or disaster (e.g. minor leaks and spills that may be contained within the construction sites) are addressed in other topic chapters as appropriate and not in this section. It is also recognised that the management framework for the Scheme is not fully defined at this stage; however, a presumption of standard practice and regulatory compliance within the adopted management framework has been assumed and will be developed following the appointment of the Principal Contractor.

17. TRAFFIC AND TRANSPORT

17.1. CONSULTATION

17.1.1. Since the Scheme is a transport scheme, extensive consultation has been carried out with relevant consultees in the early stages of feasibility design, optioneering, option selection and via two rounds of public consultation in Summer 2018 and Winter 2018.

17.1.2. There have been meetings held with the Department for Transport in relation to the Strategic Outline Business Case, transport modelling scope and appraisal methodology. Ongoing dialogue and data sharing has been maintained via monthly meetings and conference calls with Highways England; and Transport Assessment scoping meetings have been held with Norfolk County Council Highways.

17.1.3. The development of an emerging transport mitigation package known as the 'Sustainable Transport Strategy' (STS) has also been informed by two stakeholder workshops attended by relevant accessibility groups including Non-Motorised User (NMU) routes, Public transport enhancements, and Walking, Cycling and Horse Riding (WCHAR) groups. Questionnaires were issued to the group and the feedback gathered has highlighted a range of enhancement opportunities which have been considered and evaluated via the WCHAR process.

17.1.4. In response to feedback from the second round of public consultation, which highlighted a need for improved public transport in the study area to the west of Norwich, meetings have been held with local Bus Operators, First Bus and Konectbus, to develop a bus strategy to complement the NWL highway scheme. Timetabling advice has been sought from both operators, seeking to achieve a viable service that is accessible to the local communities west of Norwich. It is envisaged that this would assist in creating opportunities for non-car travel within the urban fringes of Norwich by connecting residents to key workplaces on the western edge of Norwich.

17.1.5. Bi-Monthly meetings have also been held with a Local Liaison Group (LLG) of Parish representatives since 2017. The LLG input to the STS development was sought via a questionnaire feedback form and 19 parishes responded in October/November 2019. This feedback was also taken into account within the WCHAR process.

17.1.6. A further round of additional non-statutory public consultation is planned in 2020 focussing on the Sustainable Transport Strategy (STS) interventions and localised elements of the Scheme which have not been subject to previous consultation. This will inform the further development of the emerging STS, including NMU routes, Public transport enhancements, and WCHAR connectivity improvements in the wider study area over a 5km radius around the Scheme.

17.1.7. A final public consultation will also be held prior to the planning application submission, so that public feedback on the entire Scheme can be considered and addressed in the final designs for submission where a consensus of opinion is evident. This consultation will include further details of the NWL scheme design, as well as proposed traffic mitigation measures.

17.1.8. A list of meetings and consultation activities relevant to Traffic and Transport are provided below in Table 17-1.

Table 17-1 - Consultation Undertaken to Date

Body/Organisation	Date of Consultation	Key Outcomes of Discussions
Highways England	Monthly since August 2019	Interface junction design at A47 Wood Lane junction with B1535 and Berry's Lane
Norfolk County Council Highways – TA manager	12 February 2020	Initial Traffic Assessment (TA) scoping discussion and review of earlier Transport Modelling results to agree junctions for assessment.
Sustainable Transport Stakeholder Workshop #1	18 October 2019	Sustainable Transport Intervention Ideas – suggestions of complementary walking and cycling opportunities for consideration via the WCHAR process.
Sustainable Transport Stakeholder Workshop #2	24 January 2020	Update on emerging proposals for NMU strategy and Sustainable Transport Interventions. Agreement that footpaths crossing the River Wensum SAC, should not be upgraded due to the sensitivity of the environment.
Local Liaison Group of Parishes	Bi-Monthly meetings ongoing	Nature of side road crossings, input to traffic calming and sustainable transport ideas, review of emerging NMU strategy proposals, input to public consultation materials
Bus operators – Konectbus	9 December 2019	Initial meeting to discuss potential opportunities for new, diverted or enhanced bus services in the west of Norwich. Timetable advice on a potential loop service connecting Taverham, Costessey, Drayton and key employment sites west of Norwich such as Norfolk and Norwich University Hospital (NNUH), The University of East Anglia (UEA) and Norwich Airport. Further discussion on potential western loop bus service - enhancement opportunities and modifications to route to improve efficiency.
First and Konectbus - Stakeholder workshop#2	24 January 2020	
Norfolk County Council PROW team	24 January 2020	Status of proposed routes – preference for restricted byways

