A1 Northumberland
Alnwick to Ellingham

Preliminary Environmental Information Report

February 2019

CONTENTS

TABLES

FIGURES

APPENDICES

APPENDIX A

FIGURES

APPENDIX B

SCHEDULE OF CHANGES TO SCHEME FOOTPRINT

APPENDIX C

MAJOR ACCIDENTS AND HAZARDS

APPENDIX D

TRANSBOUNDARY EFFECTS

APPENDIX E

SUMMARY OF BASELINE NOISE SURVEY WEATHER CONDITIONS

APPENDIX F

SUMMARY OF BASELINE NOISE MEASUREMENT DATA

APPENDIX G

LANDSCAPE CHARACTER

APPENDIX H

LANDSCAPE AND VISUAL AMENITY SENSITIVE RECEPTORS

APPENDIX I

FULL GAZETTEER OF HERITAGE ASSETS

1 INTRODUCTION

1.1.1. The A1 in Northumberland: Alnwick to Ellingham (the "Scheme") includes widening of a single carriageway to a dual carriageway along approximately an 8 km section of the existing A1 between Alnwick and Ellingham, in Northumberland. The Scheme also includes improving the existing junction at Charlton Mires and a new accommodation bridge at the southern end of the Scheme. The Scheme aims to increase capacity, improve safety and improve journey times. **Chapter 2** of this Preliminary Environmental Information report (PEIR) provides further details of the Scheme.

1.1.2. The PEIR sets out the preliminary results of the environmental assessment for the Scheme and it is presented as a Non-Technical Summary and two volumes: The Non-Technical Summary is a standalone document, the PEIR itself is contained within:

- **Volume 1**: The main text of the PEIR;
- **Volume 2 (Appendix A)**: The Scoping Report which sets out the proposed scope of, and approach to, the Environmental Impact Assessment (EIA)[1], and sets out the proposed structure of the Environmental Statement (ES)[2]; and
- **Volume 2 (Appendix B):** The Scoping Opinion which presents feedback from relevant parties on the Scoping Report.

1.2 PLANNING CONTEXT

1.2.1. The Scheme is defined as a Nationally Significant Infrastructure Project (NSIP) under Section 14(1)(h) and section 22(1)(b) of the Planning Act 2008 (2008 Act) because:

- It comprises the alteration of a highway;
- The highway to be altered is wholly in England;
- Highways England Company Ltd is the strategic highway authority for the highway; and
- The speed limit is 50 mph or greater and the area of development of the highway is greater than 12.5 hectares at currently approximately 31.3 hectares.

1.2.2. In accordance with the legislation, a Development Consent Order (DCO) is required for the construction and operation of the Scheme.

1.3 ENVIRONMENTAL IMPACT ASSESSMENT

1.3.1. The determination of whether a scheme requires EIA under the EIA Directive 2014/52/EU (**Ref. 1.3.1**) and the subsequent notification requirements in accordance with the Infrastructure Planning (Environmental Impact Assessment (EIA) Regulations 2017 (EIA Regulations) (**Ref 1.4.3)** is known

[1] Environmental Impact Assessment is the assessment of potential effects of a scheme on the environment and the identification of measures to reduce the severity of these effects.
[2] An Environmental Statement presents the outcomes of the Environmental Impact Assessment.

as ‘Screening’. An EIA Screening exercise (**Ref. 1.3.2**) was completed for the Scheme at the Preliminary Design stage.

1.3.2. The EIA Screening determined that the Scheme does not fall within the criteria listed in “Schedule 1” of the EIA Regulations which are: Schedule 1 Part 7(2):

‘construction of motorways and expressed roads’ and Schedule 1 Part 7(3) ‘construction of a new road of four or more lanes, or realignment and/or widening of an existing road of two lanes or less so as to provide four or more lanes, where such new road, or realigned and/or widened section of road would be 10 kilometres or more in a continuous length road’.

1.3.3. However, the Scheme does fall under Schedule 2, Part 10f (construction of roads) of the EIA Regulations. Due to the close proximity and potential direct impacts on ‘sites of historical, cultural or archaeological significance’ as set out in Regulation 9(1), the Scheme is considered to be ‘EIA development’ and will require an EIA.

1.3.4. EIA is a process of evaluating the likely significant environmental impacts of a scheme, taking into account environmental and health impacts, both beneficial and adverse. EIAs for NSIPs are reported in the following stages:

- A Scoping Report is produced to consult relevant statutory bodies on the scope of, and approach to, the EIA and ES.
- A PEIR is prepared to inform statutory consultation, the public and consultees about the Scheme.
- Following statutory consultation with the public and consultees, an ES is prepared to accompany the application for a DCO.

1.3.5. This PEIR, in combination with the Scoping Report and the Scoping Opinion, is the first stage of reporting on the likely environmental impacts of the Scheme.

1.3.6. The Scoping Report was submitted to the Planning Inspectorate (the Inspectorate) on 7 November 2018 with a request for a statutory Scoping Opinion. The Scoping Opinion was received on 18 December 2018 and has been taken into account when preparing this PEIR. The Scoping Opinion presents feedback on the Scoping Report from the Inspectorate and any other stakeholders they have consulted with. This feedback will be used to inform the ES. The A1 in Northumberland – Alnwick to Ellingham Scoping Opinion is available in **Volume 2** (**Appendix B**) of this PEIR or via the following link: https://infrastructure.planninginspectorate.gov.uk/projects/north-east/a1-in-northumberland-alnwick-to-ellingham/?ipcsection=docs.

1.4 PURPOSE OF THIS REPORT

1.4.1. The PEIR has been produced in accordance with the EIA Regulations. The aim of this PEIR is to provide the public, stakeholders and consultees with a sufficient understanding of the design and potential environmental effects associated with the Scheme, so that they can provide informed responses as part of the statutory consultation. A Non-Technical Summary of this PEIR has also been produced.

1.4.2. This PEIR presents the most up-to-date environmental assessment. Further information about the detailed proposals and assessment criteria to be used in the EIA process can be found in the Scoping Report (**Volume 2, Appendix A** of this PEIR). This PEIR provides the preliminary

environmental information available for the Scheme, along with the descriptions of the likely environmental effects and envisaged measures to mitigate these effects.

1.4.3. Preliminary environmental information is defined in Regulation 12(2) of the EIA Regulations as information that is 'reasonably required for the consultation bodies to develop an informed view of the likely significant environmental effects of the development (and of any associated development)'. The PEIR is based on the design information available at the time of writing, along with the Scoping Report and Scoping Opinion, unless otherwise stated in each environmental topic section. Refer to the **Volume 2** for full details of the information, data and previous assessment work that this PEIR is based upon. Furthermore, the Scoping Report, alongside the Inspectorate Scoping Opinion, sets out the detailed scope of assessment for each environmental topic including elements that will not be assessed through the EIA process.

1.4.4. Further EIA work is currently being undertaken to confirm the potential significant effects as a result of the Scheme. The final EIA work will be reported within the ES, which will accompany the DCO application currently proposed to be submitted to the Inspectorate in autumn 2019.

1.4.5. Since the submission of the Scoping Report, in addition to ongoing design development, the following progression relevant to each environmental topic has been made:

- A number of site surveys have been undertaken including: a more detailed Cultural Heritage walkover; programme of ecology surveys and a landscape and visual impact site visit to establish viewpoint and summer baseline;
- The traffic data has been screened by the air quality and noise specialists, and the study area for these assessments identified.
- The Environment Agency have been consulted regarding our approach to the water assessment which will be undertaken as part of the EIA.
- The proposed changes to the Public Rights of Way (PRoW) have been further developed, as reported in **Table 2-1**.

1.5 DOCUMENT STRUCTURE

1.5.1. This PEIR is structured in several chapters similar to that presented in the Scoping Report and which will be considered in the ES. This structure is in accordance with Regulations 12 and 14, and Schedule 4, of the EIA Regulations, which sets out the information to be included in the PEIR. The content and structure of this PEIR is as follows:

- **Chapter 1**: Introduction;
- **Chapter 2**: The Scheme;
- **Chapter 3**: Assessment of Alternatives;
- **Chapter 4**: Environmental Assessment Methodology;
- **Chapter 5**: Assessments;
- **Chapter 6**: Assessment of Cumulative Effects; and
- **Chapter 7**: Summary.

1.5.2. References are presented at the end of this PEIR, and a glossary of acronyms is presented at the front of the report. Figures are presented in **Appendix A** and **Appendix B** contains a schedule of changes to the Scheme Footprint since the submission of the Scoping Report (refer to **Chapter 2 – The Scheme** for further details of this).

1.6 THE EIA TEAM

1.6.1. The EIA Regulations require that the ES is prepared by 'competent experts'. On behalf of Highways England, the EIA is being undertaken by WSP.

1.6.2. WSP has been awarded the Institute of Environmental Management and Assessment (IEMA) EIA Quality Mark scheme, which demonstrates competency in undertaking EIAs and ES preparation.

1.6.3. On an individual assessment level, the EIA is being undertaken by competent experts whom have the appropriate qualifications and experience. Full details of competent experts will be included in the ES.

1.7 SCHEME PROGRAMME AND NEXT STEPS

1.7.1. The programme for the Scheme currently comprises the key project milestones indicated in **Figure 1-1** below.

Figure 1-1 - Scheme and DCO programme

1.7.2. Before an application for a DCO is submitted to the Inspectorate, the local community and other stakeholders must be formally consulted on the Scheme. This PEIR will be used to inform this consultation. The responses to the consultation will inform the continuing design and development of the Scheme, and any comments received will be taken into consideration in the EIA.

1.7.3. If the DCO application for the Scheme is accepted by the Inspectorate, it will then be taken forward for examination, which is a process in which members of the public and interested parties can also participate. The examination period can last up to six months.

1.7.4. After the examination period, the Inspectorate has three months to make a recommendation to the Secretary of State for Transport, who then has a further three months to make a decision on whether or not to approve the Scheme.

1.7.5. If the application is approved, works would start on the Scheme in 2021 with the Scheme anticipated to be open to traffic in 2023.

2 THE SCHEME

2.1 THE NEED FOR THE SCHEME

2.1.1. The A1 is one of the longest roads in the country, connecting London to Newcastle and Edinburgh. The route currently consists of motorway standard and dual carriageway standard, with some single carriageway sections including two sections running between Morpeth and Ellingham and north of Ellingham towards Berwick.

2.1.2. Over the last decade there have been significant upgrades to the A1 south of Newcastle, with many sections upgraded to motorway standard; and there are further plans to improve sections of the A1 around Newcastle and Gateshead.

2.1.3. There have been long standing calls to Government from key stakeholders and businesses to progress plans to completely dual the A1 in Northumberland. A 2014 Feasibility Study (**Ref. 2.1.1**) considered the problems experienced by users of the A1 in Northumberland. The following problems were identified:

- Drivers face a lack of alternative routes for their journeys;
- Varying carriageway standards on the route. This can lead to confusion for long distance drivers;
- Poor junction standards and layout - there are many different types of junctions along the route which can be confusing for those who are not familiar with the route;
- Many junctions and direct private accesses on to the A1, resulting in delays and potential accidents when vehicles exit or enter the main carriageway;
- Average traffic speeds on the single carriageway sections of the route are significantly lower than sections that have been upgraded to dual carriageway;
- A high proportion of heavy goods and agricultural vehicles north of Alnwick resulting in reduced speeds for following vehicles;
- Lack of overtaking opportunities on single carriageway sections of the route which slows down traffic; and
- Peak-hour traffic speeds are significantly slower than when traffic is free flowing.

2.1.4. The Scheme is designed to address these issues and improve the safety and speed of journeys along the route.

2.1.5. The Feasibility Study (**Ref. 2.1.1**) also considered the full route of the A1 in Northumberland between its junction with the A19 at Seaton Burn and the Scottish border. The study included engineering and economic aspects and the identification of environmental constraints. The feasibility study was used to identify solutions for potential improvement schemes along England's strategic road network. The outcome of this feasibility study informed the governments 'Road Investment Strategy' (RIS) which comprises a multi-year investment plan used to fund schemes along the strategic road network.

2.2 OBJECTIVES OF THE SCHEME

2.2.1. The objectives of the Scheme are to:

- Improve journey times on this route of strategic national importance;
- Improve network resilience and journey time reliability;

- Improve safety;
- Maintain access for local traffic whilst improving the conditions for strategic traffic;
- Facilitate future economic growth;
- Avoid, mitigate and compensate for potential impacts upon the built and natural environment;
- To seek to support the aim of no net loss of biodiversity;
- To ensure the effective measures are in place to protect watercourses from pollutant spillage on the highway; and
- To investigate and encourage the use of environmentally friendly operations and products throughout the Scheme life cycle.

2.2.2. In addition, decisions on the Scheme will be made in the context of the Performance Specification set out for Highways England in the RIS which identifies Key Performance Indicators, targets and requirements relating to the environment and to cyclists, walkers and other vulnerable users of the network (e.g. the elderly). These include, for example, delivering better environmental outcomes, road safety improvements (safer junctions and crossings) and improved provisions for cyclists, walkers and other vulnerable users.

2.3 DESCRIPTION OF THE SCHEME

SCHEME LOCATION

2.3.1. The Scheme is located within the county of Northumberland and forms part of Highways England's strategic road network. The Scheme is located along the A1 between Denwick and North Charlton and is approximately 8 km in length (see **Appendix A - Figure A1: Scheme Location Plan**).

SCHEME FOOTPRINT

2.3.2. The Scheme Footprint, as defined by the Scheme boundary in **Figure A1: Scheme Location Plan** in **Appendix A**, comprises all land (both temporary and permanent) required to construct and operate the Scheme. The Scheme Footprint has been developed to allow for some flexibility in the design process as the design of the Scheme is progressed, therefore the Scheme Footprint may be reduced further. The EIA will consider a worst-case Scheme Footprint to ensure adequate mitigation can be implemented during construction and operation of the Scheme.

2.3.3. Since submission of the Scoping Report to the Inspectorate, changes to the Scheme Footprint have been made. A summary of the changes is presented as follows, alongside a full schedule in **Appendix B** of this PEIR:

- Exclusion of areas where no temporary or permanent requirements for land would be generated, i.e. where the design has been refined and confirmed.

2.3.4. Since the completion of the Scoping Report, the location of the Charlton Mires junction has now been confirmed and the Scheme boundary amended to reduce land take to the west of the existing junction. Further details of these amendments are set out in **Appendix B**.

THE SCHEME

2.3.5. Throughout the length of the Scheme, the existing A1 would form the new northbound carriageway and a new southbound carriageway would be built to the east of the existing A1. The mainline width of each carriageway is 9.3 m. The road design standard would be a two-lane dual carriageway to

rural standards, known as D2AP. The national speed limit would apply along the Scheme, which would be 70 mph for cars, motorcycles, car-derived vans and dual-purpose vehicles as well as motorhome and motor caravans less than 3.05 tonnes. A 60 mph limit would apply for motorhomes and motor caravans above 3.05 tonnes as well as vehicles towing caravans or trailers. A 60 mph speed limit for buses, coaches, mini buses, and goods vehicles less than 7.5 tonnes and a 50 mph speed limit for goods vehicle over 7.5 tonnes would also apply along the Scheme.

2.3.6. Construction is planned to commence in 2021, with the Scheme being open to traffic in 2023. It is anticipated that the construction period would last approximately 18 months. The majority of the works would be undertaken during the day; however, it is anticipated that some night-time, evening and weekend work may be required.

2.3.7. A detailed description of the Scheme is provided in the following paragraphs and shown on **Figure A2 – General Arrangement** in **Appendix A**. Two locations are being considered for an accommodation bridge across the A1. Both options are described below but only one option will be taken forward and included in the final scheme design.

CHARLTON MIRES JUNCTION

2.3.8. The existing at-grade junction at Charlton Mires and Rock Lodge would be replaced with a compact grade separated junction located at Charlton Mires, called Charlton Mires Junction. This would be in the form of a bridge above the A1 which would separate the local traffic from long-distance traffic. The junction would remove the need for direct access from B6341 and B6347 on to the A1, improving safety for end-users. Charlton Mires junction would also separate the local traffic using the B6347 and B6341 from the strategic traffic using the A1.

2.3.9. A roundabout would be provided where there is a sharp existing north-west bend in the B6347, to the north of Rock Lodge. The roundabout would provide safe access to the B6437 west and B6341, northbound carriageway of the A1 and southbound carriageway of the A1 and B6347 east via the new grade-separated junction.

2.3.10. Charlton Mires Junction would include a footway to facilitate safe, pedestrian access. The footway would link the diverted Footpath 129/004, to the east of the Scheme, extend across the A1 and along the improved B6341, to the west of the Scheme, to approximately Rock Lodge.

2.3.11. The dimensions of the bridge would be no greater than a span of 50 m, the width 13 m, the parapet height by no more than 9.5 m above the new road surface.

ACCOMMODATION BRIDGE

2.3.12. There are a number of crossing points along this stretch of the A1 that are currently used for people using PRoWs and / or agricultural vehicles. These would need to be closed as part of the Scheme, for safety reasons. Charlton Mires Junction would replace a number of the crossing points at the north end of the Scheme and a single accommodation bridge at the southern end of the Scheme would replace the remainder. These type of crossings, to maintain existing crossing points, following the construction of a new road are referred to as accommodation crossings.