Body/Organisation	Date of Consultation	Key Outcomes of Discussions
		where possible to allow carriage driving.
Members of the Public & Users of the Local Road network	Public consultation Spring 2020 Winter 2018/Early 20219 Summer 2018	Feedback on emerging proposals following the Preferred highway alignment announcement – focussing on local access and side road strategy. Shortlisted options for a New highway Link and potential complementary measures The need for the scheme and type of interventions

17.2. STUDY AREA

17.2.1. For assessment of effects on NMUs and Road Safety, the study area will be consistent with that used for the WCHAR study which is broadly a 5km radius around the Scheme highway alignment. The geographic area covered is shown in Figure 2 of the Transport Assessment (TA) Scoping Note in Appendix F.

17.2.2. For Traffic impact purposes, the Scheme traffic model has been used to identify highway links which are likely to experience noticeable changes in traffic as a result of the Scheme.

17.2.3. It should be noted that the TA scope is expected to be subject to further discussion and agreement with Norfolk County Council Highways and Highways England once the updated Norwich Area Transportation Strategy (NATS) traffic model is available. This is currently under development following extensive traffic monitoring across the whole of Norwich to update the model to a 2019 base year.

17.2.4. The junctions agreed for consideration of traffic impacts are as shown in Figure 3 of the Transport Assessment scoping report provided in Appendix F. The final scope of assessment based on the updated traffic model will be based on professional judgement but is expected to be based on criteria defined as follows:

- Links experiencing a noticeable peak hour change in traffic as a result of the Scheme. For urban routes this would include links where changes in traffic are greater than 1 vehicle per minute in both directions;
- For minor roads and rural roads with low base flows, professional judgement would be used but based on initial model results, this is expected to include links through Felthorpe to the north of the Scheme and the area south of A47 between Wymondham and Honingham;
- At priority junctions ('T' junctions, crossroads and roundabouts) where The Ratio of Flow to Capacity (RFC) in 2040 exceeds 0.85 the 2025 results will also be reviewed; and
- Similarly, at signalised junctions where the Degree Of Saturation (DOS) exceeds 90% in 2040, 2025 results will also be reviewed;

17.2.5. In addition to the above, qualitative comparisons will be carried out for those junctions where the NWL shows a beneficial impact to demonstrate the benefits of the Scheme.

17.3. BASELINE CONDITIONS

17.3.1. The transport baseline for the Scheme is set out in detail in the Option Appraisal Report dated March 2019 and Option Selection Report document published in July 2019. The data which informed these reports was taken from a wide variety of sources including UK Census 2011 and the 2015 NATS model. The evidence base will be supplemented with additional data from new traffic surveys carried out in 2019 and updated accident records.

17.3.2. Site visits were carried out to the surrounding highway network to understand existing conditions for all users of the affected road network as part of the WCHAR study (Walking, Cycling and Horse Riding Assessment Report). Stakeholder feedback has also been gathered through sustainable transport workshops and previous rounds of public consultation.

17.3.3. The current NATS model has been approved for use in the Strategic Outline Business Case (SOBC) and optioneering stages of the project by DfT and is agreed with Norfolk County Council Highways as offering a robust basis for TA scoping. The updated model being prepared in 2020 will be used to inform the TA baseline.

17.3.4. The model provides a forecast to 2025 (the proposed opening year of NWL), 2040, the Design year 15 years after opening and a horizon year of 2050. The baseline modelling assumes that the Highways England A47 dualling schemes at Blofield, Thickthorn and North Tuddenham to Easton are in place by 2025.

17.3.5. Committed developments to be considered within the transport model, will be set out within the Uncertainty Log agreed with the Local Planning and Highway Authorities. The current model used to inform the scoping process includes all major developments set out in the Greater Norwich Development Partnership (GNDP) Local Plan to 2026, plus National Trip End Model (NTEM) forecasts to 2050, plus other sites with approved planning permission which are near certain. Further updates will be applied based on the emerging policy such as the January 2020 GNLP consultation and committed transport improvements from the Local Transport Plan consultation draft 2020.

17.3.6. The current model indicates that the future baseline situation in 2040 is expected to be characterised by increases in traffic volume, increased vehicle delays and congestion on urban roads in the west of Norwich, including the Inner and Outer Ring Roads and Longwater Lane. However, the baseline forecast will be updated to inform the TA.

17.3.7. It is also evident that the presence of the A1270 as a northern bypass of Norwich now serves to attract increased traffic through the rural roads and villages to the west of Norwich, including HGV and LGV movement on narrow constrained minor unclassified roads which were not designed to cater for strategic traffic. This is due to a strategic gap in the Major Road Network between A47 Dereham Road and A1067 Fakenham Road radial routes into Central Norwich.

17.3.8. Census analysis on Journey to Work origins and destinations indicates that many desire lines cross through the area to the west of Norwich, many from south west of Norwich towards the coast in the north east of Norfolk. The situation also limits access to Norwich International Airport, Norfolk and Norwich University Hospital and the University of East Anglia, amongst other key employment sites on the west of Norwich.

17.3.9. The current strategic gap prevents the Major Road Network (MRN) from adequately catering for strategic orbital movement around Norwich, whilst the A1270 is underutilised. This places additional

pressure on A47 southern bypass of Norwich and the outer ring road forcing strategic traffic to travel long distances around Norwich. Without intervention alternative route options available in central Norwich will be unable to cope with the expected increases in travel demand by 2040 and additional environmental protection would be needed to prevent rat-running through minor rural villages west of Norwich.

17.4. MITIGATION

17.4.1. The Scheme proposals are intended to alleviate many of the problems summarised above which are related to the impacts of longer distance strategic traffic movement using minor roads and urban roads inappropriately to access a wide range of destinations on the urban fringe of Norwich and towards the North Norfolk Coast that are not accessible by other modes. The Scheme would also potentially assist with improving journey times for employees, visitors and emergency vehicles accessing medical facilities at key land uses on the western periphery of Norwich including NNUH, Norwich Retail Park (NRP), UEA and Norwich International Airport.

17.4.2. A Sustainable Transport Strategy is being developed to support the Scheme, seeking to enhance opportunities for non-car travel in order to counteract severance issues which may be introduced by the Scheme highway alignment (either physical severance due to access restrictions or severance caused by increases in traffic on existing routes).

17.4.3. For consistency with the Walking Cycling and Horse Riding Assessment Report, the mitigation strategy for non-car modes covers approximately a 5km study area around the Scheme. A non-motorised User strategy has been identified which seeks to improve local connectivity in the immediate vicinity of the Scheme highway alignment, enhancing Public Rights of Way and dedicating new footpaths bridleways and restricted byways to create a more attractive connected network for recreational access.

17.4.4. A review of bus services is also being carried out considering links between communities in the western urban fringe of Norwich and key land uses on the edge of the City such as NNUH, NRP and UEA. This is currently being developed in consultation with local bus operators.

17.4.5. The Transport Assessment will also identify where Traffic Management measures are required to mitigate the effects of the Scheme. At this stage, it is expected this will be focussed at the extremities of the highway alignment to the north and south of A47 where strategic traffic would potentially be drawn through the local road network in response to the Scheme.

17.4.6. The effects of the Scheme will be assessed with the mitigation in place as it is unlikely to proceed without mitigation.

17.5. DESCRIPTION OF LIKELY SIGNIFICANT EFFECTS

17.5.1. The Traffic and Transport effects for construction and operation are proposed to be covered in the Transport Assessment (TA) with a summary of effects only provided within the ES. This approach has been discussed and agreed with Norfolk County Council Highways.

17.5.2. The following table summarises the elements proposed to be scoped in or out of further assessment.

Table 17-2 - Elements Scoped in or Out of Further Assessment

Element	Phase	Scoped In	Scoped Out	Justification
Traffic & Transportation effects on all users of the transport network	Construction	✔		As discussed and agreed with Norfolk County Council Highways and for consistency with other similar schemes, construction phase effects will be considered within the Transport Assessment and a summary of effects provided in the ES.
Traffic & Transportation effects on all users of the transport network	Operation	✔		The outputs of the Transport Assessment will be appended to the ES. However a summary of effects will be provided in the ES chapter. .