2.3.13. This Scheme would include a single bridge over the new dual carriageway that would accommodate the crossings at the southern end of the Scheme. This would be located at either Broxfield (option 1) or Heckley Fence (option 2) and would be designated as a Bridleway. At Heckley Fence there is a

crossing currently used by a tenant farmer who lives to the east and works fields to the west of the A1 and at Broxfield there is an existing Byway Open to All Traffic (BOAT)[3].

2.3.14. The accommodation bridge would be constructed in one location only; the design and structure will be similar in each location.

Broxfield option (option 1)

2.3.15. An accommodation bridge for vehicular and WCHs would be provided across the A1 to the west of Broxfield, called the Broxfield bridge. This option would retain existing location of the link between Byway 129/022 and Byway 110/013.

2.3.16. The dimensions of this bridge would be no greater than a span of 40 m, the width 9.5 m, the parapet height by no more than 9.5 m above the new road surface.

Heckley Fence option (option 2)

2.3.17. An accommodation bridge for vehicular and Walking, Cycling and Horse-riding (WCH) would be provided across the A1 to the east of Heckley Fence, called the Heckley Fence option. The existing access track to the west and east of the A1, near Heckley Fence, would be designated as a Bridleway. This option would extinguish Byway 129/022 and Byway 110/013, and maintain the existing crossing for agricultural vehicles.

2.3.18. The dimensions of this bridge would be no greater than a span of 40 m, the width 9.5 m, the parapet height by no more than 9.5 m above the new road surface.

PRIVATE MEANS OF ACCESS

2.3.19. Private Means of Access (PMA) would be provided for properties where existing access to the A1 would be stopped up. The existing direct access between Rock South Farm and the A1 would be stopped up and Footpath 129/005 upgraded to an access road to service these properties. The direct access between Heckley Fence and the A1 would also be stopped up, meaning residents would have to travel north and access the A1 from the Charlton Mires Junction.

2.3.20. Two access tracks would be located to the north of Charlton Mires Junction and run parallel to the upgraded A1 on either side of the route. West Linkhall Access Track would service West Linkhall and Paterson Cottage. East Linkhall Access Track would service East Linkhall and West Lodge.

RESIDENTIAL PROPERTIES

2.3.21. It is anticipated at this stage of the Scheme that two residential dwellings would need to be demolished to accommodate the proposed Charlton Mires Junction. These properties include East Cottage and Charlton Mires Farm, which are located to the east of the existing junction between the A1 and B6347 at Charlton Mires.

[3] A byway open to all traffic is a way where there is a right for vehicular and all other traffic, but the way is used mainly for the purposes for which footpaths and bridleways are used.

DRAINAGE AND CULVERTS

2.3.22. The existing drainage system along the A1 would not be re-used, other than potentially the outfalls. This is due to its capacity being insufficient and the assets being in poor condition. The Scheme would be divided into drainage catchments, primarily on a topographic basis (i.e. draining from high points to low points) and asset ownership. The drainage system for each catchment would feed an outfall into a watercourse. At each outfall location, a dry detention basin would be provided to ensure that the rate of flow would be attenuated to greenfield rates. The capacity of each basin would be calculated to include an appropriate allowance for climate change. It is anticipated at this stage of the Scheme that six detention basins would be required and six new outfalls at different locations to the existing outfalls.

2.3.23. Filter drains would be installed along the length of the Scheme with some urban gully drainage installed around the junctions. At this stage of the Scheme, the drainage design would treat water quality through sedimentation in the dry detention basins and filter drains. If necessary, the basins could be increased in size and swales / reed beds incorporated to achieve sufficient sediment removal. Such features are most likely to be required where large catchments are required to discharge into small watercourses, so that there is little dilution.

2.3.24. Current estimates suggest that the Scheme would require fifteen additional or modified culverts.

TRAFFIC COMMUNICATION

2.3.25. An initial review of existing technology between Alnwick and Ellingham has been undertaken at preliminary design and it has been identified that there is minimal traffic communication technology across the Scheme extents, with only two traffic monitoring units (TMUs) currently being identified.

2.3.26. The current recommendation is for these to be replaced with TMUs of current standards. However, this is subject to further consultation with Highways England's Operation Directorate and National Traffic Control Centre (NTCC) and it may be that the two existing TMUs need to be decommissioned and no replacement required.

UTILITY DIVERSIONS

2.3.27. Utilities would need to be diverted as part of the Scheme including Northumbrian Water mains, gas diversions, electric diversions, water diversions, BT telecoms, Virgin telecoms and Vodafone telecoms. Extra high voltage (EHV) cables that originate at Middlemoor Wind Farm would also have to be diverted as part of the Scheme (see **Section 3.1** for more detail).

2.3.28. The existing telecommunication mast to the north of Black Plantation would not need to be relocated as part of the Scheme.

LIGHTING

2.3.29. At this stage it is considered that road lighting would not be required due to the economic and safety case not being sufficient. Further consideration will be given as to whether Charlton Mires Junction would be lit. It should be noted that this stretch of road is not currently lit.

WALKERS, CYCLISTS AND HORSE RIDERS (FORMALLY NON-MOTORISED USERS)

2.3.30. A network of PRoW surrounds and traverse the Scheme. The PRoW network provides access between residential properties and recreational routes, in particular within Rennington, Rock and

South Charlton. There are no National Trails or National Cycle Routes within 500 m of the Scheme Footprint.

2.3.31. **Figure A2 – General Arrangement (Appendix A)** and **Table 2-1** provides detail of the permanent PRoW diversions during the operation of the Scheme. The table lists the PRoW from the south of the Scheme to the north of the Scheme.

Table 2-1 - Permanent PRoW Diversions

PRoW	Permanent Diversion during Operation	
	Broxfield	Heckley Fence
Footpath 110/004	The connection to Footpath 129/014 would be severed by the Scheme. Footpath 110/004 would be diverted north to Byway 110/013, across Broxfield bridge and along Byway 129/022. The total length of the diversion would be 1.35 km, compared to a previous length of 0.8 km along the existing PRoW network.	The footpath would be severed at the access track south-west from where it intersects the existing A1 route. The section of Footpath 110/004 between this point and Footpath 129/014 would be extinguished. Footpath 110/004 would be diverted along the access track northwards to the Heckley Fence bridge, at which point it would cross the A1 via a proposed PRoW constructed to bridleway standard. The diverted route would then meet Footpath 129/005 and continue south until it meets Footpath 129/023. The total length of the diversion is 4.6 km, compared to a previous length of 1.8 km along the existing PRoW network.
Footpath 129/014	Footpath 129/014 (0.8 km) would be closed during operation of the Scheme, as the connection to Footpath 110/004 would be severed thus making it redundant. Footpath users would be diverted along Byway 129/022, across Broxfield bridge and along the diverted length of Footpath 110/014. The total length of the diversion would be 1.35 km, compared to a previous length of 0.8 km along the existing PRoW network.	Footpath 129/014 is to be extinguished. PRoW diversion as per Footpath 110/004.
Byway 110/013	The byway would remain along its existing route during operation of the Scheme. The connection between Byway 110/013 and Byway 129/022 would be reinstated via Broxfield bridge.	Byway 110/013 would be severed and diverted north to the Heckley Fence bridge, at which point it would cross the A1 via a proposed PRoW constructed to bridleway standard. The diverted route would then meet Footpath 129/005 and continue south until it meets Footpath 129/023. The total length of the diversion is 3.6 km, compared to a previous length of 1.0 km along the existing PRoW network. The severed section of Footpath 110/013 would be extinguished.

PRoW	Permanent Diversion during Operation	
	Broxfield	Heckley Fence
Byway 129/022	The byway would remain along its existing route during operation of the Scheme. The connection between Byway 110/013 and Byway 129/022 would be reinstated via Broxfield bridge.	Byway 129/022 is to be extinguished. PRoW diversion as per Footpath 110/013.
Footpath 110/019	The connection to Footpath 110/003 would be severed by the proposed Scheme. Footpath 110/019 would be diverted south, running parallel to the A1 before joining PRoW 110/013 where users would cross Broxfield bridge and travel along Footpaths 129/022 and 129/005 to Rock South Farm. The total length of the diversion is 5.6 km, compared to a previous length of 1.0 km along the existing PRoW network.	The connection to Footpath 110/003 would be severed by the Scheme. Footpath 110/019 would be diverted south, running parallel to the A1 before reaching the Heckley Fence bridge where users would cross over and travel along Footpath 129/005 northwards to Rock South Farm. The total length of the diversion is 3.9 km, compared to a previous length of 1.0 km along the existing PRoW network.
Footpath 110/003 / Footpath 129/009	Footpaths 110/003 and 129/009 (1.0 km) would be extinguished during operation of the Scheme, as the connection to Footpath 110/019 would be severed thus making them redundant. Footpath 110/019 would be diverted south, running parallel to the A1 before joining PRoW 110/113 where users would cross Broxfield bridge and travel along Footpaths 129/022 and 129/005 to Rock South Farm. The total length of the diversion is 5.6 km, compared to a previous length of 1.0 km along the existing PRoW network.	Footpaths 110/003 and 129/009 (1.0 km) would be extinguished during operation of the Scheme, as the connection to Footpath 110/019 would be severed thus making them redundant. Footpath 110/019 is to be diverted south, running parallel to the A1 before reaching Heckley Fence bridge where users would cross over and travel along Footpath 129/005 northwards to Rock South Farm. The total length of the diversion is 3.9 km, compared to a previous length of 1.0 km along the existing PRoW network.
Footpath 110/010 / Footpath 129/021	Footpath 110/010 would be diverted south, running parallel to the A1 before joining PRoW 110/113 where users would cross Broxfield bridge and travel along Footpaths 129/022 and 129/005 to Rock South Farm. The total length of the diversion is 5.6 km, compared to a previous length of 1.0 km along the existing PRoW network.	Footpath 110/010 is to be diverted south, running parallel to the A1 before reaching the Heckley Fence bridge where users would cross over and travel along Footpath 129/005 northwards to Rock South Farm. The total length of the diversion is 4.6 km, compared to a previous length of 1.0 km along the existing PRoW network.
Footpath 129/024	Footpath 129/024 (0.15 km) would be extinguished during operation of the Scheme, as the connection to Footpath 129/004 would be severed thus making it redundant. Footpath users would be diverted north along the B6341 and would cross over the A1 at Charlton Mires Junction using footways provided along the road's edge. The footpath users would then cross the B6347 and continue south along diverted Footpath 129/004 that would run parallel to the A1. The total length of the diversion would be 1.7 km, compared to a previous length of 0.15 km along the existing PRoW network.	

PRoW	Permanent Diversion during Operation	
	Broxfield	Heckley Fence
Footpath 129/004	The connection to Footpath 129/024 would be severed by the proposed Scheme. Footpath users would be diverted north via a PRoW diversion that runs parallel to the A1 and ends at the B6347, before they cross over the A1 at Charlton Mires Junction and continue south along the B6341 using footways provided along the road's edge. The total length of the diversion would be 1.7 km, compared to a previous length of 0.15 km along the existing PRoW network.	
Footpath 129/005	Footpath 129/005 would be upgraded to an accommodation road for Rock South Farm, which is to still be utilised as a PRoW. A shared surface is proposed for PRoW users and vehicles accessing Rock South Farm.	

2.3.32. A Walking, Cycling and Horse-riding Assessment Report has been prepared for the Scheme. The report includes a number of opportunities for WCH facilities that have been considered as part of the Scheme design. This may include strategic opportunities discussed with local bus service operators to complement the existing bus route provided along the A1. Pedestrian and equestrian opportunities incorporated into the design of the Scheme also include improving connectivity and ensuring access for equestrians is retained on all bridges through the inclusion of parapet fencing into bridge designs to accommodate safe equestrian movements.

BUS STOPS AND PARKING LAY-BYS

2.3.33. Three existing bus stops are proposed to be extinguished for the Scheme, including one official bus stop (with the relevant road markings and infrastructure) and two informal bus stops. The official bus stop (ID: nldatpag) is located southbound on the A1 near the existing junction at Charlton Mires. The informal bus stop (ID: nldgpmgw) is located northbound on the A1, north of the B6347 near Charlton Mires, whilst the other unidentified informal bus stop is located on the B6341 west of the A1. This unidentified bus stop would be replaced by two new bus stops along the realigned B6341 to the west of the A1. One of these new bus stops would be located along the southbound carriageway and the other along the northbound carriageway. No new bus stops are proposed along the route of the A1. A total of six parking lay-bys are proposed along the route of the improved A1, with three of the parking lay-bys being located along the southbound carriageway and three along the northbound carriageway. The location of the proposed bus stops and parking lay-bys are shown on **Figure A2 – General Arrangement** in **Appendix A**.

TRAFFIC MANAGEMENT ROUTES

2.3.34. Road closures along the A1 would be required for traffic management installation (especially removal of road markings and application of temporary markings), bridge beam installation, surfacing at tie-ins and other key tasks. In addition, closures of side roads would be required for the purposes of bridge and junction construction.

2.3.35. At the time of writing, seven potential diversion routes were being considered for the construction period. These potential diversion routes are located along the A1, B6341 and B6347, and range in length from 4.5 miles to 52.2 miles. The majority of the diversions routes would be implemented on weekends (nights and days) and during the night on weekdays. However, it should be noted

extended closures (beyond nights and weekends) could potentially be required for the construction of the bridges. The main communities that would be affected by the diversion routes include Rennington, Preston, Bellshill, Chatton and Wooler.

TEMPORARY COMPOUNDS

2.3.36. Three locations for temporary site compounds have been identified, with a maximum of two being used for the construction of the Scheme. The Main Compound would be located to the west of Thirston New Houses (see **Figure A2 – General Arrangement in Appendix A**) and shared with the A1 in Northumberland: Morpeth to Felton scheme. A site compound has also been proposed to the south of Alnwick (see **Figure A2 – General Arrangement in Appendix A**) adjacent to the salting and gritting depot at Lionheart Enterprise Park. This salting and gritting depot was designed to service the A1 in Northumberland. If either of these site compounds are deemed unsuitable and / or if the Lionheart Enterprise Park Compound is not available at the time of construction, a field to the south-east of Charlton Mires would be used as a temporary construction site compound. This potential site compound is called Charlton Mires Site Compound and is located within the Scheme Footprint to the east of the existing A1, in an existing field to the south of Charlton Mires.

2.3.37. It should be noted that if the A1 in Northumberland: Morpeth to Felton scheme is not consented, the Lionheart Enterprise Park Compound and / or the Charlton Mires Site Compound would be used in place of the proposed Main Compound.

2.3.38. If the Lionheart Enterprise Park Compound and Main Compound are utilised, it is anticipated that welfare facilities, site office and construction plant, materials and waste would be stored at the Lionheart Enterprise Park Compound and the majority of site supervision staff located within the Main Compound. The main vehicular journeys between the Lionheart Enterprise Park and the Site are likely to be to transport staff (including the workforce, contractor staff and client staff), traffic management, contractor attendances (fuel bowser, road sweeper etc.) as well as other vehicle movements (including wagons and wheeled plant). It is anticipated that vehicle movements between the Main Compound and Site would be to transport staff (including the workforce, contractor staff and client staff), traffic management, contractor attendances (fuel bowser and welfare maintenance crew), contractor deliveries (including materials and plant) as well as road wagons.

2.4 OVERVIEW OF BASELINE CONDITIONS

2.4.1. The A1 runs through an extensive rural landscape, close to the coastline. The section of the A1 within the Scheme Footprint is used by a wide variety of road users for many different reasons. These include business users travelling long distance between Newcastle and Edinburgh, local traffic accessing rural areas where there is no public transport, and tourists who come to visit the many historic attractions and coastline.

2.4.2. **Figure A3: Environmental Constraints Plan** in **Appendix A** sets out the environmental constraints within the Scheme Footprint and a 1 km buffer of the Scheme. The area surrounding the Scheme is characterised by predominantly rural land uses, with the existing A1 running adjacent to arable and pasture fields (Grade 3 Agricultural Land) and near woodlands. The existing A1 is a large linear feature which dissects the gently rolling landscape. To the east, the landform gradually rises to approximately 100 m Above Ordnance Datum (AOD) near Rennington Moor. To the west, the land is slightly hillier with more undulations and a high point of approximately 140 m AOD near White

House Folly. A number of natural resources and areas classified or protected under legislation and policy are located within the corridor and surrounding area as detailed below. The below text is split into three sections of the Scheme, including the Main Scheme Area (the area within the Scheme Footprint between Alnwick and Brownieside), Lionheart Enterprise Park Compound and the Main Compound, located west of Thirston New Houses.

MAIN SCHEME AREA (INCLUDING CHARLTON MIRES SITE COMPOUND)

2.4.3. The largest town within 5 km of the Main Scheme Area is Alnwick, which is located south-west of the most southern extent of the Scheme. Smaller hamlets and villages such as Denwick, South Charlton, North Charlton and Brownieside are interspersed throughout the length of the Scheme. In addition, isolated residential dwellings, commercial properties and several farms lie adjacent to the Scheme, within the Scheme Footprint. A network of PRoW crosses and lie within 500 m of the Scheme. There are no national cycle routes or national trails within 500 m of the Scheme.