17.6. OPPORTUNITIES FOR ENHANCING THE ENVIRONMENT

17.6.1. The provision of a new strategic highway link such as this Scheme is expected to offer significant reduction of traffic on the surrounding rural road network, improving residential amenity (e.g. by improving air quality and reducing noise and vibration) for local communities and reducing fear and intimidation for non-motorised users. This traffic relief should offer improved journey times for public transport, and make existing routes more accessible for vulnerable users such as pedestrians, cyclists and equestrians. Traffic reduction would also have secondary beneficial effects on air quality and noise (considered in Chapters 4 and 5 of the ES).

17.6.2. The Scheme is also anticipated to offer traffic relief to minor rural roads through local villages such as Weston Longville and Ringland. This would potentially reduce HGV and LGV movement close to residential receptors and contribute towards enhanced quality of life and residential amenity for village residents.

17.6.3. The NMU strategy offers opportunities for enhancing accessibility and connectivity around the Scheme highway alignment which would potentially reduce severance for local communities.

17.6.4. The Sustainable Transport Strategy would complement the Scheme and seeks to encourage mode shift for local short distance trips between residential areas and key employment sites in the west of Norwich.

17.7. PROPOSED ASSESSMENT METHODOLOGY

17.7.1. The assessment of transport effects of new development is required by the Town and Country Planning (Environmental Impact Assessment) Regulations 2017. The following documents will also be used to inform and guide the assessment methodology:

- The Institute of Environmental Management and Assessment (IEMA) 'Guidelines for the Environmental Assessment of Road Traffic' (1994); and
- Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment.

17.7.2. The ES Chapter will also be carried out in consideration of wider legislative context as listed below, which is applicable to highway design and accessibility in general – in particular the legal requirements of the Disability Discrimination Act 2010, Equalities Act 2010 and Human Rights Act

1998 require that proposed solutions and interventions do not discriminate against particular sectors of the community, especially those with protected characteristics such as mobility, maternity, race, gender, religion, etc.

17.7.3. The Transport Assessment would be informed by the Walking Cycling and Horse Riding Assessment Report (WCHAR) which is an assessment of Non-Motorised User provision and accessibility within a 5km radius around the Scheme footprint.

17.7.4. The assessment would also be informed by a review of relevant national and local adopted and emerging policy documents including the following:

- National Planning Policy Framework (NPPF) 2019;
- Planning Practice guidance (PPG), 2018;
- The DfT Circular 02/2013 - Strategic road network and the delivery of sustainable development
- The Strategic Road Note (SRN) 'Planning for the Future' (2015);
- Connecting Norfolk, Norfolk Local Transport Plan 2011-2026;
- Norfolk Strategic Framework – Shared Spatial Objectives for a Growing County (July 2017);
- Norwich Area Transportation Strategy (October 2004);
- Norfolk Strategic Infrastructure Delivery Plan (2018-2028);
- Safe, Sustainable Development (SSD, revised November 2019);
- The Current Broadland District Council Local Plan and sub documents;
- Norwich City Council Local Plan;
- South Norfolk District Local Plan;
- Breckland District Council Local Plan;
- The emerging Norfolk County Council Transport Plan 2020 – 2036; and
- The emerging Greater Norwich Local Plan (GNLP) 2018-2038.

17.7.5. Within the study area, the following types of transport effects on all travellers will be considered for the Operational and Construction Phases:

- Severance – the connectivity of an area or place (this section will summarise effects on NMUs living in close proximity to the Scheme. Severance effects are expected to result where existing routes crossing the Scheme are closed to some of all users and where significant changes in traffic flows along existing roads impact on the ability of pedestrians and cyclists to cross the road);
- Driver Delay & Stress – the extent to which drivers are delayed in stationary or slow-moving traffic. This also includes Driver Stress which can be influenced by uncertainty, poor signage, slow moving traffic and complex junctions;
- NMU Delay – the degree that traffic and transport delays the movement of pedestrians, cyclists, equestrians and vulnerable users;
- NMU Amenity – the relative pleasantness of a journey for pedestrians, cyclists, equestrians and vulnerable road users;
- Fear and Intimidation – the perceived danger, fear or intimidation resulting from the proximity or lack of protection from traffic;
- Accidents and Safety – the likely effect on accident frequency or severity and safety for all transport network users; for the construction phase, this includes consideration of risks presented by Hazardous Loads.

17.7.6. In the context of Traffic and Transportation, receptors will be considered to be all travellers on the transport network and local residential communities living in close proximity to the Scheme alignment within the 5km radius around the Scheme consistent with the WCHAR study area.

17.7.7. The Data used to inform the assessment will include the updated NATS model which is currently being revalidated to a 2019 base year following extensive surveys across the City of Norwich in Autumn 2019. The model will be validated to adequately match the existing traffic conditions in the base year for the surrounding road network in accordance with WebTAG guidance. Model validation will be based on highway link flows and journey times. A Local Model Validation Report will set out the extent to which the model replicates observed traffic conditions.

17.7.8. A core growth scenario will be used as the main case for assessment but additional sensitivity testing will also be carried out for a high growth scenario. The model suite also includes a Variable Demand Module which will also be used to test the range of variability with sustainable transport improvements and other mitigation also considered.

17.7.9. Additional observed data on queues or delays would be used to calibrate individual junction models (for the junctions within the TA Scope of assessment). Other data to be used includes demographic data from UK Census 2011, highway boundary extents, accident analysis will also be based on STATS19 Personal Injury Accident Data obtained for the last five year period for road links within the TA scope of assessment.

17.7.10. To assist with assigning a magnitude to traffic and transport impacts, the IEMA Guidelines sets out considerations, and in some cases thresholds, in respect to changes in the volume and composition of traffic.

17.7.11. The assessment methodology for defining the magnitude of traffic and transport impacts has been derived from IEMA guidance and is set out below. Where no guidance is available, commonly agreed thresholds for judging the magnitude of traffic and transport impacts and professional judgement, backed-up by qualitative or quantified information would be applied as suggested in paragraph 4.5 of the IEMA guidance.

17.7.12. DMRB LA 112 provides additional guidance for the assessment of effects on pedestrians, cyclists, equestrians and the community. It suggests where relevant, it should include the key facilities and their catchment area. DMRB guidance also states that in addition to the above, other factors such as level of use, use by vulnerable users and availability of alternative facilities should be taken into account.

17.7.13. Dependent on whether magnitude of impact is positive or negative, the effect on receptors would be classified as beneficial or adverse. An impact will also be classed as temporary or permanent.

NMU Severance

17.7.14. IEMA Guidelines set out a range of indicators for determining the significance of impact on pedestrian severance. Changes in traffic flow of 30%, are regarded as producing ‘slight’, 60% as ‘moderate’ and 90% as ‘substantial’ changes. These indicators, together with specific local conditions (such as the provision of crossing facilities and traffic signal settings), have been used to determine the significance of impact on severance.

17.7.15. Alternatively, DMRB LA 112 defines severance impacts on a fiver point magnitude scale: no change, negligible, minor, moderate and major and these are defined with examples within DMRB LA 112.

17.7.16. As IEMA guidance is based on percentage change rather than absolute values, this will be used as a primary assessment means for road links within the western urban fringe of Norwich. However, for rural roads surrounding the scheme which are likely to experience low base flows percentage changes can be misleading, hence impacts of the Scheme will be checked against DMRB criteria and professional judgement will be applied.

NMU Delay

17.7.17. There is no formal or published guidance for the assessment of NMU delay. However, the IEMA Guidelines recommend assessors use their professional judgement to determine the significance of effects. For the purpose of this assessment changes in traffic flows of 30%, 60% and 90% are considered to represent a low, medium and high magnitude impact on pedestrian delay. However, for rural links with low base flows professional judgment will be used based on the absolute changes in traffic flows. Locations where changes of traffic more than 1 vehicle per minute at peak times in one direction are expected to be noticeable, so would be scoped in for assessment.

NMU Amenity

17.7.18. The IEMA Guidelines suggest a screening threshold for judging the significance of changes in pedestrian amenity would be where the traffic flow is halved or doubled. In the absence of other criteria, this threshold will be used in this assessment.

Fear and Intimidation

17.7.19. Considerations key to assessing the impact on fear and intimation include: volume of traffic, percentage of HGVs and the proximity of pedestrians to traffic. In addition, the speed of traffic, the number of turning movements, the proximity of schools and the level of vulnerable groups would be considered.