2.4.4. There are no Air Quality Management Areas (AQMAs) or Noise Important Areas (NIAs) within or near the Scheme. Two registered park and gardens are located within the vicinity of Scheme: Alnwick Castle approximately 1 km to the south-west and Howick Hall approximately 5 km to the east. Northumberland Coast Area of Outstanding Natural Beauty (AONB) lies approximately 5 km to the east of the Scheme. The Kyloe Hills and Glendale Area of High Landscape value and an intermediate area of landscape value are situated approximately 1 km north of the Scheme. In addition, a former area of high landscape value is situated to the west of the Scheme. Key visual receptors include individual rural properties and recreational viewpoints from PRoW.

2.4.5. There are nine scheduled monuments located within 1 km of the Scheme, with seven of these being below ground archaeological remains and earthworks. One scheduled monument is located within the Scheme Footprint, two scheduled monuments abut the Scheme Footprint and one is located in close proximity to the Scheme Footprint. A total of 51 built heritage assets are located within 1 km of the Scheme and consist of 42 assets designated as Listed Buildings, two designated as Scheduled Monuments (SM) (note – one of these is also a Listed Building) and eight non-designated heritage assets. Two mileposts are located within the Scheme Footprint; milepost 40 m north of entrance to Heckley House (NHLE 1153486) and milepost north of Shipperton Bridge (HER 16878). Two Grade II Listed Buildings, Patterson Cottage (NHLE 1371080) and West Linkhall farmhouse (NHLE 1298856), lie within 25 m of the Scheme Footprint. There are 15 historic landscape types recorded within 500 m of the Scheme. There is also potential for underground unknown buried archaeological remains.

2.4.6. No statutory ecological sites are located within the Scheme Footprint. Four Special Areas of Conservation (SAC) as well as one Special Protection Area (SPA) and Ramsar are located within 10 km of the Scheme. One local nature reserve (Hulne Park) is situated 1.5 km west of the Scheme and one Local Wildlife Site (LWS) (Ratcheugh Crag – Pepper Moor) 2 km east of the Scheme. A number of protected and / or notable species recorded or suspected within the surrounding area include badger, great crested newts (GCN), bats, barn owl, badgers, water vole, otter, reptiles, red squirrel, breeding and wintering birds as well as terrestrial invertebrates. Swineclose wood is an area of ancient semi-natural woodland 5.18 ha in size, located 1.88 km to the north east of the Scheme.

2.4.7. 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, there are small

areas of Flood Zone 3 located at the southern section of the study area to the north-west of Denwick, and to the east of Shipperton Bridge, where the risk of flooding from fluvial sources is greater than 1 in 100 in any year. Sections of the Scheme are at high, medium and low risk of flooding from surface water sources. The Scheme alignment crosses or is located within 500 m of 16 ordinary watercourses. There are no main rivers within 500 m of the Scheme.

2.4.8. The Scheme is underlain by Secondary A Aquifer in the bedrock. The majority of the Scheme is underlain by Secondary (undifferentiated) Aquifer in the superficial deposits. Small sections of superficial deposits classified as Secondary A Aquifer are located in the northern and southern sections of the Scheme. The Scheme is not located within a Source Protection Zone (SPZ).

2.4.9. The construction of the Scheme would require the production, transport and use of materials, and the generation of waste.

MAIN COMPOUND

2.4.10. The Main Compound is located west of Thirston New Houses. The site is bordered by existing tree and hedgerow planting on all boundaries. There are a number of residential receptors within vicinity of the site. To the west, on the other side of the A1, are two residential properties located approximately 400 m from the Scheme called West Moor Houses. Approximately 200 m to the east, a grouping of properties called Thirston New Houses are located. Eshott Airfield is located immediately south of the Main Compound. There are no National Trails, National Cycle Routes or PRoW within 500 m of the site. There are no AQMAs or NIAs within or near the Main Compound.

2.4.11. There is one Grade II listed milepost recorded within the Main Compound boundary (NHLE 1371021) although a recent site inspection failed to locate it in this location. There are three non-designated assets recorded within 500 m of the Main Compound (two below ground assets and one built heritage asset). There are eight designated built heritage assets within 1 km of the site.

2.4.12. A single statutory nature conservation site is located within 2 km of the Site; the River Coquet and Coquet Valley Woodlands Site of Special Scientific Interest (SSSI) which is located 580 m north of the Main Compound. The woodlands located south of the River Coquet and associated with the River Coquet Valley Woodlands SSSI is also designated as Ancient Woodlands. Coquet River Felton Park LWS is also located 580 m north of the Main Compound. Additionally, habitats at the boundary of the Main Compound location provide some value for nesting birds where clearance is required for access.

2.4.13. The Main Compound is located in close proximity to one watercourse; an unnamed tributary of the Thirston Burn which flows along the northern boundary of the compound and forms part of the Northumbria Rivers Basin District. The Thirston Burn discharges into the River Coquet approximately 4 km downstream of the Main Compound. The River Coquet is a Main River and forms part of the River Coquet and Coquet Valley Woodlands SSSI. A surface water pond is also located approximately 400 m to the south-east of the Main Compound. The bedrock geology is classified as Secondary A Aquifer and the majority of the superficial deposits are classified as Secondary A Aquifer. There are no active or historical landfills within 250 m of the Main Compound.

2.4.14. The Main Compound is located within 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. It is also at low risk of flooding from surface water sources.

LIONHEART ENTERPRISE PARK COMPOUND

2.4.15. Highways England are currently in the process of constructing a Salting and Gritting Depot at Lionheart Enterprise Park to the south of Alnwick. It is proposed that the Scheme would utilise the new depot as well as the immediately surrounding area that has been identified within the local plan for commercial development.

2.4.16. The site is bordered by an existing hedgerow to the south, existing industrial estate to the north and an existing PRoW to the west. There is a total of four PRoW within 500 m of the site. No National Trails or National Cycle Routes are located within 500 m of the site. The Duchess's Community High School is located approximately 350 m to the west of the Lionheart Enterprise Park Compound.

2.4.17. There are no AQMAs or NIAs within or near the Lionheart Enterprise Park Compound. Sensitive receptors are predominantly commercial as it is located on an industrial estate. The nearest residential receptor is the new Hogs Head Inn and hotel approximately 400 m to the west.

2.4.18. Four Grade II listed buildings lie within 1 km of the site. Part of the compound area at Lionheart Enterprise Park has already been subject to archaeological evaluation as part of an earlier Highways England planning application (Ref. 16/04691/FUL). The surveys identified several possible soil-filled features.

2.4.19. No statutory ecological designated sites are located within 2 km of the Lionheart Enterprise Park Compound. However, habitats at the boundary provide some value for nesting birds where clearance is required for access.

2.4.20. The Lionheart Enterprise Park Compound is located within 500 m of two ordinary watercourses; the Willow Burn to the north; and the Cawledge Burn to the south. Superficial deposits underlying the site consist of Glaciofluvial deposits (Devensian) consisting of sand and gravel. The majority of the superficial deposits are classified as Secondary A Aquifer.

2.4.21. The Lionheart Enterprise Park Compound is located within 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. There is a small area 400 m to the south that is in the high-risk Flood Zone 3 where the risk of flooding from fluvial sources is greater than 1 in 100 in any year. The site is at low risk of flooding from surface water sources. However, the land immediately adjacent to the Cawledge Burn is at a medium risk of surface water flooding.

2.4.22. A historical landfill site, East Cawledge, is located 186 m to the north of the site. Records show that the historical landfill was first recorded in 1927 and last recorded in 1972, there are no details relating to the waste types deposited.

3 ASSESSMENT OF ALTERNATIVES

3.1 ALTERNATIVES ASSESSMENT METHODOLOGY

3.1.1. The development of options has followed the stages set out below making it compliant with Highways England's major project lifecycle:

- Strategy, Shaping & Prioritisation Stage;
- Option Identification Stage;
- Option Selection Stage; and
- Preliminary Design Stage (the current Stage).

3.1.2. The below sections outline how each of these stages have been followed for the Scheme.

STRATEGY, SHAPING & PRIORITISATION STAGE

3.1.3. In February 2014, a Feasibility Study (**Ref 2.1.1**) was undertaken to consider the full route of the A1 in Northumberland between its junction with the A19 at Seaton Burn and the Scottish border. The study included engineering and economic aspects and the identification of environmental constraints. The feasibility of conceptual options was appraised using sifting tools.

3.1.4. This Study led to the definition of a scope of work for improvement to the A1 in Northumberland as announced in the RIS in December 2014, which was then progressed to the Option Identification Stage.

OPTION IDENTIFICATION STAGE

3.1.5. The scope of work for the improvement to the A1 in Northumberland was refined at this stage. Three route options were identified for A1 in Northumberland: Alnwick to Ellingham, taking into account the environmental constraints previously identified in the feasibility study. The three options were as follows:

- **Orange Option**: Upgrade the existing road to dual carriageway, widening either to the east or the west depending on the local features that needed to be considered.
- **Green Option**: Upgrade approximately 1.2 miles (2 km) of existing road to dual carriageway, and build a new carriageway to the east of the existing road at Heckley Fence, before crossing over to the west of the existing road at Elsnook Plantation and continuing until Shipperton Burn.
- **Blue Option**: Upgrade the majority of the existing road to dual carriageway, with approximately 2.2 miles (3.5 km) section of new carriageway built to the west of the existing route between Elsnook Plantation and Shipperton Burn.

3.1.6. An early public engagement exercise was undertaken in May 2016 to obtain feedback to aid the development and consideration of the three route options.

3.1.7. A Preliminary Economic Assessment was also progressed at this stage, in order to refine the options.

OPTION SELECTION STAGE

3.1.8. In September 2016, due to funding constraints, the Orange Option was identified as the sole viable option to take through to the Option Selection Stage. The key aspects of the Orange Option that was considered for the Option Selection Stage Environmental Assessment Report (EAR) (**Ref 3.1.1**) include:

- Widening of the existing A1 to the east.
- Second carriageway constructed alongside the existing A1.
- One new junction at South Charlton (connecting the A1, B6341 and B6347).
- Closing existing accesses onto the current A1 except two existing private accesses near South Charlton (which would become left-in, left-out only access).
- Access from other properties would be via local roads to the new junction.
- Existing junctions from B6341 and B6347 would be closed and diverted to join the new dual carriageway at the new junction.
- New local roads and access bridges would provide access for businesses and properties to the new junction.
- The byway open to all traffic near Broxfield would cross the A1 on a bridge.

PRELIMINARY DESIGN STAGE

3.1.9. Due to the funding constraints highlighted, the Orange Option was identified as the Preferred Option for progression into the Preliminary Design Stage. The Preferred Route Announcement (PRA) was made in September 2017, details of which can be found at: https://highwaysengland.citizenspace.com/he/a1-in-northumberland/results/n170030_a1-northumberland_pra---morpeth-to-ellingham_v3_digital.pdf.

Review of route alignment option

3.1.10. Following the PRA, work has been completed to determine whether the new carriageway would be located to the east or the west of the existing carriageway.

3.1.11. Initially it was considered that alignment to the west would be most beneficial as this would avoid the need to divert 5 km of EHV cables that originate at Middlemoor windfarm and the associated costs of completing this work.

3.1.12. Although the wind farm is located on the west, the cable runs to the east of the existing carriageway from the southern extent of the Scheme up to the existing junction adjacent to Charlton Mires where it transfers to the west.

3.1.13. Retaining the EHV cable in its current location and building the new carriageway to the west was considered a significant financial saving to the Scheme due to the reduced requirement to divert the cable. However, when constructability was considered, this option was considered unviable on Health and Safety grounds due to the risks associated with constructing new drainage infrastructure immediately adjacent to the EHV. It is now understood that the cable would be diverted ahead of the main works and that it would be located at a safe distance to the construction of drainage infrastructure.

3.1.14. Further to the issues associated with the diversion of the EHV cable, the alignment to the east is required for operational performance and to retain two houses located directly to the west of the Scheme. The alignment to the west would require the new carriageway cross section to be unconventionally profiled to meet accepted design and safety standards and for it to tie in to the existing dual carriageway, directly to the north of the Scheme.

3.1.15. On this basis, the alignment is now set to the east of the existing carriageway.

Accommodation bridge

3.1.16. At EIA Scoping two potential locations were identified for the accommodation bridge that would maintain PRoW. At this stage, an initial environmental assessment of the two options has been completed and set out in this PEIR. The Statutory Consultation will seek views on the preferred option for the location of this bridge.

3.2 ALTERNATIVE DESIGN CONSIDERATIONS

3.2.1. As part of the EIA, alternative design options will be considered and the findings reported in the ES. This assessment will be undertaken in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 11 Section 2, Part 5 Assessment and Management of Environmental Effects. The assessment of alternatives would include consideration of technology, design, size, scale, demand, delivery, scheduling and mitigation, as appropriate. Options for these elements would be appraised to determine potential significant environmental effects, and ultimately inform the Scheme. Particular attention has and will be given to the potential effects of the Scheme on the Scheduled Monuments within and abutting the red-line boundary. Alternative design considerations will be reported in the ES.

4 ENVIRONMENTAL ASSESSMENT METHODOLOGY

4.1 EIA PROCESS

4.1.1. The development and design of major highway schemes is governed by guidance set out in the Design Manual for Roads and Bridges (DMRB). Volume 11 (see **Ref. 4.1.1**) of the DMRB provides guidance on producing an EIA specific to highway projects. Volume 10 of the DMRB (see **Ref. 4.1.2**) contains guidance for Environmental Design and Management. Interim Advice Notes (IANs) have also been issued that relate to certain topics within this PEIR. These IANs will be followed where applicable.

4.1.2. An EIA will be undertaken in line with the most up-to-date relevant guidance in the DMRB and IANs, the EIA Regulations, and additional best practice guidance where appropriate. EIA is a systematic process to identify, predict and evaluate the environmental effects of a proposed scheme. The primary purpose of EIA is to provide environmental information to those who will make the decision as to whether a scheme should be consented. The EIA process influences the design of a proposed scheme as it enables early identification of potential environmental impacts and, where possible, their avoidance through sensitive design. In addition, EIA identifies enhancement opportunities that can be incorporated into the design where appropriate.

4.1.3. The National Policy Statement for National Networks (NPS NN) (see **Ref 4.1.3**) sets out the need for NSIPs on the national road and rail networks in England, together with the policies to deliver them. The NPS NN is used by the Secretary of State as the primary basis for making decisions on DCO applications for NSIPs. As the Scheme is a road network NSIP, the approach adopted towards the EIA will be in accordance with the NPS NN.

4.1.4. The National Planning Policy Framework (NPPF) (see **Ref. 4.1.4**) sets out the Government's planning policies for England and how these should be applied. The NPPF was revised in July 2018. The principles of the revised NPPF will be considered throughout the development of the Scheme. Consideration will be given to 'achieving sustainable development' and 'promoting sustainable transport'. In addition, the topic specific paragraphs of the NPPF will be considered in the specialist assessments.

SCREENING

4.1.5. An EIA Screening aims to determine whether a scheme requires an EIA in line with the EIA Regulations.

4.1.6. As detailed in Chapter 1 of this PEIR, a screening exercise has been undertaken and it was identified that as the Scheme falls under Schedule 2, Part 10f (construction of roads) of the EIA Regulations and the potential direct impacts of the Scheme on 'sites of historical, cultural and archaeological significance' as set out in Regulation 9(1), the Scheme requires an EIA.

SCOPING

4.1.7. The Scoping process is used to determine which environmental topics should be assessed and the level of detail that should be included in the EIA. A Scoping Report, available in **Volume 2** (**Appendix A)** of this PEIR, has been prepared and submitted to the Inspectorate on 7 November 2018 with a request for a statutory Scoping Opinion, setting out the key potential impacts and the

proposed approach to the EIA (refer to **Chapter 1** of this PEIR). The Scoping Opinion was received on 18 December 2018 and has been taken into account when preparing the PEIR.

STUDY AREAS

4.1.8. **Table 4-1** presents the current study areas for each environmental topic assessment. These study areas may be subject to change as the EIA progresses.