Driver Delay & Stress

17.7.20. To determine the traffic and transport impact of the Scheme on driver delay, junctions on the local and strategic highway network surrounding the Scheme will be modelled using appropriate junction assessment software (Junctions 9 or priority junctions or LINSIG for signalised junctions). Delays in the with scheme scenario will be compared with the baseline (without scheme) scenario, and significant changes classified based on the difference or percentage change. The junctions within the scope of assessment for the TA are identified in Figure 2 of the TA scoping note at Appendix F.

17.7.21. The magnitude of impact on driver delay will be based on the percentage change in average driver delay per vehicle. The percentage thresholds for low, medium and high magnitude impact will be based on standard IEMA thresholds of 30%, 60% and 90%.

Accidents and Safety

17.7.22. An estimate can be made of potential changes to accident statistics relative to change in traffic flows. However, in the case of change to the character of traffic or the road and transport network professional judgement will be needed to assess the implications.

Hazardous Loads

17.7.23. If the number of hazardous load movements during construction is expected to be significant, a risk or catastrophe analysis will be required to illustrate the potential for an accident to happen and the likely effect of such an accident.

Receptor Sensitivity

17.7.24. The sensitivity of a receptors to traffic and transport impacts depends upon a combination of its value and susceptibility.

The sensitivity of different receptors to traffic and transport effects is defined in DMRB LA 112 from Negligible to Very High. Is **Significance of Effects**

17.7.25. As set out in Schedule 4 of the EIA Regulations, it is the effects, not the impacts, of a development which are to be reported in its environmental statement.

17.7.26. The significance of the traffic and transport effect is a product of the receptor's sensitivity and magnitude of impact. Significance of traffic and transport effects is assessed using the general methodology defined in DMRB LA 104.

17.7.27. Following the classification of an effect as detailed in DMRB LA 104, a clear statement is made as to whether the effect is 'significant' or 'not significant'. As a general rule, major and moderate effects are considered to be significant and minor and negligible effects are considered to be not significant. However, professional judgement is also applied where appropriate.

Residual Effects

17.7.28. The assessment would assume mitigation is in place, so there would be no need for a separate assessment of residual effects.

Cumulative Effects

17.7.29. The combined effects of the Scheme along with other major developments in close proximity to the Scheme will be assessed within the ES.

17.7.30. There are two non-residential development that will be considered as part of the ES. They are A47 dualling and the Food Enterprise Zone at Easton. These will be described in more detail at ES stage as part of the baseline in the updated NATS model and assumed to be in place by 2025 in the opening year of assessment. It is also expected that the timescales for construction would overlap with NWL. The TA and ES chapter will consider the combined effects on all travellers of the developments outlined above being under construction simultaneously with the Scheme.

LIMITATIONS AND ASSUMPTIONS

17.7.31. The following limitations and assumptions have been identified:

- As agreed with Norfolk County Council Highways via pre-application consultation, the ES chapter on Traffic and Transportation will contain a summary of construction phase and operational effects only derived from results presented in the Transport Assessment (TA).
- The assessment of effects for the Scheme will include the proposed mitigation as the Scheme is not expected to proceed without mitigation.
- A draft Construction Environmental Management Plan (CEMP) has been prepared and will support the planning application. The measures outlined in the draft CEMP are assumed to be implemented in full. The CEMP will be secured by planning condition and worked up in more detail in consultation with the Planning and Highway Authorities.

Secondary Effects

17.7.32. The following impacts will be informed by this assessment, however they will be not assessed directly within the Traffic and Transport chapter:

- Noise and Vibration;
- Air Quality; and
- Population and Human Health.

17.7.33. Traffic flow information from the transport models will be utilised in the environmental appraisal for air quality and noise. For the opening year and design year (15 years after opening) Do-Something and Do-Minimum flows will be provided for the 'with Scheme' and 'without Scheme' scenarios. The following data will be provided:

- Average link flow data:
  - 24-hour annual average daily traffic (AADT) data for air quality modelling
  - 18-hour annual average weekday traffic (AAWT) data for noise modelling
- Link Speed data – either average speeds or speed limits
- Percentage mix of HGV traffic (vehicles greater than 3.5 tonnes)

17.7.34. The Air and Noise assessment results derived from the above will also inform the Population and Human Health topic chapter within the ES.