Table 4-1 – Study areas for each environmental topic

Topic	Current Assessment Study Area	Justification / Commentary
Air Quality	Construction – within 200 m of the Scheme Footprint. The study area for impacts associated with dust emissions during construction will be 200 m either side of the affected roads including routes between site compounds and the Main Scheme Area. Operation – 200 m corridor either side of all roads included in the Affected Road Network (ARN)	The study area is in accordance with DMRB HA207/07 (**Ref. 4.1.5**).
Noise and Vibration	Construction – Identified noise and vibration sensitive receptors local to working areas, construction compounds, and construction traffic routes. Operation (Noise) – 600 m calculation area around the Scheme and affected links within a 1 km radius of the Scheme. In addition, 50 m buffers around identified affected links greater than 1 km from the Scheme. Operation (vibration) – 40 m buffer around all affected routes identified in determination of the 600 m noise calculation area.	The construction phase noise and vibration assessments will be undertaken at representative sensitive receptors closest to the Scheme. The operational phase study areas for noise and vibration have been defined based on currently available traffic data and adopting the methodology presented within DMRB HD213/11 (**Ref. 4.1.6**)
Landscape and Visual	Construction – 2 km study for landscape and visual receptors Operation – 2 km study for landscape and visual receptors	An initial study area was defined based on a review of desk study information and a Zone of Theoretical Visibility (ZTV). This initial study area was refined to a 2 km study as a field visit determined that significant landscape and visual effects are unlikely to occur beyond 2 km. . This approach is in accordance with IAN 135/10 (**Ref. 4.1.7**) and GLVIA 3 (**Ref. 4.1.8**).
Cultural Heritage	Non-designated assets – a study area of 500 m from the Scheme Footprint. Statutory designated assets, conservation areas and historic landscapes – a wider study area of 1 km from the Scheme Footprint.	In accordance with DMRB HA208/07 (**Ref. 4.1.9**).
Biodiversity	Protected and noteworthy species (desk study) – 2 km from the Scheme Footprint.	In accordance with DMRB Vol. 11, 4.1 (**Ref. 5.12**) and the Guidelines for

Topic	Current Assessment Study Area	Justification / Commentary
	Bat species (desk study) – 5 km from the Scheme Footprint. Non-statutory designated sites and statutory designated sites of national importance (desk study) – 2 km from the Scheme Footprint. Statutory designated sites of international and European importance (desk study) – 10 km (and 30 km for bats in relation to SAC) from the Scheme Footprint. Survey area for the Phase 1 habitat survey (including priority and notable, and other, habitats) and the majority of the field surveys undertaken for protected and/or notable species – 500 m from the Scheme Footprint. Bat roost potential surveys and activity surveys, and reptile surveys – 100 m from the Scheme Footprint. National Vegetation Classification (NVC) survey – 200 m from the Scheme Footprint.	Preliminary Ecological Appraisal (Chartered Institute of Ecology and Environmental Management (CIEEM), 2013) (**Ref. 5.4**). An Ecological Zone of Influence (EZoI) will be established for the EIA (once further assessment information is available in relation to air quality and hydrology) to determine significant effects.
Road Drainage and the Water Environment	The study area for both the construction and operation phases will encompass: Surface water features up to 0.5 km from the Scheme.	This distance is considered appropriate for the assessment of direct effects (i.e. associated with overland migration of pollutants directly to surface features, pollutants conveyed in drainage systems, and works within a river channel).
	Features that are in hydraulic connectivity with the Scheme will also be considered, including surface water abstractions and downstream watercourses. Based on the professional judgement of the assessor and current knowledge of the area, features located up to a distance of 1 km from the Scheme will be considered.	This distance is considered appropriate for the assessment of indirect effects, although if sensitive features located further than 1 km from the Scheme are identified to be at risk, these features will also be considered within the assessment.
	Groundwater features up to 0.5 km of the Scheme and groundwater abstractions up to 1 km from the Scheme.	This distance is considered appropriate for the assessment of surface-borne pollutants migrating to groundwater features, although if sensitive features located further than 1 km from the Scheme are identified to be at risk, these features will also be considered within the assessment.
Geology and Soils	Construction – Scheme Footprint plus 250 m buffer	In accordance with DMRB Volume 11, Section 3 Part 6 and Part 11 (**Ref. 4.1.11** and **Ref. 4.1.12**) and DMRB

Topic	Current Assessment Study Area	Justification / Commentary
	Operation – Scheme Footprint plus 250 m buffer	Volume 11, Section 2 Part 5 HA 205/08 (**Ref. 4.1.13**)
Population and Health	Construction – Physical Assets (500 m from the Scheme Footprint), WCH: Journey Length and Amenity (500 m from the Scheme Footprint) and Community Amenity and Severance (1 km from the Scheme Footprint). Operation – Physical Assets (500 m from the Scheme Footprint), WCH: Journey Length and Amenity (500 m from the Scheme Footprint) and Community Amenity and Severance (1 km from the Scheme Footprint).	DMRB Volume 11, Section 3 Part 6, Part 8 and Part 9 (**Ref. 4.1.11**, **Ref. 4.1.14**, and **Ref. 4.1.15**) do not specify a scheme assessment area when considering the effects of a road scheme on physical assets, WCH, communities or vehicle travellers. Study areas have therefore been selected based on professional experience and expert judgement.
	Health data has been collected at a regional and national level. However, the study areas for other environmental topics relevant to health are as follows: ▪ Air quality – 200 m of the ARN; ▪ Noise and vibration – 600 m noise calculation area; and ▪ Road drainage and the water environment – 500 m.	There is currently no guidance to define the study area for health and, therefore, the heath study area is based on professional judgement. The relevant guidance used to determine the study areas for air quality, noise and vibration as well as Road Drainage and the Water Environment are detailed within the relevant sections of this table.
Material Resources	Construction - primary study area is within the Scheme Footprint. The secondary study area extends to the availability of construction materials and capacity of recycling and waste management infrastructure within North East England (Northumberland, Tyne & Wear, Durham and the Tees Valley).	The study areas are defined by guidance set out in Interim Advice Note (IAN) 153/11 (**Ref. 14.1.16**) *Environmental Assessment of Material Resources* and emerging best practice guidance.
	Operation – this lifecycle phase has been scoped out of the assessment.	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 impacts and effects.

Topic	Current Assessment Study Area	Justification / Commentary
Climate	Greenhouse Gas (GHG) Assessment: Construction - for construction carbon the study area principally takes account of emissions associated with Scheme activities and their associated transport. Operational - the study area for the traffic element of the operational GHG emissions assessment will be based on the ARN. The study area for operational replacement will take account of resurfacing activities as outlined for construction.	Construction – the scope of construction GHG emissions is set by emissions source rather than by geographic location as the environmental impact of GHG emissions is not related to the location of the emissions. This approach is in line with best practice guidance such as PAS2080. Operation – In accordance with Chapter 4 (Greenhouse Gas) of TAG Unit A3, DMRB 11.3.1 and emerging best practice guidance.
	Vulnerability of the project to climate change: Construction and operation: North East England UKCP09 region.	Climate projections at the administrative region scale are used to determine likely climate the Scheme would operate in and therefore forms the study area for this assessment. Probabilistic projections are given for a range of likelihoods and emissions scenarios, which is best practice for critical infrastructure and is in line with guidance such as IEMA EIA guide to Climate Change Resilience and Adaptation.
Cumulative Effects	For traffic related topics, planning applications will be considered within a study area based upon the ARN. If the ARN is not suitable for non-traffic related topics, i.e. encompasses an area that is too extensive, the landscape ZTV will be used. The ZTV will be used as it is the second largest study area that will be used for the environmental assessments. The planning applications will be identified as the EIA progresses and will include those submitted to Northumberland County Council (NCC) together with Highways England schemes likely to be constructed in the same time as and in proximity to the Scheme.	In accordance with DMRB Volume 11, Section 2, Part 5 (HA 205/08) (**Ref. 4.1.13**), NPS NN (2014) (**Ref. 4.1.3**) and The Planning Inspectorate Interim Advice Note 17 (**Ref. 4.1.17**)

BASELINE

4.1.9. The first step in the EIA is to determine the baseline conditions, to understand the existing environment that could be impacted by the Scheme. Baseline conditions are not necessarily the same as those that exist at the current time; they are the conditions that would exist in the absence of the Scheme either (a) at the time construction is expected to start, for impacts arising from construction or (b) at the time that the Scheme is expected to open to traffic, for impacts arising from its operation. Therefore, the identification of the baseline conditions involves predicting changes that are likely to happen in the intervening period, for reasons unrelated to the Scheme. This PEIR

presents the baseline conditions within and around the Scheme, further detail can be found within the Scoping Report **(Volume 2, Appendix A, Chapters 7 - 16**).

4.1.10. As part of this step, sensitive receptors are identified. Sensitive receptors may be a physical resource or asset (e.g. a water body or a residence) or a user group (e.g. recreational users of an area or local residents).

4.1.11. This PEIR includes changes to the baseline or additional information made available since the Scoping Report was produced. A full update of the baseline will be undertaken as part of the EIA and incorporated in the ES.

PREDICTED ENVIRONMENTAL IMPACTS

4.1.12. The next stage of the EIA process is to predict the potential impacts that might arise as a result of the Scheme. Impacts are changes to the environment, compared with the baseline environment, attributable to the construction and operation of the Scheme and may be beneficial or adverse, direct or indirect, temporary or permanent. The methods for predicting impacts vary by topic.

4.1.13. For the purposes of traffic related topics, the assessment will be undertaken for the following years:

- Baseline Year (2018);
- Opening Year of the Scheme i.e. when traffic can begin to use the road (2023); and
- Future Year of the Scheme i.e. 15 years from the opening year which is typically considered to be the time when the Scheme would be operating at its most efficient or mitigation measures would be fully effective by this time (2038).

4.1.14. For the non-traffic related assessments, the baseline year will vary between topic depending on when data has been collected. For example, the baseline for ecology will vary between 2017 and 2019 depending on when surveys were, or are to be, completed. Opening and Future years are the same as the traffic related topics.

SIGNIFICANCE

4.1.15. The EIA process then provides an evaluation of how significant the impacts as a result of the Scheme are likely to be. Residual effects are those that are likely to remain after mitigation and design measures have been implemented.

4.1.16. The significance of an impact is determined by taking account of the sensitivity of the environmental receptor, the magnitude of the impact (i.e. degree of change against the existing or predicted baseline) and whether it can be mitigated through good design or management. The greater the environmental sensitivity of the receptor and the greater the magnitude of impact, the more significant the effect. Impacts considered to be of moderate or above significance are therefore regarded as significant impacts.

4.1.17. All assessments of impact will be based on professional judgement supported through the application of guidance found in the DMRB Volume 11 Section 2 Part 5 (HA205/08) (**Ref. 4.17**) Assessment and Management of Environmental Effects, as well as topic-specific DMRB guidance where applicable. Tables 2.1, 2.2, 2.3 and 2.4 of DMRB Volume 11 Section 2 Part 5 (HA205/08) (**Ref. 4.17**) provide advice on typical descriptors of environmental value (or sensitivity), magnitude of change and significance of effects.

MITIGATION AND ENHANCEMENT

4.1.18. Where adverse effects are identified, mitigation may be proposed to remove, reduce or offset the impacts. In some cases, EIA professionals and stakeholders involved in the process may also identify and recommend enhancement opportunities for a scheme in order to achieve improved environmental outcomes. It is therefore important that the EIA process takes place alongside the development of the Scheme design to make the most of such opportunities.

4.2 LIMITATIONS

4.2.1. This PEIR is based on the latest design and construction information. As such, these findings may be subject to change as the design progresses. The assessment of the significance of effects will be undertaken as part of the EIA and reported in the ES. Refer to the Scoping Report in **Volume 2 (Appendix A)** for full details of limitations and assumptions relevant to each environmental topic.

4.2.2. **Table 4-2** summarises the main topic specific limitations that this PEIR is based upon. It should be noted that the lack of construction information currently available is identified as a limitation which applies to all the topic area assessments. However, as the design progresses, construction information will be available and considered within the ES.

Table 4-2 – Limitations to the information set out in this PEIR

Topic	PEIR Limitations
Air Quality	Preliminary information relates to currently available data for the Scheme which may be subject to change as the assessments progress. The assessment of operational impacts is based on traffic modelling undertaken for the Scheme which incorporates a number of assumptions, the details of which will be presented in the Transport Assessment for the Scheme.
Noise	Provides preliminary information as it relates to the Scheme to date and to data currently available and gathered at this point of the assessment process. The results of the traffic modelling undertaken to inform the design of the Scheme have been used as a basis for identifying affected traffic links and defining the operational phase noise study area. In applying these traffic figures, a number of assumptions have been incorporated, the details of these assumptions will be presented within the Transport Assessment.
Landscape and Visual	Winter landscape and visual assessment not yet completed. Landscape design not completed. The ZTV has been developed based on the Broxfield accommodation bridge option only. All assessment effects are based on current understanding of tree loss, effects will be reviewed following receipt of an arboricultural survey. The baseline site work was carried out in October 2018 and February 2019. Therefore, it will be the baseline situation which stood at this time that will form the basis of this assessment. Operational effects are considered at Year 15 (to allow for vegetation to establish), the mitigation discussed within this PEIR may change during further design development.

Topic	PEIR Limitations
Cultural Heritage	Full geophysical survey results not yet available. The information presented in this PEIR has been drawn from data obtained from a variety of sources, and includes secondary information. It is assumed that this information is accurate. The data provided by Historic Environment Records is not a record of all surviving heritage assets, but a record of the discovery of wide range of archaeological and historical components of the historic environment. There is a potential for the presence of further, unrecorded, heritage assets and components of the historic environment including historic landscape types.
Biodiversity	Assessment has been primarily produced following completion of a desk study analysis, including a review of previous reports produced early in the Scheme assessment and option appraisal period, and therefore has been informed by a historic baseline. This assessment has been supplemented with results of recent protected species surveys (i.e. undertaken in 2018), however, surveys are still required and will recommence in 2019. A full suite of surveys and updated baseline with inform the EIA and be presented within the ES, and therefore information used to inform the PEIR is not assessed to constitute a gross limitation.
Road Drainage and the Water Environment	Topographic data of water courses, and therefore the hydrological model not yet available. This PEIR is based on currently available information, and can be subject to change as the design 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.
Geology and Soils	This PEIR is based on currently available information. Results of Ground Investigation are not yet available. Additional consultation with NCC, relating to provision of required environmental information. Further consultation with respect to mineral resources required. Agricultural Land Classification (ALC) survey not yet completed.
Population and Health	This PEIR is based on currently available information. Results of ALC survey (including farmer interviews) not yet available.
Material Resources	Materials quantities not yet available. Baseline data and information for the assessment are (unless otherwise stated) only available to 2016. Lack of industry-agreed criteria or thresholds for assessing the sensitivity and magnitude of impacts from materials, site arisings and waste presents a challenge in consistently and robustly determining the associated significance of effects

Topic	PEIR Limitations
	UK landfill operators can claim commercial confidentiality for their data at time of submission to the Environment Agency; data for sites with a commercial confidentiality in place are therefore unavailable for the analyses presented in this PEIR. It is not anticipated that the lack of data in this context will significantly affect the results of the assessment. Department for Environment Food and Rural Affairs (Defra) has been consulted to determine whether generation and recovery rates for construction, demolition and excavation (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 (**Ref. 4.2.1**); 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.
Climate	This PEIR is based on currently available information.
Cumulative Effects	The assessment for cumulative effects is reliant on the technical assessments of the Scheme being well progressed and data relating to other developments within the vicinity being confirmed and as up-to-date as possible. As such, although this Chapter presents the current understanding of likely cumulative effects it is not possible to identify likely significant effects with confidence at this stage.

4.2.3. Any gaps in information identified in this PEIR will be considered and addressed along with specific mitigation measures as part of the assessment during the production of the ES.

4.3 NON-STATUTORY CONSULTATION AND ENGAGEMENT

4.3.1. At the time of writing, the following discussions were ongoing:

- Historic England;
- NCC;
  - Archaeologist;
  - Environmental Health Officer (EHO);
  - Lead Local Flood Authority (LLFA) officer; and
  - PRoW officer;
- Environment Agency; and
- Natural England.

4.3.2. Further information on non-statutory consultation and engagement taken to date can be found in the Scoping Report (**Volume 2, Appendix A, Chapter 5 Consultation**).

4.3.3. Scoping Opinion responses (refer to **Volume 2, Appendix B**) have been noted in this PEIR and will be taken into account in the ES.

4.4 FURTHER WORK FOR THE EIA

4.4.1. The following paragraphs provide information on the further assessment work that will be undertaken as part of the ES or has been scoped out of the ES.

MAJOR ACCIDENTS AND HAZARDS

4.4.2. Schedule 4 Part 5 of the EIA Regulations details the requirement for a description of the likely significant effects on the environment resulting from, amongst others, the risks to human health, cultural heritage or the environment (for example due to disasters).

4.4.3. An assessment of the vulnerability of the Scheme to major events identified will be undertaken. A qualitative assessment will be carried out and reported within the relevant individual environment topics in the ES. **Appendix C** presents the methodology for this assessment.

TRANSBOUNDARY EFFECTS

4.4.4. Schedule 4 Part 5 of the EIA Regulations requires a description of the likely significant transboundary effects to be provided in an ES.

4.4.5. The nearest European Economic Area (EEA) State to the Scheme is Ireland, located approximately 350 km west of the Scheme.

4.4.6. It is considered that the Scheme would not generate significant effects upon any other EEA States, as reported in the Screening Matrix (Planning Inspectorate Advice Note 12, December 2015 (**Ref. 4.4.1**)) in **Appendix D**. Therefore, transboundary effects are currently scoped out of the ES.

5 ASSESSMENTS

5.1 AIR QUALITY

INTRODUCTION

5.1.1. This section considers the implications of the Scheme on local and regional air quality during the construction and operational phases and any likely significant effects. Air quality can affect human health, quality of life and the natural environment.

5.1.2. The principal sources of atmospheric pollutants considered within the assessment are construction dust, nitrogen dioxide (NO_2) and particulate matter (PM_{10}).

EXISTING BASELINE KNOWLEDGE

Air Quality Thresholds

5.1.3. Thresholds for the concentration of pollutants in ambient air to protect the environment (human health and ecosystems) are set in UK national legislation (referred to as air quality objectives) and in European Directives (referred to as limit values). For the NO_2, the limit values and objectives are numerically equivalent and set out in **Table 5-1**.

Table 5-1 - Air Quality Thresholds

Pollutant	Air Quality Objective / Limit Value	
	Concentration	Averaging Period
Nitrogen Dioxide (NO_2)	40 µg/m^3	Annual Mean
	200 µg/m3 not to be exceeded more than 18 times a year	1-hour Mean
Nitrogen Oxides (NO_x)	30 µg/m^3	Annual Mean
Particles (PM_{10})	50 µg/m_3 not to be exceeded more than 35 times a year	24-hour Mean
	40 µg/m^3	Annual Mean
Particles ($PM_{2.5}$)	25 µg/m^3	Annual Mean

Local Authority Monitoring

5.1.4. NCC undertake air quality monitoring across the region as part of the Local Air Quality Management regime. As a result of this monitoring and the findings of previous NCC Air Quality Review and Assessments, Progress Reports and Annual Status Report, NCC has not declared any AQMAs within its administrative boundary. As such, no part of the Scheme is located within an AQMA, nor do any of the potential routes that may be affected by the Scheme lie within an AQMA.

5.1.5. NCC undertake air quality monitoring using a combination of automatic (continuous) and passive (diffusion tube) techniques. The closest NCC administered monitoring site is located at Alnwick (Site 8N, approximately 2.3 km south-west of the Main Scheme Area, approximately 1.7 km north of the

Lionheart Enterprise Park Compound). There have been no exceedances of the relevant objectives at any monitored location within the past five years in the NCC area (**Table 5-2**).

Table 5-2 - NO_2 Monitoring results within Northumberland County

ID	Location Name	Annual Mean NO_2 Concentration ($\mu g/m^3$)		
		2013	2014	2015
CR	Cowpen Road	27	24	25
8N	Bondgate Without, Alnwick	28	30	30
B1	Waterloo Road, Blyth	29	27	29
B3	Cowpen Rd. West, Blyth (Coloc)	33	32	32
B5	Cowpen Rd. East, Blyth	24	24	23
B11	Blyth YMCA, Blyth	25	26	26
B12	Bridge St, Blyth	25	24	24
B15	South Newsham Road	21	20	19
C1	High Pit Road, Cramlington	24	25	23
C9	Trebor, Cramlington	21	22	20
C10	Bay Horse (B1505)	28	27	23
C11	Storey Street (B1505)	19	22	19
CM2	Newgate St, Morpeth	22	23	19
CM4	Bridge St, Morpeth	28	26	22
CM5	Thorpe Ave, Morpeth	-	-	21
CM6	Telford Bridge, Morpeth	-	-	25
CM7	Greystoke Cottage, Clifton			26
W17	Front Street East, Bedlington	27	28	20
W21	Newbiggin Road, Ashington		21	24
SD1	Salvation Army, Seaton Delaval	26	25	25

5.1.6. NCC also monitors PM_{10} at two locations in the region: the Cowpen Road and Blyth Library sites. Both sites are located over 30 km south of the Scheme (over 20 km south of the Main Compound near West Thirston) and as such provide indicative information on regional ambient concentration of PM_{10}. **Table 5-3** summarises the results of the last three years of monitoring.

5.1.7. There were no exceedances of the Air Quality Objective for annual mean PM_{10} at any monitoring location within the county in the past three years.

Table 5-3 - Type NO_2 Monitoring results within Northumberland County

Site ID	Name	PM_{10} Annual Mean Concentration (µg/m^3)		
		2013	2014	2015
BL	Blyth Library	35	15	13
CR	Cowpen Rd	25	14	14

Background Air Quality Data

5.1.8. Background pollutant concentrations, i.e. those resulting from distant sources and pollutant transport, have been taken from the mapped data provided by Defra on a 1 km x 1 km grid covering the UK, interpolated to the locations of the selected receptors (**Ref. 5.1**).

5.1.9. Average annual mean background pollutant concentrations for the grid squares covering the Scheme are summarised in **Table 5-4** below, comprising background pollutant concentrations of nitrogen oxides (NOx) (oxides of nitrogen), NO_2, PM_{10} and $PM_{2.5}$ for the baseline year (2017) and the Scheme opening year (2023).

Table 5-4 - Annual mean background pollutant concentrations from Defra mapped data

Year	Nitrogen Oxides	Nitrogen Dioxide	Particulate Matter PM10	Particulate Matter PM2.5
Limit Value (µg/m3)	30	40	40	25
Total Pollutant Concentrations (µg/m3)				
2017	5.94	4.65	10.99	6.78
2023	4.83	3.81	10.75	6.57

5.1.10. Average concentrations of all pollutants are well below the relevant limit values, as shown in **Table 5-1**.

5.1.11. Defra undertakes air quality modelling using their Pollution Climate Mapping (PCM) to inform when zones / agglomerations comply with the EU Limit Values. PCM data for 2015 is available from Defra's UK-Air website (**Ref 5.1**). The nearest PCM link to the Scheme is within Morpeth, where the maximum PCM modelled concentration is less than 31 µg/m^3 for annual mean NO_2, which is well below the EU limit value. The Scheme is therefore unlikely to risk achievement of compliance with the EU Directive.

Highways England Monitoring

5.1.12. Scheme specific monitoring was undertaken by Highways England, using NO_2 diffusion tubes, between February and July 2017 at eight sites within or near to the Scheme as shown in **Table 5-5**. Concentrations of NO_2 were reported at all sites to be well below the annual mean NO_2 air quality objective threshold. The maximum measured annual mean concentration was 11.9 µg/m^3.

Table 5-5 - Summary of diffusion tube locations and monitored concentration

ID	Location			Distance to A1	Annual Mean NO_2 2016 Concentration
	X	Y	Z	(m)	($\mu g/m^3$)*
B1	416924	622976	2.6	30	9.1
B2	417144	621909	2.8	56	10.8
B3	417396	621297	2.5	35	6.9
B4	417755	620610	2.6	38	11.9
B5	417802	620014	2.5	96	9.7
B6	418139	618240	2.6	421	7.2
B7	420094	616686	2.6	920	7.2
BG	421041	616322	0.9	N/A	5.4

* Bias adjusted results using national factor of 0.91

Sensitive Receptors

5.1.13. In accordance with the DMRB HA207/07 (**Ref. 5.2**), examples of sensitive receptors include dwellings, hospitals, schools, community facilities, designated areas (e.g. SAC, SPA, SSSI), and PRoW.

5.1.14. As the Scheme passes through a rural area, it is likely that the majority of sensitive receptors would comprise residential, educational and ecological assets.

5.1.15. The following sensitive receptors have the potential to experience a change in air quality levels during both the construction phase and the operational phase (this list is not definitive and may be subject to change during progression of the air quality assessments):

- 1 to 13 The Cottages;
- The Cottages;
- Charlton Hall
- 1 to 4 West Link Hall Cottages
- West Link Hall Farm
- Patterson Cottage
- Charlton Mires Farm House
- Rock Lodge
- Heiferlaw Bank
- Heckley Fence
- Rennington Moor;
- Heckley House & Cottage;
- Broxfield Farm & Cottages;
- Golden Moor Farm and Cottage
- Waterside House and Cottage

5.1.16. As the assessment progresses, sensitive receptors will be refined and confirmed within the ES.

POTENTIAL IMPACTS

Construction

5.1.17. Air quality impacts due to construction would be temporary. Impacts would typically include an increase in emissions of dust from earthworks, general construction activity, construction compounds and a loss of amenity due to the presence of construction traffic. Vehicle movements to and from construction compounds have the potential to results in changes to emissions of oxides of nitrogen (NO_x) and nitrogen dioxide (NO_2) from vehicle exhaust using the route.

5.1.18. In addition, traffic management measures, road closures and diversions may result in both beneficial and adverse changes to emissions from vehicle exhausts and roadside pollution concentrations. As detailed information on construction vehicle movements become available then traffic management measures and the effect of additional construction vehicles will be assessed as an additional scenario. For impacts associated with dust emissions during construction, the assessment will comprise a 200 m corridor either side of all construction activities and within 200 m of construction traffic routes, for the assessment of impacts relating to construction vehicle movements on the road network.

Operation

5.1.19. The Scheme is expected to result in both beneficial and adverse changes to emissions of oxides of nitrogen (NO_x) and nitrogen dioxide (NO_2) due to changes in exhaust emissions from road traffic along the A1 and linked roads. Although an increase in pollutants are anticipated along the sections of the Scheme, with background concentrations well below the objective, the increase is unlikely to exceed the objective.

The "Affected Road Network"

5.1.20. Pollutant concentrations from traffic emissions disperse rapidly away from a road, returning to background concentrations within 200 m. Relevant receptor locations are chosen based on where sensitive receptors may be present within 200 m of an 'affected road'. These receptors would be the worst affected, so an assessment based on them would represent a 'worst case scenario'. The area that will be considered in the assessment therefore consists of 200 m corridors either side of all roads in the ARN.

5.1.21. Therefore, the assessment of operational impacts on air quality in the ES will comprise land within 200 m of "affected roads" which has been determined by analysis of the traffic data. The criteria for defining affected roads as detailed in the Design Manual for Roads and Bridges (DMRB) (**Ref. 5.2**) are as follows:

- Road alignment that would change by 5 m or more, or
- Daily traffic flows that would change by 1,000 Annual Average Daily Traffic (AADT) or more, or
- Heavy Duty Vehicle (HDV) flows that would change by 200 AADT or more, or
- Daily average speed that would change by 10 km/hr or more, or
- Peak hour speed that would change by 20 km/hr or more.

5.1.22. These criteria have been applied to road links within the Traffic Reliability Area (TRA), as outlined in IAN185, and to changes with the Scheme in the opening year. The links meeting the above criteria, known as the ARN are shown in **Figure A4: Affected Road Network** (**Appendix A**). As defined in DMRB HA207/07 (**Ref. 5.2**), the study area extends up to 200 m from the ARN. Beyond this distance the impact of the Scheme would be imperceptible.

5.1.23. For the Scheme, the study area is largely determined by total traffic flow changes rather than changes in vehicle speeds or changes in the numbers of HDV i.e. there are no links triggering the criteria for speed or HDV changes that do not already trigger the daily traffic flow criterion.

5.1.24. The local air quality impact assessment will also include nature conservation sites (known as designated sites) within 200 m of affected roads. The designated sites considered are SACs, SPA, SSSI and Ramsar sites which have designated features sensitive to air pollutants. No such sites lie within 200 m of the ARN identified at this stage.

5.1.25. As a result of the Scoping Opinion, locally designated and non-designated ecology sites will also be subject to the same air quality impact assessment. These sites will be identified following consultation with Natural England and the NCC County Ecologist.

Accommodation bridge options

5.1.26. The construction of the proposed bridge at either Broxfield or Heckley Fence has the potential to affect nearby sensitive receptors during the construction phase as a result of dust and particulate matter emissions arising due to construction activities.

5.1.27. The Heckley Fence option would be located approximately 45 m to the east of one sensitive receptor located at Heckley Fence. The nearest sensitive receptor to the Broxfield option, lies approximately 400 m to the west and as such is less likely to experience adverse impacts as a result of construction dust.

5.1.28. At either location there is a slight risk of impacts due to construction dust during the construction period, with a slightly higher risk at the Heckley Fence location as a result of the proximity to the nearby receptor. This risk can be minimised with the application of best practice and mitigation measures where appropriate as detailed in a Construction Environment Management Plan (CEMP), following which no residual effect is anticipated.

DESIGN, MITIGATION AND ENHANCEMENT MEASURES

Construction

5.1.29. Best practice mitigation would be required to control dust and emissions from construction works and plant. These measures would be set out in the Scheme CEMP and would typically include the following:

- Minimisation of areas to be stripped of vegetation.
- Dampening down of dust generating activities and materials, including site roads, during dry weather, in addition to site monitoring.
- As far as possible temporary roads should be hard surfaced to reduce dust generation.
- Road sweeping to be carried out on access roads and local roads to remove any material tracked out of the site.
- Management of stockpiled materials with the potential to generate dust by rolling, covering and/or revegetating as soon as appropriate.

Operation

5.1.30. On the basis of low existing pollutant concentrations across the area as well as assessments undertaken to date, no specific mitigation or Air Quality Action Plans are likely to be required for the operation of the Scheme. However, should there be a requirement as a result of a significant air

quality effects (as per Interim Advice Note (IAN) 174/13) or an EU Directive compliance risk (as per IAN 175/13), Scheme specific mitigations will be identified.

LIKELY SIGNIFICANT EFFECTS

5.1.31. The comparison of preliminary likely significant effects between the two accommodation bridge options are set out in **Table 5-6** below, based upon currently available information and professional judgement. Following implementation of appropriate mitigation measures, no significant residual air quality effects are anticipated during construction and operation of the Scheme. However, these effects could change as the EIA progresses. Mitigation measures are outlined in the above section.

Table 5-6 - Preliminary Likely Significant Effects of the two accommodation bridge options

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
Properties within 200 m of construction activities	Construction	Increased dust emissions from construction activities and traffic, including vehicle movements between site compounds and the Main Scheme Area, could lead to potential loss of amenity at sensitive receptors within 200 m of construction activities. Traffic management measures may result in both beneficial and adverse changes to emissions from vehicle exhausts and roadside pollutant concentrations.	Not anticipated	Not anticipated
Properties within 200 m of the ARN	Operation	Increased and decreased vehicular emissions as a result of changes to traffic flows along the Scheme are likely to generate a change in pollutant concentrations (NOx, NO_2 and PM_{10}) at receptors close to affected roads.	Not anticipated Existing pollutant concentrations are well below the relevant objectives and the Scheme is unlikely to exceed the objective.	Not anticipated Existing pollutant concentrations are well below the relevant objectives and the Scheme is unlikely to exceed the objective.
Ecological sites within 200 m of the ARN identified in liaison with Natural England and the County Ecologist	Operation / construction	Increased and decreased vehicular emissions as a result of changes to traffic flows along the Scheme are likely to generate a change in pollutant concentrations (NOx, NO_2 and PM_{10}) at designated close to affected roads.	Not anticipated Existing pollutant concentrations are well below the relevant objectives and the Scheme is unlikely to exceed the objective.	Not anticipated Existing pollutant concentrations are well below the relevant objectives and the Scheme is unlikely to exceed the objective.

A summary of the preliminary likely significant effects of the Scheme is presented in **Table 5-7** below, based upon currently available information and professional judgement. Following implementation of appropriate mitigation measures, no significant residual air quality effects are anticipated during construction and operation of the Scheme. However, these effects could change as the EIA progresses.

Table 5-7 - Summary of Preliminary Likely Significant Effects

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Properties within 200 m of construction activities	Construction	Increased dust emissions from construction activities and traffic, including vehicle movements between site compounds and the Main Scheme Area, could lead to potential loss of amenity at sensitive receptors within 200 m of construction activities. Traffic management measures may result in both beneficial and adverse changes to emissions from vehicle exhausts and roadside pollutant concentrations.	Best practice measures will be set out within a CEMP to control dust and emissions from construction works and plant.	Not anticipated
Properties within 200 m of the ARN	Operation	Increased and decreased vehicular emissions as a result of changes to traffic flows along the Scheme are likely to generate a change in pollutant concentrations (NOx, NO_2 and PM_{10}) at receptors close to affected roads.	No specific mitigation or Air Quality Action Plans are likely to be required for the operation of the Scheme. However, should there be a requirement as a result of a significant air quality effect (as per Interim Advice Note (IAN) 174/13) or an EU Directive compliance risk (as per IAN 175/13), Scheme specific mitigation measures will be identified.	Not anticipated Existing pollutant concentrations are well below the relevant objectives and the Scheme is unlikely to exceed the objective.
Ecological sites within 200 m of the ARN identified in liaison with Natural England and the County Ecologist	Operation / construction	Increased and decreased vehicular emissions as a result of changes to traffic flows along the Scheme are likely to generate a change in pollutant concentrations (NOx, NO_2 and PM_{10}) at designated close to affected roads.	No specific mitigation or Air Quality Action Plans are likely to be required for the operation of the Scheme. However, should there be a requirement as a result of a significant air quality effect (as per Interim Advice Note (IAN) 174/13) Scheme specific mitigation measures will be identified	Not anticipated Existing pollutant concentrations are well below the relevant objectives and the Scheme is unlikely to exceed the objective

FURTHER WORK FOR THE EIA

5.1.32. A simple level assessment of potential impacts on air quality during the construction and operational phases of the Scheme will be undertaken in accordance with the methodology set out DMRB Volume 11, Section 3, HA207/07 Air Quality (**Ref 5.2**), and in line with the requirements of the NPS NN (**Ref 5.3**).

5.1.33. In addition to the assessment detailed in the Scoping Report (**Volume 2, Appendix A, Chapter 6 Air Quality**), and in response to the Scoping Opinion (**Volume 2, Appendix B, Section 4.1**), the following will be carried out for the EIA:

- Assessment of particulate matter (PM_{10}) impacts as a result of operation of the Scheme, and an assessment of human health impacts associated with increased $PM_{2.5}$ from the Scheme with reference to the modelled impact on PM_{10}.
- For impacts associated with dust emissions during construction, the study area will consist of a 200 m corridor either side of the affected roads.
- Construction traffic impacts will be based on the same traffic change criteria used to define the ARN for the air quality assessment;
- Locally designated and non-designated ecological sites will also be included in the assessment; and
- Monitoring requirements during construction and operation will be considered and addressed within the ES.

5.2 NOISE AND VIBRATION

INTRODUCTION

5.2.1. This section considers the implications of the Scheme on noise and vibration during construction and operation and details any potentially significant effects. The assessment considers potential impacts relating to noise and vibration on sensitive receptors during both construction and operation.

5.2.2. At this stage, where the level of information for a detailed construction noise and vibration assessment is not yet available, the assessment of construction related noise and vibration associated with working areas involves:

- Identification of construction working areas;
- Identification of areas where intensive activities such as piling, ground stabilisation, demolition, or extended periods of breaking out of hard ground may be required;
- Description of likely construction activities;
- Identification of sensitive receptors close to the working areas;
- Identification of construction traffic routes and associated diversions; and
- Identification of mitigation as appropriate.