18. CUMULATIVE EFFECTS

18.1. PROPOSED ASSESSMENT METHODOLOGY

18.1.1. The combined and cumulative assessment will follow DMRB Volume 11, Section 2, Part 5 (HA 205/08) guidance and consider the nature of the affected receptor and the impact concerned.

18.1.2. In accordance with DMRB HA 205/08, the assessment will cover the most likely significant combined and cumulative effects, rather than reporting every potential interaction. The criteria outlined in DMRB HA 205/08 Table 2.6, will be used alongside professional judgement to determine the significance of combined and cumulative effects. However, this guidance will be adapted based upon professional judgement and experience with regard to assessing cumulative impacts in order to make it relevant to each environmental factor in the ES.

CUMULATIVE EFFECTS

18.1.3. The assessment of cumulative effects will be undertaken in accordance with the requirements of the EIA Regulations 2017 and adopting the methodology outlined below.

Step 1 – Identification and evaluation of projects for consideration

18.1.4. In order to inform potential committed developments, a high-level review of planning applications and applications for Development Consent Orders (DCO) submitted to the Norfolk County Council in the last 6 years will be undertaken in order to identify potential projects that could give rise to in-combination interaction with the Scheme.

18.1.5. In addition, committed developments and development allocations as per the Broadlands District Council Local Plan will also be considered in the assessment.

18.1.6. In setting the study area for the cumulative effects assessment, consideration will be given to schemes that:

- Have a concurrent demolition, construction or operational phase with the Scheme;
- Are ‘in proximity’ to the Scheme; or
- Are considered likely to result in environmental effects which could act in synergy with effects arising from the Scheme.

18.1.7. Applicable projects for consideration of in-combination effects will be determined using the following criterion:

- Projects that are under construction;
- Permitted application(s) not yet implemented;
- Submitted application(s) not yet determined but have the potential to be determined prior to the determination of the Scheme; and
- All refusals subject to appeal procedures not yet determined.

Step 2 – Identification of common receptors

18.1.8. In the first instance, common receptors will be evaluated in terms of their broad receptor category in accordance with Regulation 4(2) of the EIA Regulations 2017. The specific receptors will then be identified and evaluated; ensuring that cumulative effects are duly considered at the receptor level and a more detailed level of assessment is only undertaken where there is a common receptor and likely significant effect.

Step 3 – Assessment of cumulative effects

18.1.9. Once the receptors for assessment have been defined, where possible, consideration will be given to their tolerance to the cumulative effects from the developments identified in Step 1 above.

18.1.10. In order for there to be a potential cumulative effect, there needs to be a potential effect from the Scheme in combination with the developments identified on the same receptor for a similar duration within the overall programme. There may be effects at the project level which require due consideration and management, but these effects will not be reconsidered as part of the cumulative effects assessment.

18.1.11. The qualitative evaluation at the receptor level will consider the following:

- Combined magnitude of impact;
- Sensitivity/ value/ importance of the receptor/ receiving environment to change; or/and
- Duration and reversibility of effect.

18.1.12. Through a combination of the qualitative evaluation and mitigation presented in the ES, conclusions will be drawn as the likelihood for significant cumulative environmental effects resulting from the Scheme in combination with other developments.

18.1.13. Each factor chapter of the ES will ensure consideration of the identified developments, once finalised through consultation with Norfolk County Council, to determine the potential significant cumulative effects.

18.2. COMBINED EFFECTS

18.2.1. The study area for the combined effects assessment will be set for each individual environmental factor in line with DMRB.

18.2.2. Each factor chapter will assess the categories of receptors and/or specific named receptors relevant to that factor's methodology. In some instances, the same receptor or resource may be assessed in more than one factor chapter. In these cases, there is the possibility that several individual effects on the same receptor may add up to create a significant cumulative effect. Thus, when considering the combined effects on a given receptor, several factor chapters will be reviewed.

18.2.3. The assessment of effect interactions will be approached from the perspective of changes in baseline conditions at specific sensitive receptors based on information in the factor chapters of the ES. A matrix of effect interactions will be formulated for the Scheme, corresponding to the construction and operational phases.

COMBINED EFFECTS DURING CONSTRUCTION

18.2.4. The construction of the Scheme could potentially have the following effects:

- Increased dust, noise and vibration;
- Visual intrusion;
- Adverse effects on surface water, groundwater and flood risk;
- Ground disturbance on built and buried heritage assets; and
- Impacts to ecological receptors.