5.2.3. The operational phase assessment is based on the detailed assessment methodology of the Design Manual for Roads and Bridges, Volume 11, Section 3, Part 7, HD 213/11 Revision 1 (DMRB HD213/11) (**Ref 5.2.1**). At this stage, the assessment of operational road traffic noise has involved:

- Identification of affected road links in the Short Term (2023) along with associated noise level changes;
- Identification of affected road links in the Long Term (2038) along with associated noise level changes;
- Determination of the operational phase noise study area and noise calculation area;
- Identification of sensitive receptors within close proximity to the Scheme; and
- Identification of outline mitigation options as appropriate.

5.2.4. At the outset of the project, consultation discussions have been undertaken with NCC in June, August and October 2018, to agree the baseline noise survey scope and extent as well as impact assessment methodologies.

EXISTING BASELINE KNOWLEDGE

5.2.5. The Scheme passes through a predominantly rural area. For areas remote from existing road traffic routes, existing baseline noise and vibration levels are expected to be relatively low. As well as road traffic noise from the A1, other local roads in the area, such as the B6347, B6341 and B1340, are expected to dominate the existing noise and vibration environment for many sensitive receptors. The contribution of road traffic noise to existing baseline noise and vibration levels is dependent on distance to roads, and the existing traffic flow, composition and speeds on those roads.

5.2.6. The East Coast Main Line railway is located at a distance greater than 3 km to the east of the Scheme and is not expected to influence noise levels in the area. Other than industrial facilities such as the Lionheart Enterprise Park to the south of Alnwick, within close proximity to the proposed Lionheart Enterprise Park Compound, there are minimal industrial / commercial noise sources which are expected to influence baseline noise levels within the vicinity of the Scheme. It is expected that baseline noise levels will also be influenced by noise associated with farming activities. Although

there is a small private airfield located to the west of the A1 within the vicinity of Charlton Mires Farm House it is expected that, given its proximity to the A1, which is the dominant noise source in this locality, the influence of air traffic noise on the baseline noise environment will be minimal.

Site survey

5.2.7. In order to inform the assessment work for both the construction and operational stages, a detailed baseline noise survey was undertaken in September 2018. Noise measurements were undertaken at a number of locations within the local area, selected as being representative of sensitive receptors which may be affected during the construction and operational stages. **Figure A5: Baseline Noise Survey Location Plan** (**Appendix A**) presents the noise measurement locations adopted.

5.2.8. **Table 5-8** details the noise measurement locations that were adopted for the purpose of the baseline survey. All measurements were undertaken in free-field conditions (i.e. at a distance of at least 3 m from reflective surfaces such as buildings) at a height of approximately 1.5 m above ground level.

Table 5-8 – Baseline noise measurement locations

Location	Description	Baseline noise environment
ST1	West of Denwick Hamlet - within a field to the north of the B1340 to the west of dwellings overlooking the B1340	Dominated by road traffic noise from the B1340 and the A1
ST2	Heiferlaw Bank - within a small field to the north of Heiferlaw bank approximately 9 m to the west of the B6341 and 430 m to the west of the A1	Dominated by road traffic noise from the A1 and occasional traffic pass-bys on the B6341
ST3	Patterson Cottage - on the grassed verge to the west of the A1 at a distance of approximately 60 m to the north of Patterson Cottage	Dominated by road traffic noise from the A1. Noise from barking dogs at the Patterson Cottage Boarding Kennels was also intermittently audible
ST4	9 The Cottages - immediately to the east of the front gardens of the cottages	Dominated by noise from the A1. At night, the noise environment was also influenced by construction noise (e.g. vehicles / machinery idling, white noise reverse sirens and operatives talking) associated with night-time roadworks which were underway at the time of the survey
ST5	East Cawledge Farm - to the south-west of the farm access track positioned at a distance of approximately 380 m to the south-east of the A1	Dominated by road traffic noise from the A1 with occasional vehicle pass-by events on the access track
LT1	Loaning Head Cottage - within the garden area to the north of Loaning Head Cottage at a distance of approximately 4 m from	Dominated by distant road traffic noise from the A1, with local vehicle pass-by movements on the B6341 also contributing

Location	Description	Baseline noise environment
	the B6341 and approximately 900 m to the west of the A1	
LT2	Heckley Fence - within the garden of the dwelling	Natural sources such as rustling vegetation and bird song. Intermittent road traffic noise from the B6341 and more constant road traffic noise from the A1 was also present
LT3	Drythropple - within the garden of the dwelling	Baseline noise levels were influenced by distant, continuous road traffic noise from the A1, occasional car pass-by events on the B6347 and rustling vegetation
LT4	Charlton Hall - within the garden area to the east of the dwelling at approximately 100 m to the east of the A1	Dominated by road traffic on the A1

5.2.9. Due to problems encountered when on site with gaining access to ST5, along with noise generative activities and technical difficulties encountered at LT3, it was not possible to complete all measurements at the time of the initial survey. As part of the work to be undertaken at the ES stage, additional site visits will be undertaken to complete measurements not yet undertaken.

5.2.10. When in attendance on site at location ST4 it was noted that the northbound carriageway of the A1 was closed to traffic with all traffic (northbound and southbound) using the southbound carriageway. The roadwork section was noted to start at a point to the north of the A1 junction with Charlton Hall Road, and continued northwards beyond ST4. Based on on-site observations, it was concluded that measurement locations other than ST4 were unaffected by the night-time road works. It was noted that roadworks and associated traffic management were not in place during the day.

5.2.11. During attendance on site on 11, 12 and 13 September 2018, weather conditions were observed to be conducive to obtaining accurate and reliable noise measurement data, remaining dry with wind speeds generally below 5 m/s. During the remainder of the survey period which was unattended, meteorological data has been obtained from www.wunderground.com for weather station IALNWICK14, which is the closest to the Scheme. **Appendix E**, Charts 1 and 2 present the rainfall, wind speed and wind direction data for the remaining duration of the survey.

5.2.12. On analysis of this weather data, data collected during rainy periods and periods where wind speeds were consistently above 5 m/s have been discounted from the baseline measurement data. **Table 5-9** sets out periods have been excluded.

Table 5-9 - Periods excluded due to weather

Date	Period start	Period end	details
18/09/18	07:15	09:15	Data excluded due to rainfall
13/09/18	13:30	16:30	Data excluded due to winds in excess of 5 m/s
14/09/18	09:45	14:30	
18/09/18	12:40	17:05	
19/09/18	08:15	12:05	

5.2.13. A summary of the measured baseline noise levels is presented within **Appendix F**.

Noise Important Areas

5.2.14. The current Noise Action Plan for major roads (Defra, 2014 (**Ref 5.2.2**)) outlines a number of NIAs at round 2 of the UK noise mapping project[4]. These NIAs were identified in accordance with the requirements of the EU Environmental Noise Directive (2002/49/EC), and comprise areas that have a greater level of exposure to road traffic noise.

5.2.15. The closest NIA to the Scheme is NIA1001 which is located at a distance of approximately 2.1 km to the north of the closest section of Scheme and falls well outside of the defined operational study area.

Sensitive Receptors

5.2.16. In accordance with the DMRB HD 213/11 Volume 11, Section 3, Part 7 “Noise and Vibration” (**Ref.5.2.1**), examples of sensitive receptors include dwellings, hospitals, schools, community facilities, designated areas (e.g. AONB, National Park, SAC, SPA, SSSI, SM), and PRoW.

5.2.17. As the Scheme passes through a rural area, it is likely that the majority of sensitive receptors would comprise residential, educational and cultural heritage assets. There are no statutory landscape or wildlife areas which are likely to be affected.

5.2.18. The following sensitive receptors have the potential to experience a change in noise and vibration levels during both the construction phase and the operational phase (this list is not definitive and may be subject to change during progression of the noise and vibration assessments). The majority of listed receptors are also indicated within the Environmental Constraints Plan (**Figure A3** in **Appendix A**):

- 1 to 13 The Cottages;
- The Cottages;
- Charlton Hall;
- East Link Hall Farm and Cottages;

[4] Noise mapping was undertaken to inform the Noise Action Plan: Roads. Round 2 refers to the noise mapping that was undertaken in 2012.

- West Link Hall Farm and Cottages;
- Patterson Cottage;
- Drythropple;
- Rook Moor House;
- Rook Moor Farm House and Cottages;
- Riding Centre at Rook Moor;
- Rock Midstead Farm and Cottages;
- Rocking Horse Café;
- West Mires Cottage;
- The Old House;
- Rock Lodge;
- Rock South Farm and Cottages;
- Heiferlaw Bank;
- Heckley Fence, Heckley House & Stables, and Heckley Cottage;
- Rennington Moor;
- Heckley House & Cottage;
- Broxfield Farm & Cottages;
- Southmoor, Westfield, Pirley Moor Cottage, The Steadings, and The Olde Shieldings, Denwick Lane End;
- Moor House;
- Whinney Moor;
- Lane End Cottages;
- Broomhouse Farm Cottages;
- Golden Moor Farm; and
- East Cawledge Park Farm and Cottages.

5.2.19. As the assessments progress, noise sensitive receptors will be refined and will be confirmed within the ES.

POTENTIAL IMPACTS

Construction

5.2.20. In addition to the construction of the new carriageway, construction activities, such as piling, breaking and demolition can cause temporary high levels of noise and vibration. In the case of this Scheme, such works are anticipated to be required at specific locations, including the following key elements:

- Construction of Broxfield Bridge. Construction of Rook South Farm access track.
- Construction of Charlton Mires Junction.
- Construction of West and East Linkhall access tracks.
- Demolition works at East Cottage and Charlton Mires Farm.

5.2.21. In addition, the above specific works, it is also possible that temporary high levels of noise and vibration may result due to the following works undertaken at varying points along the length of the Scheme:

- General widening in verges.
- Utility diversions.
- Box culvert construction and extensions throughout the Scheme.

- Installation of temporary sheet piles for excavations.
- Potential rotary drilling and the grout pump for the coal mining grouting throughout the Scheme.

5.2.22. Three locations for temporary site compounds have been identified, with a maximum of two being used for the construction of the Scheme. There are two proposed off-site construction compounds (Main Compound and Lionheart Enterprise Park Compound) and one on-site construction compound (Charlton Mires Compound). Any identified noise sensitive receptors within close proximity to these construction compounds have the potential to experience adverse impacts as a result of noise and / or vibration levels which may be generated. The construction compounds which are to be considered within the ES noise and vibration chapter include the Main Compound to the west of Thirston New Houses which would be shared with the A1 in Northumberland: Morpeth to Felton scheme, the Lionheart Enterprise Park Compound and Charlton Mires Compound (see **Figure A2: General Arrangement** in **Appendix A**).

5.2.23. The proximity of the above identified sensitive receptors to the Scheme (and those in the vicinity of any proposed construction compounds) allied to the scale and complexity of the works, means that there is potential for some disruption, albeit temporary, during the construction phase. Most of the works would be undertaken during midweek daytime periods, potential impacts would therefore generally be constrained to these periods, however, it is anticipated that some night-time, evening and weekend work may be required with resulting potential temporary impacts applicable to these periods.

5.2.24. Various road closures would be required along the A1 during construction of the Scheme, thus necessitating the requirement for diversion routes to be put in place. The potential diversion routes currently being considered are located along the A1, B6341, and B6347. The diversion routes would be implemented at weekends (nights and days) and during the night on weekdays. It is therefore possible that potential noise impacts would be experienced at sensitive receptors local to these routes as a result of changes to traffic flow and composition during periods when diversion routes are in place.

5.2.25. The potential impacts associated with the construction of the Scheme are likely to include:

- The generation of noise and vibration from on-site activities during the construction phase potentially causing a temporary disturbance to proximate sensitive receptors.
- An increase in noise emissions from road traffic and non-road mobile machinery (NRMM), which may potentially cause a temporary disturbance to proximate sensitive receptors.

5.2.26. The significance of these potential impacts is dependent upon a number of factors including, but not limited to, the level of noise or vibration generated, the location of sensitive receptors and the duration of noise / vibration generative activities.

Operation

5.2.27. The potential adverse and beneficial effects associated with the operation of the Scheme are likely to include:

- The change in physical alignment of the road, associated junctions and works to minor road links that would change the physical location of vehicles. These changes would also have the potential to result in changes to vehicle flow characteristics such as flow volumes, composition, and speeds with associated effects on noise levels experienced at local sensitive receptors adjacent to the Scheme.

5.2.28. At this stage, the Scheme traffic data has been analysed and used to define the noise study area which is expected to be adopted for the ES operational phase assessment. The noise study area has been defined following the prescribed methodology presented within DMRB 213/11 (**Ref.5.2.1**). This assessment work has included the following:

- The start and end points of the physical works associated with the Scheme have been identified along with existing routes that are being improved.
- A boundary 1 km from the carriageway edge of the routes identified has been determined.
- Adopting the calculation methodology presented within the former Department of Transport / Welsh Office technical memorandum Calculation of Road Traffic Noise (CRTN) (**Ref 5.2.3**), a series of Basic Noise Level (BNL) calculations have been undertaken for the full road traffic network considered within the Transport Assessment to determine affected links both within the defined 1 km buffer and outside of this. An affected route is where there is the possibility of a change of 1 dB $L_{A10, 18h}$ or more in the short-term or 3dB $LA10_{, 18h\ or}$ more in the long term (i.e. conditions (ii), (iii), (iv), or (v) given in paragraph A1.8 of HD 213/11 (**Ref.5.2.1**)).
- A 600 m boundary from the carriageway edge around each of the routes identified above and also 600 m from any other affected routes within the 1 km boundary have been determined. The total area within these 600 m boundaries is termed the 'calculation area'.

5.2.29. The identified affected links in the short-term and long-term are presented in **Figures A6: Short Term Affected Routes** and **Figure A7: Long Term Affected Routes** in **Appendix A**. The defined study area is presented within **Figure A8: 1 km Study Area and 600 m Calculation Area** in **Appendix A**.

Accommodation bridge options

5.2.30. Construction of the proposed bridge at either Heckley Fence or Broxfield has the potential to result in adverse noise and vibration effects at sensitive receptors located close to each bridge. Such effects are expected to be limited to the construction phase and would therefore be short-term and temporary in nature.

5.2.31. The Heckley Fence option is in close proximity to one residential dwelling located at Heckley Fence at a distance of approximately 45 m to the west. The next closest receptor is Hollywell Farm Cottage at approximately 510 m to the north-west.

5.2.32. The closest noise sensitive receptors to the Broxfield option include Heckley Cottage and Heckley House to the west at distances of approximately 400 m and 550 m respectively, and Broxfield Farm at approximately 590 m to the east.

5.2.33. Given the close proximity of the dwelling at Heckley Fence to the Heckley Fence option, it is expected that adverse construction phase noise and vibration effects have the potential to be greater when compared to those associated with the construction of the Broxfield option.

DESIGN, MITIGATION AND ENHANCEMENT MEASURES

Construction

5.2.34. Mitigation for temporary construction phase effects will be identified during the EIA. Good practice measures would be used to control noise and set out within a CEMP. Such measures may include the following:

- The use of silenced or sound reduced plant and equipment fitted with acoustic enclosures.

- Pneumatic tools to be fitted with silencers or mufflers.
- Deliveries to the site to be programmed, as far as possible, to arrive during daytime hours only. Delivery vehicles to be routed so as to minimise disturbance to local residents.
- All plant items to be properly maintained and operated according to manufacturer's recommendations in such a manner as to avoid causing excessive noise.
- All plant to be sited so that the noise impact at nearby noise sensitive properties is minimised.
- Local hoarding, screens or barriers to be erected as appropriate to shield particularly noisy activities.
- The adoption of a considerate and neighbourly approach including works only taking place during given periods.
- Measurement of noise levels at sensitive receptor locations during construction works.

5.2.35. Further location specific mitigation measures may be required, and will be set out in the ES and included in a CEMP.

Operation

5.2.36. As part of the design, low noise Thin Surface Course System (TSCS) would be incorporated along the main A1 carriageways within the Scheme extents.

5.2.37. Other mitigation measures such as noise barriers and noise insulation works will be considered through the EIA.

LIKELY SIGNIFICANT EFFECTS

5.2.38. The comparison of preliminary likely significant effects between the two accommodation bridge options are set out in **Table 5-10** below, based upon currently available information and professional judgement. However, these effects could change as the EIA progresses. Mitigation measures are outlined in the above section.

Table 5-10 - Preliminary Likely Significant Effects of the two accommodation bridge options

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
Heckley Fence	Construction	The generation of noise from on-site activities including night-time and evening working, together with an increase in noise emissions from construction and road traffic, could cause a temporary adverse noise effect resulting in loss of amenity.	Not anticipated	Anticipated with increased potential where night-time eve and weekend works take place.
	Operation	No potential effects anticipated.	Not anticipated	Not anticipated
Holywell Cottage	Construction	The generation of noise from on-site activities including night-time and evening working,	Not anticipated	Not anticipated but with increased

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
		together with an increase in noise emissions from construction and road traffic, could cause a temporary adverse noise effect resulting in loss of amenity.		potential where night-time eve and weekend works take place.
	Operation	No potential effects anticipated.	Not anticipated	Not anticipated
Heckley House & Heckley Cottage	Construction	The generation of noise from on-site activities including night-time and evening working, together with an increase in noise emissions from construction and road traffic, could cause a temporary adverse noise effect resulting in loss of amenity.	Not anticipated but with increased potential where night-time eve and weekend works take place	Not anticipated.
	Operation	No potential effects anticipated.	Not anticipated	Not anticipated
Broxfield Farm	Construction	The generation of noise from on-site activities including night-time and evening working, together with an increase in noise emissions from construction and road traffic, could cause a temporary adverse noise effect resulting in loss of amenity.	Not anticipated but with increased potential where night-time eve and weekend works take place	Not anticipated.
	Operation	No potential effects anticipated.	Not anticipated	Not anticipated

5.2.39. A summary of the preliminary likely significant effects is presented in **Table 5-11** below, based upon currently available information and professional judgement. However, these effects will be explored in further detail through the EIA and could change as the EIA progresses.

5.2.40. At this stage, no residual vibration effects are expected during construction and operation. However, this will be considered further during the EIA.

Table 5-11 - Summary of Preliminary Likely Significant Effects – noise and vibration

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Receptors located to the east of the Scheme (e.g. West Lodge, Charlton Hall, East Link Hall Farm, Drythropple, dwellings at Rock Midstead, Rock South Farm & Cottages)	Construction	The generation of noise from on-site activities including night-time and evening working, together with an increase in noise emissions from construction and road traffic, could cause a temporary adverse noise effect resulting in loss of amenity.	Good practice measures would be used to control noise, and will be incorporated into a CEMP.	Anticipated for a small number of closest receptors, with increased potential where night-time eve and weekend works take place.
	Operation	Increased operational traffic flows, changes to traffic speed and composition, and road traffic noise moving closer to properties the east of the new carriageway could generate adverse effects upon sensitive receptors.	Low noise surfacing (TSCS). Consideration of the need for environmental noise barrier or earthworks to screen properties.	Anticipated for a small number of closest receptors.
Receptors located to the west of the Scheme (e.g. Heckley House, Heckley Fence, Heiferlaw Bank, Rock Lodge, The Old House, West Mires Cottage, Patterson Cottage, West Link Hall Farm & Cottages)	Construction	The generation of noise from on-site activities including night-time and evening working, together with an increase in noise emissions from construction and road traffic, could cause a temporary adverse noise effect resulting in loss of amenity.	Good practice measures would be used to control noise, and will be incorporated into a CEMP.	Anticipated for a small number of closest receptors, with increased potential where night-time eve and weekend works take place.
	Operation	Increased operational traffic flows and changes in traffic speed and composition could generate adverse effects upon sensitive receptors.	Low noise surfacing (TSCS). Consideration of the need for environmental noise barrier or earthworks to screen properties.	Anticipated for a small number of closest receptors.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Receptors located close to Charlton Mires Junction (e.g. West Mires Cottage, Drythropple)	Construction	The generation of noise from on-site activities including night-time and evening working, together with an increase in noise emissions from construction and road traffic, could cause a temporary adverse noise effect resulting in loss of amenity.	Good practice measures would be used to control noise, and will be incorporated into a CEMP.	Anticipated
	Operation	The change in physical location of traffic using the junction, increased operational traffic flows, and changes to traffic speed and composition could generate adverse effects upon sensitive receptors.	Low noise surfacing (TSCS). Consideration of the need for environmental noise barrier or earthworks to screen properties.	Anticipated
Receptors located close to Broxfield bridge (e.g. Broxfield Farm, Heckley Cottage)	Construction	The generation of noise from on-site activities including night-time and evening working, together with an increase in noise emissions from construction and road traffic, could cause a temporary adverse noise effect resulting in loss of amenity.	Good practice measures would be used to control noise, and will be incorporated into a CEMP.	Anticipated for a small number of closest receptors during night-time and evening operations.
	Operation	Increased operational traffic flows and changes in traffic speed and composition could generate adverse effects upon sensitive receptors.	Low noise surfacing (TSCS). Consideration of the need for environmental noise barrier or earthworks to screen properties.	Not Anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Receptors located immediately adjacent to temporary diversion routes	Construction	Increase in traffic flows and a change in traffic composition (greater percentage HDVs) could cause a temporary adverse noise effect resulting in loss of amenity	Good practice measures would be used to control noise, and will be incorporated into a CEMP.	Anticipated at some of the closest receptors to diversion routes.
	Operation	No potential effects anticipated.	No significant effects anticipated therefore no mitigation measures likely to be required.	Not anticipated
Receptors located in close proximity to Rock South Farm Access Track (e.g. Rock South Farm & Cottages, Rock Midstead, Farmhouse, and Cottages)	Construction	The generation of noise from on-site activities, together with an increase in noise emissions from construction and road traffic, could cause a temporary adverse noise effect resulting in loss of amenity.	Good practice measures would be used to control noise, and will be incorporated into a CEMP.	Anticipated at the closest receptors.
	Operation	No potential effects anticipated.	No significant effects anticipated therefore no mitigation measures likely to be required.	Not anticipated
Receptors located in close proximity to construction compounds (e.g. East Cawledge Park Farm and Thirston New Houses)	Construction	The generation of noise from compound activities, together with an increase in noise emissions from construction and road traffic, could cause a temporary adverse noise effect resulting in loss of amenity.	Good practice measures would be used to control noise, and will be incorporated into a CEMP.	Not anticipated
	Operation	No potential effects anticipated.	No significant effects anticipated therefore no mitigation measures likely to be required.	Not anticipated

FURTHER WORK FOR THE EIA

5.2.41. A detailed level assessment of potential impacts on noise and vibration during the construction and operational phases of the Scheme will be undertaken in accordance with the methodology set out in DMRB HD 213/11 Volume 11, Section 3, Part 7 "Noise and Vibration" (**Ref. 5.2.1**) and following the approach set out within the Scoping Report (**Volume 2, Appendix A, Chapter 7 Noise and Vibration**). This will include the following:

- A quantitative assessment of construction noise and vibration;
- A full assessment of permanent traffic noise impacts;
- An assessment of potential eligibility of receptors under the Noise Insulation Regulations (NIR);
- An operational noise and vibration nuisance assessment; and
- An assessment of cumulative operational noise and vibration impacts considering this Scheme and the A1 in Northumberland: Morpeth to Felton scheme in combination.

5.2.42. Additional baseline noise measurements will be undertaken at locations not yet completed during the initial baseline noise survey. Together with professional judgment, the results of the surveys will be used for model verification purposes and to inform the construction noise assessment. The additional noise measurement data will be reported along with that already presented as part of the EIA.

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

5.2.44. The Scheme will be assessed as a whole against the aims of National Noise Policy as set out within the Noise Policy Statement for England (NPSE) (**Ref 5.2.4**). In line with the NPSE, both LOAEL[5] and SOAEL[6] will be considered for construction and operational noise and vibration and will follow the approach detailed within the Scoping Report (**Volume 2, Appendix A)**.

5.2.45. It is noted that, a noise level above SOAEL does not automatically result in a significant environmental effect. Other factors including, but not limited to the following may also influence whether levels above SOAEL may result in a significant environmental effect:

- Predicted noise level change;
- Circumstances of receptors (e.g. where receptors have reduced sensitivity to noise due to good noise insulation, noise levels above a defined SOAEL may not result in a significant environmental effect at that receptor);
- Acoustic context;
- Likely perception of residents; and
- The duration for which a SOAEL is reached or exceeded.

[5] Lowest Observed Adverse Effect Level – This is the level above which adverse effects on health and quality of life can be detected.
[6] Significant Observed Adverse Effect Level - This is the level above which significant adverse effects on health and quality of life occur.

5.2.46. For construction noise or vibration, a significant environmental effect will be reported if levels above SOAEL thresholds are predicted at residential and other sensitive receptors for 10 days (or nights) or more in any 15, or for more than 40 days (or nights) in any six-month period. SOAEL thresholds will be defined based on relevant guidance presented within BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise (**Ref 5.2.5**) and Part 2: Vibration (**Ref 5.2.6**)

5.2.47. For operational noise and vibration, the methodology presented within Section 3 of HD 213/11 will be used to define the magnitude of a predicted noise level change. The magnitude of change between the Do-minimum scenario in the baseline year against the Do-something scenario in the baseline year (short term) will be used as a starting point for determining significance of effect. Justification for the determined level of significance will be provided considering a number of contextual factors including, but not limited to, differing magnitude of change predicted in the long term compared to the short term, absolute noise level with reference to LOAEL and SOAEL, circumstances of receptors, acoustic context, likely perception of change by residents, and whether there are any designated sites which are predicted to be affected.

5.2.48. In addition to the assessment detailed in the Scoping Report, and in response to the Scoping Opinion (refer to **Volume 2, Appendix B, Section 4.2**), the following will be carried out for the EIA:

- Assessment of noise and vibration, during both the construction and operational phase, on nationally and locally designated, and non-designated ecological sites will also be included.
- Construction and operational assessment study areas will be defined in accordance with applicable standards and guidance and will be agreed with the relevant consultation bodies.
- As part of the detailed construction phase assessments, the anticipated construction programme and working hours will be considered and will be clearly set out along with any assumptions made as part of the assessment.
- The effectiveness of any proposed mitigation measures will be thoroughly assessed in the ES.
- The calculation methodology to be applied within the construction vibration assessment will be clearly set out within the ES.
- The methods adopted for assessing construction noise, including the derivation of appropriate construction noise assessment criteria will be clearly set out within the ES.

5.3 LANDSCAPE AND VISUAL EFFECTS

INTRODUCTION

5.3.1. This section considers the potential effects of the Scheme on landscape and visual amenity during construction and operation and details any potentially significant effects.

5.3.2. The Landscape and Visual Impact Assessment (LVIA) considers the two separate (but linked) topics of:

- Landscape: landscapes take their character from a combination of elements, including landform, land use and pattern, land cover (vegetation and built form), open space and the influence of heritage features.
- Visual Amenity: a view, its components and context can have great effect on the quality of people's lives.

Scope and methodology

Scope of the Assessment

5.3.3. This section provides an update on the scope of the assessment and re-iterates / updates the evidence base for effects following further iterative assessment since submission of the **Scoping Report, Volume 2, Appendix A** and work completed as part of the simple assessment within the Options Selection Stage EAR.

5.3.4. For the purpose of this LVIA, all 'Moderate and Major' landscape and visual effects are considered to be significant. All other effects (Negligible to Minor) are considered not significant.

Guidance

5.3.5. The following guidance documents have been used during the preparation of this section and methodology:

- DMRB IAN 135/10 (**Ref 5.3.1**); and
- Guidelines for Landscape and Visual Assessment, 3rd Edition, (GLVIA3) (2013) (**Ref 5.3.2**).and
- Photography and photomontage in landscape and visual impact assessment, Landscape Institute Advice Note 01/11(**Ref 5.3.3**).

Assessment Methodology

5.3.6. The EIA Scoping Report as presented in **Volume 2 (Appendix A**) sets out the methodology and sensitivity criteria for this assessment at paragraph **8.7.5**.

EXISTING BASELINE KNOWLEDGE

Method of Baseline Data Collation

Desk Study

5.3.7. A desk based review of existing information including Local Plans, supplementary planning documents, character assessments, aerial photographs and Ordnance Survey data was undertaken in order to determine landscape pattern, existing landscape features and landscape character.

Zone of Theoretical Visibility (ZTV)

5.3.8. A ZTV is a tool used to assist the design and assessment process.

5.3.9. The ZTV shows the area within which there may theoretically be views of the Scheme as shown on **Figure A9: Zone of Theoretical Visibility** in **Appendix A**.

5.3.10. For this LVIA, the ZTV has been computer generated using OS Terrain 5 data, with an observer height of 1.5 m. It shows the theoretical visibility of a line 4.5 m above the Scheme centreline based on existing ground levels (to allow for views of high-sided vehicles) and the high points of the bridge and junction.

5.3.11. Inclusion of an area within the ZTV is not an indicator that all potential receptors within the area would experience views of the Scheme, but rather establishes the area where there would be a view in the absence of any above-ground features. Many views from potential receptors within the ZTV would be screened or filtered by features such as individual buildings, hedgerows, small copses or localised variations in landform.

5.3.12. The ZTV demonstrates that the Main Scheme Area would potentially be visible within the immediate context of the A1 and potentially within long range views to the north east near High Newton-by-the-Sea. To the south the ZTV illustrates that the potential visibility of the Scheme and the proposed compound extends to Shilbottle and to areas on higher ground in Hulme Park to the south-west of the Main Scheme Area. To the north-west potential visibility extends to the areas of higher ground near Cateran Hill.

Field Visit

5.3.13. Baseline field visits were carried between the 1 and 4 of October 2018 and 5 of February 2019 in clear conditions. The extents of the computer generated ZTV were walked and reviewed on Site to refine the proposed study area, taking into account features affecting visibility e.g. built form and vegetation, which would potential filter / screen views. This analysis determined the potential visibility of the Scheme, visual receptors and study area as shown on **Figure A13: Visual Receptor Plan** in **Appendix A**.

5.3.14. All the viewpoint locations were noted and photographs of each view taken. Photographs were taken using a Nikon D3200 (digital camera with a 35 mm lens[7].

5.3.15. The photographs were combined into panoramas using ‘Photoshop CS6’ software and for each receptor the key features of the existing view were described. Views into the Scheme from the surrounding area were assessed and a study area determined and plotted on an OS plan as illustrated on **Figure A10: Viewpoint Locations Plan** in **Appendix A**.

Study Area

5.3.16. An initial study area was defined based on a review of desk study information and the ZTV as set out in paragraph 5.3.12 above. This initial study area was refined to a 2 km study area, as illustrated on **Figure A13: Visual Receptor Plan** in **Appendix A**. The study area was refined as a field visit

[7] ‘normal’ or ‘standard’ lens, equivalent to a 35 mm format SLR with a 50 mm lens, considered to give an image close to that perceived by the human eye.

determined that significant landscape and visual effects are unlikely to occur beyond 2 km, due to the layering of vegetation, built form and topography limiting broader visibility.

Consultation

5.3.17. Consultation was undertaken with NCC and a number of other consultees during September 2018 to agree viewpoint locations and the assessment methodology. A summary of the consultation is set out in **Table 5-12** below.

Table 5-12 – Consultation Summary

Consultee	Summary of Response	Action
Historic England	Deferred to local knowledge of NCC landscape and heritage officers. However, suggested a viewpoint within the Rock Conservation Area.	The Rock Conservation Area was visited during the Summer 2018 site visit, at this time the Rock Farm Trail was walked to determine a potential viewpoint location. However due to the distance from the Main Scheme Area and lack of inter-visibility with the site caused by the layering of intervening vegetation and built form no suitable viewpoint location was found.
NCC – Landscape Planner	Broadly agreed with the viewpoints chosen for receptors identified. Requested further assurances the Scheme would not have an adverse impact on the AONB.	Areas of the AONB shown to have views of the Scheme in the ZTV were visited during October 2018. Due to intervening landform and layering of field boundary vegetation views to the A1 are limited, where long distance views are available the proposed construction activities and Scheme would be a feature within the backdrop of wider landscape views. As a result, receptors are not anticipated to experience significant visual effects and therefore have been scoped out of the visual assessment. The AONB falls within a number of LCA's and will assist in determining the overall of value of these areas for the landscape assessment.
NCC – AONB Officer	*"Content that the Alnwick to Ellington Improvement Scheme will not have a significant effect on the special qualities of the Northumberland Coast AONB and so have no further comments."*	N/A
NCC – Conservation Team	No response received.	N/A

Consultee	Summary of Response	Action
Natural England	Agreed with the proposed methodology and selected viewpoint locations.	N/A
Northumberland National Park	Agreed with the proposed viewpoint locations.	N/A

5.3.18. The baseline field work and desk study were carried out in October 2018 and February 2019, which identified a number of landscape and visual receptors. The data collated during this work forms the basis of this assessment.

5.3.19. For the purpose of this PEIR the Scheme consists of the following components:

- Main Scheme Area– A1 transport corridor, including Charlton Mires Site Compound;
- Lionheart Compound - Temporary Construction Compound; and
- Main Compound – Temporary Construction Compound.

Landscape Character

5.3.20. GLVIA 3 describes landscape character as *"A distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another."* The following sections review the statutory designations and landscape context to understand the existing landscape features, pattern, grain, scale and their overall contribution to landscape character.

Statutory Designations

5.3.21. Northumberland Coast AONB lies approximately 5 km to the east of the Scheme as shown on **Figure A10: Viewpoint Locations Plan** in **Appendix A**. The Scheme is not located within the boundary of the AONB. However, NCC recommended during consultation that the LVIA responds to the Scheme's proximity to the AONB boundary and clearly explores how the site contributes to the setting of the AONB both in visual and landscape character terms.

5.3.22. Alnwick Castle Registered Park and Garden is located approximately 1 km to the south-west of the Main Scheme Area as shown on **Figure A3: Environmental Constraints Plan** in **Appendix A**.

5.3.23. Statutory designations that contribute to sense of place, but do not directly relate to landscape, are shown on **Figure A3: Environmental Constraints Plan** in **Appendix A**. Designations include Listed Buildings and Scheduled Ancient Monuments, the settings of which are discussed in detail in **Section 5.4 - Cultural Heritage**. However, the LVIA considers the visual effects of the Scheme for those visitors to the heritage assets.