18.2.5. Receptors most at risk from combined effects during Scheme construction are those in proximity to construction activities. The severity of effects would be dependent upon:

- The type of works being undertaken;
- The duration of the works;
- The distance between the works and their respective proximity to the receptor;
- The sensitivity of the receptor; and
- The visible presence of the works.

18.2.6. Temporary land-take required for ancillary works such as compounds, diversions or working space and material storage would also have the potential to cause environmental effects.

COMBINED EFFECTS DURING OPERATION

18.2.7. The operation of the Scheme could potentially have the following effects:

- Changes to noise and vibration;
- Adverse effects on surface water, groundwater and flood risk;
- Loss and severance of priority/protected habitats;
- Reduction in traffic congestion on the existing road network and provision of a more consistent traffic speed;
- Improved accessibility to services and opportunities leading to beneficial effects on the population and economy;
- Adverse effects on the setting and quality of the local landscape; and
- Reduction in visual amenity for residents, highway and PRoW users.

18.2.8. Receptors closest to the road are likely to be exposed to more combined effects; i.e. possibly experiencing a combination of reduced visual amenity, noise pollution and improved accessibility as a result of the same development.

18.2.9. The common sensitive receptors will be identified and will be outlined alongside their residual effect per environmental factor. This will enable a qualitative assessment of the overall significance of the cumulative effects on the common sensitive receptors identified using professional judgement and the technical information provided in the ES and supporting appendices.

18.2.10. The combined effects will be presented in a spreadsheet of impacts for each receptor which has more than one impact.

18.2.11. The common sensitive receptors will be identified and will be outlined alongside their residual effect per environmental factor. This will enable a qualitative assessment of the overall significance of the cumulative effects on the common sensitive receptors identified using professional judgement and the technical information provided in the ES and supporting appendices.

18.2.12. The combined effects will be presented in a spreadsheet of impacts for each receptor which has more than one impact.

18.3. LIMITATIONS AND ASSUMPTIONS

18.3.1. The assessment of effect interactions resulting from the Scheme will be focused on the residual effects from the construction and operational phases following the implementation of mitigation measures. It will be assumed that identified mitigation measures would be incorporated or adopted to mitigate any negative effects resulting from the Scheme.

18.3.2. The assessment of cumulative effects with other developments will be based on the interpretation and assessment of data provided by third parties.

18.4. IN-COMBINATION CLIMATE CHANGE IMPACTS ASSESSMENT

18.4.1. An in-combination climate change impact (ICCI) assessment will be undertaken at the ES stage. The ICCI assessment will consider the extent to which climate change exacerbates effects on aspect receptors which have been identified in the other discipline chapters.

18.4.2. As such, individual factor chapters will undertake an ICCI assessment with consideration for climate change within:

- Future baseline: The future climate baseline presented in [refer to Chapter 14- climate future baseline] will be considered by all environmental factor chapters in relation to their respective future baselines.
- Assessment: All factor chapters will consider the extent to which climate change exacerbates effects on aspect receptors which have already been identified within their assessments. This will be presented within individual factor chapters.

19. SUMMARY

19.1. SCOPE OF THE EIA

19.1.1. It is proposed that the following environmental factors, as listed under Article 3(1) of EU Directive 2014/52/EU, are included in the scope of the EIA:

- Population and Human Health;
- Biodiversity;
- Land, soil, water, air and climate; and
- Material assets, cultural heritage and the landscape

19.1.2. The factor-specific elements scoped in and out of further assessment are outlined in chapters 5 to 18 above and is summarised in chapter 4.

19.2. PROPOSED STRUCTURE OF THE ES

19.2.1. The proposed structure of the ES is set out in Appendix G.

Appendix A

PROJECT LOCATION PLAN

Date Modified: 26/05/2020

Drawn By: UKECF002

File: \\uk.wspgroup.com\Central Data\Projects\700419xx\70041922 - Norwich Western Link\02 WIP\TP Transport planning\02 Drawing\GIS\EIA Scoping Report\Location_Plan_v4.mxd

Key

- Proposed Scheme
- Site Extents Boundary

0 0.5 1 2 3 4 Kilometres

wsp

PROJECT:

NORWICH WESTERN LINK

FIGURE:

LOCATION PLAN

Appendix B-1

SCHEME CONSTRAINTS PLAN