Non-statutory Designations

5.3.24. **Figure A3: Environmental Constraints Plan** in **Appendix A** illustrates the location of a number of Areas of Landscape Value, which are designated within local policy and set out below:

- The former Berwick-upon-Tweed Borough Local Plan (**Ref 5.3.4**) designated the Kyloe Hills and Glendale Area of High Landscape Value (AHLV), located to the north and west of the Main Scheme Area near Glanton and Brownieside (saved policy);
- The former Alnwick District Wide Local Plan (**Ref 5.3.5**) designated an AHLV which runs in close proximity to the west of the Main Scheme Area and to the south (saved policy); and

- The former Berwick-upon-Tweed Borough Local Plan (**Ref 5.3.4**) designated an Intermediate Area of Landscape Value (IALV), located to the north of the Main Scheme Area near Brownieside.

5.3.25. Further non-statutory designations that contribute to sense of place, but do not directly relate to landscape, are shown on **Figure A3: Environmental Constraints Plan** in **Appendix A**. Designations include Ancient Woodlands, which are discussed in detail in **Section 5.5 - Ecology**

Landscape Context

5.3.26. The study area lies 5 km west of the Northumberland Coast. The A1 road is a large linear feature which dissects the gently rolling landscape. To the east, the landform gradually rises to approximately 100 m AOD near Rennington Moor. To the west, the land is slightly hillier with more undulations and a high point of approximately 140 m AOD near White House Folly.

5.3.27. The River Aln meanders through the south of the study area. The A1 is a noticeable straight feature which cuts across the irregular grain of the landscape, minor roads weave through the landscape. Settlement pattern consists of sparsely scattered farmsteads and small self-contained villages across most of the study area with the larger town of Alnwick to the south-west. A number of PRoWs are present within the study area which connect farmsteads and small settlements (see **Figure A3: Environmental Constraints Plan** in **Appendix A**).

5.3.28. Wind turbines of Middlemoor and Wandylaw Wind Farms are a noticeable skyline feature of the landscape to the west as shown in **Figure 5-1**. Field boundaries are defined by low hedgerows, which enable long expansive views across the majority of the landscape. In localised areas, (near Alnwick and along sections of close proximity PRoW) views are filtered by the undulating landform and woodland and plantation tree planting.

Figure 5-1 - View to the west across the A1

National Character Areas

5.3.29. The Scheme lies partly within National Character Area (NCA): Northumberland Sandstone Hills (**Ref 5.3.6**), (to the west) and partly within NCA: Northumberland Coastal Plain (**Ref 5.3.7**), (to the east). Key characteristics of both NCAs relevant to the study area are set out below:

Northumberland Sandstone Hills

- *"Scattered pattern of individual isolated farmsteads and small hamlets, served by the main market town of Alnwick and smaller service centre of Rothbury. Buildings constructed from locally quarried dressed or rubble sandstone, with slate roofs;*
- *Tranquil, rural landscape with low population and a few strategic major roads but with increasing numbers of vertical structures such as communications masts and wind turbines prominent on the skyline";*

Northumberland Coastal Plain

- *"Farmed landscape of predominantly large, open arable fields and permanent pasture, with some remnant semi-natural grassland in the valleys and coastal fringes. Fields are bounded by low, often fragmented hedgerows, grey sandstone walls and post-and-wire fences;*
- *Dispersed pattern of isolated large-scale farmsteads, small nucleated villages, fishing villages and small coastal resort towns, with buildings often single storey and commonly constructed from local sandstone with roofs of blue slate or red clay pantiles;* and
- *Coastal trails, wildlife and historic sites attract large numbers of visitors to this popular area of coast, with access provided by the A1 and East Coast Main Line."*

Regional Landscape Character Areas

5.3.30. The Northumberland Landscape Character Assessment (**Ref 5.3.8**) provides detail about Regional Landscape Character Areas (Regional LCAs) and Landscape Character Types (LCTs), the Scheme lies within a number of LCAs as set out below:

Main Scheme Area and Charlton Mires Compound:

- 8c Charlton Ridge LCA (Outcrop Hills and Escarpments LCT);
- 3c Rock LCA (Farmed Coastal Plain LCT);

Lionheart Enterprise Park Compound:

- 2a Lower Aln LCA (Coastal Incised Valley LCT);
- 38a Longframlington LCA (Lowland Rolling Farmland LCT);

Main Compound:

- 38b Longhorsley LCA (Lowland Rolling Farmland LCT).

5.3.31. The following Regional Landscape Character Areas are also present within the 2-5 km, wider study area:

- 10a Rosebrough Moor LCA (Smooth Moorland LCT); and
- 7a Hulne Park LCA (Estate Valley LCT).

5.3.32. The key characteristics of these Regional LCTs and LCAs are detailed within **Appendix G**. The location of the LCAs listed above and others in close proximity to the Scheme are shown on **Figure A11: Landscape Character Areas** in **Appendix A**.

Local Landscape Character

5.3.33. Following the receipt of the Scoping Opinion, the key characteristics of the Local Landscape Character Areas identified within the Alnwick LCA Supplementary Planning Document (**Ref 5.3.9**) have been included, as set out below:

Main Scheme Area and Charlton Mires Compound:

- 6 North East Farmed Coastal Plain LCA;
- 11 Charlton Ridge LCA;

Lionheart Enterprise Park Compound:

- 7 Lower Aln Valley LCA;
- 18 Longframlington / Shilbottle Rolling Farmland LCA.

Main Compound:

- The main compound lies within the former Castle Morpeth District area. The relevant LCAs covering this district are no longer recognised within policy and have been superseded by the Regional LCA set out at paragraph 5.3.26 above.

5.3.34. The information contained within the Alnwick Local Landscape Character Assessment (**Ref 5.3.9**) will be used to inform the assessment and mitigation proposals to ensure the Scheme responds at a local scale.

Scheme Specific Landscape Character

5.3.35. The Scheme lies north of the built-up area of Alnwick, west of the Northumberland Coast AONB (over 5 km), south of Brownieside and east of Middlemoor Windfarm. The landscape is gently undulating with a highpoint along the existing A1 alignment of approximately 112 m AOD (representative view shown in **Figure 5-2** below). To the west, the landform within the study area continues to rise to a high point of approximately 140 m AOD near White House Folly and to the east a highpoint of approximately 100 m AOD near Rennington Moor.

5.3.36. The undulating landform contains fields of arable pasture and improved grassland bordered by a variety of treatment types (walls, fences and hedgerows) as shown in **Figure 5-2** below and **Figure A18 Phase 1 Habitat Survey** in **Appendix A**. A number of plantation woodlands and waterbodies have also been identified within the study area.

5.3.37. The Lionheart Industrial Estate Compound is located to the south of the study area near Alnwick, bordered by an existing hedgerow to the south, existing industrial estate to the north and west, and an existing PRoW to the west.

5.3.38. The Main Compound is located further south off the B6345, this site is bordered by existing tree and hedgerow planting on all boundaries.

Figure 5-2 - View from the layby looking to the south along the A1

Figure 5-3 - View towards the existing A1 from The Avenue, illustrating the variety of land uses within the study area

5.3.39. **Table 5-13** below lists the LCAs considered within the assessment.

Table 5-13 - List of Receptors for Landscape Assessment

Landscape Character Area
8c Charlton Ridge LCA within Outcrop Hills and Escarpments LCT
3c Rock LCA within Farmed Coastal Plain LCT
38a Longframlington LCA within Lowland Rolling Farmland LCT
2a Lower Aln LCA within Coastal Incised Valley LCT
38b Longhorsley LCA within Lowland Rolling Farmland LCT
6 North East Farmed Coastal Plain LCA
11 Charlton Ridge LCA
7 Lower Aln Valley LCA
18 Longframlington / Shibottle Rolling Farmland LCA

5.3.40. The following LCAs have been scoped out of the assessment, due to lack of intervisibility between the character areas and the Scheme:

- 10a Rosebrough Moor LCA (Smooth Moorland LCT); and
- 7a Hulne Park LCA (Estate Valley LCT).

5.3.41. The Northumberland Coast AONB has been scoped out of the assessment, due to the lack of inter-visibility between the AONB and the Scheme. There would be no anticipated landscape or visual effects on those receptors within, nor the landscape character of the AONB due to the Scheme. However, as the AONB lies within the 3c Rock and 2a Lower Aln LCA's it will raise the sensitivity of these character areas for the assessment.

Visual Amenity

5.3.42. To establish the degree of change anticipated from the Scheme, it is important to understand the baseline situation in terms of visual amenity, and availability of views from within the local area.

Viewpoint Locations

5.3.43. Viewpoints have been selected to represent the nature and type of visual amenity from a given area or direction of view. They are not offered as the 'only view' but are used to inform a greater understanding of the extent of visibility and the nature of change.

5.3.44. GLVIA3 (**Ref 5.3.2**) recognises three types of viewpoint:

- Representative: selected to represent the experience of different types of visual receptor, where large numbers of viewpoints cannot all be included individually and where significant effects are unlikely to differ – for example, certain points may be chosen to represent the views of users of particular public footpaths and bridleways;

- Specific: chosen because these are key and sometimes promoted viewpoints within the landscape, including for example specific local visitor attraction, viewpoints in areas of particularly noteworthy visual and/or recreational amenity such as landscapes with statutory landscape designations, or viewpoints with particular cultural landscape associations; and
- Illustrative: chosen specifically to demonstrate a particular effect or specific issues, which might, for example, be the restricted visibility at certain locations.
- The frequency, range and duration of the view, may however, vary. In many cases the viewpoints selected are representative of more than one type of receptor. And these elements will vary depending on whether the receptor is representative of residents, drivers or cyclists on local roads.

5.3.45. Based on the receptors identified during the site visit, a photographic record of 20 representative viewpoints have been selected from publicly accessible locations. These are set out in **Table 5-14** below and illustrated on **Figure A10: Viewpoint Locations Plan** (**Appendix A**) and **Figure A12: Viewpoint Photography** (**Appendix A**).

Table 5-14 - Viewpoint Locations

Viewpoint	Viewpoint Description
Viewpoint 1	View looking south-east from North Charlton, representative of nearby properties
Viewpoint 2	View looking east from West Linkhall, representative of nearby properties and walkers travelling along PRoW Refs 112 / 008 and 112 / 009
Viewpoint 3	View east from South Charlton, representative of nearby properties
Viewpoint 4	View looking north from Rock Lodge and Rock Nab, representative of nearby properties
Viewpoint 5	View looking east from Heiferlaw Bank, representative of nearby properties and walkers travelling along PRoW Refs: 110 / 010 and 110 / 018
Viewpoint 6	View looking east from Heckley Fence, representative of nearby properties and walkers travelling along PRoW Ref: 110 / 019
Viewpoint 7	View looking east from Heckley House, representative of nearby properties and walkers travelling along PRoW Ref: 110 / 013
Viewpoint 8	View looking north east along PRoW Ref: 110 / 004 and representative of nearby residential properties
Viewpoint 9	View looking west along PRoW Ref: 110 / 013, representative of adjacent PRoWs (129 / 022 and 129 / 014) and close proximity residents at Broxfield an Silvermoor
Viewpoint 10	View looking west from PRoW Ref: 129 / 009, representative of nearby properties at Rock South Farm
Viewpoint 11	View looking south west along PRoW Ref: 129 / 004 and representative of close proximity residential properties at Rock Midstead.
Viewpoint 12	View looking west, Charlton Mires from the B6347

Viewpoint	Viewpoint Description
Viewpoint 13	View looking north west from B6347, representative of nearby residents at Drythropple and Rock Moor House.
Viewpoint 14	View west from Chipperton Bridge, representative of nearby residential receptors at Chipperton Bridge and East Linkhall
Viewpoint 15	View looking north along PRoW Ref: 141 /013
Viewpoint 16	View looking south – westward from unnamed road and commercial development at Lionheart Enterprise Park
Viewpoint 17	View looking south from PRoW Ref: 129 / 005 and representative of adjacent PRoW (129 / 010, 129 /012 and 129 / 025) and nearby residents at West Farm
Viewpoint 18	View looking north west from B1340
Viewpoint 19	View looking west from PRoW Ref: 129 / 006
Viewpoint 20	View looking north east from B6341

5.3.46. The extent of visibility from the study area towards the Scheme is set out below and within **Figure A-10: Representative Viewpoint Location Plan** and **Figure A12: Viewpoint Photography**:

- To the north – the view towards the Main Scheme Area extends to the rear of properties at the southern edge of North Charlton (**Viewpoint 1**). Further north, visibility is restricted by intervening vegetation along Charlton Burn and local landform.
- To the east – views are available in close proximity to the Main Scheme Area and Charlton Mires Compound from the residential properties at East Linkhall and West Lodge (**Viewpoint 14**), Charlton Mires, Drythropple (**Viewpoint 12**), Rock Midstead Cottages and Farmhouse (**Viewpoint 11 and 13**), Broxfield (**Viewpoint 9**). Where gaps in vegetation and rise in ground levels allow, longer range views are available from PRoW Ref: 129/044, 129/005, 129/006, 129/009, 129/022 and 129/014 (**Viewpoint 9, 10, 17 and 19**).
- To the south-east – views towards the Main Scheme Area are available in close proximity from properties at Goldenmoor and the north-western edge of Denwick (**Viewpoint 18**). Further to the south-east of the study area where gaps in vegetation allow, views towards the Main Scheme Area would be available for road users travelling along the B1340.
- To the south-west – views toward the Lionheart Enterprise Park Compound are available in close proximity for walkers travelling along PRoW Ref: 141/013 over the western site boundary (**Viewpoint 15**). Views are available from the commercial receptors at Lionheart Enterprise Park in the middle distance and from the residential properties at Greensfield Moorhouse over intervening field boundary vegetation **(Viewpoint 16**).
- To the west – the undulating landscape lends itself to longer range views such as at properties at Brockley Hall, South Charlton, South Charlton Farm and the Whinny (**Viewpoint 3**). Close proximity views are available towards the Main Scheme Area for residents at West Linkhall

(**Viewpoint 2**), Rock Nab, Rock Lodge (**Viewpoint 4**), Heiferlaw Bank (**Viewpoint 5**), Holywell Cottage, Holywell, Heckley Fence (**Viewpoint 6 and 20**), Heckley House (**Viewpoint 7**), Loaning Head and Broom House Farm (**Viewpoint 8**). The properties at Rock Nab and Rock Lodge would also experience views of the Charlton Mires Compound at close proximity. Views are available from close proximity PRoW Ref: 110/004, 110/013110/019, 110/010, 112/009, 112/008.

- To the south of the study area, views are available towards the Main Compound Area from nearby residential properties (The Boarding House, Hemelspeth, Glenshotton, Cahore Cottage, Tithemans Cottage, Thirston New Houses and Thirston New House), for people travelling along PRoW Ref: 422/020 and recreational users of Eshott Airfield.

5.3.47. The visual receptors that will be considered as part of the assessment, and which are subject to agreement with the relevant stakeholders, are set out in **Table 5-15** below.

Table 5-15 - Receptors for Visual Assessment

Receptor Type	Ref	Receptor
Main Scheme Area		
Residential	1	Broom House (5 properties)
	2	Loaning Head (1 property)
	3	Heckley House and Heckley Cottage (2 properties)
	4	Heckley Fence (1 property)
	5	Heiferlaw Bank (1 property)
	6	Rock Lodge (1 property)
	7	Rock Nab (1 property)
	8	Holywell Cottage, Holywell (4 properties)
	9	Broxfield and surrounding properties (2 properties)
	10	West Linkhall Farmhouse and surrounding properties including Patterson Cottage and properties to the west
	11	Rock Midstead Cottages and Rock Midstead Farmhouse (6 properties)
	12	Rock South Farm (7 properties)
	13	Drythropple (1 property)
	14	Rock Moor House (1 property)
	15	West Lodge
	16	Properties at East Linkhall (2 properties)
	17	Properties at North Charlton
	18	Properties at South Charlton
	19	Whinny
	20	Brockley Hall Cottages and Brockley Hall
	21	South Charlton Farm

Receptor Type	Ref	Receptor
	22	Silvermoor
	23	Goldenmoor
	24	Properties at Denwick
Recreational	25	PRoW Ref: 112/008
	26	PRoW Ref: 112/009
	27	PRoW Ref: 129/004
	28	PRoW Ref: 129/005
	29	PRoW Ref: 129/009 and 110/003
	30	PRoW Ref: 110/019
	31	PRoW Ref: 110/010
	32	PRoW Ref: 129/022
	33	PRoW Ref: 110/013
	34	PRoW Ref: 110/004
	35	PRoW Ref: 129/014
	36	PRoW Ref: 129/006
Transport	37	Road users travelling along the A1
	38	Road users travelling along the B6347
	39	Road users travelling along the B6341
	40	Road users travelling along the B1340
Main Compound		
Residential	46	The Boarding House (6 Properties)
	47	Hemelspeth (8 Properties)
	48	Glenshotton
	49	Cahore Cottage (3 Properties)
	50	Tithemans Cottage (2 Properties)
	51	Thirston New Houses
	52	Thirston New House
Recreational	53	PRoW Ref: 422/020
	54	Recreational users of Eshott Airfield
Transport	55	Road users travelling along the unnamed local road
Lionheart Enterprise Park Compound		
Residential	41	Greensfield Moor Farm
Recreational	42	PRoW Ref: 141/013

Receptor Type	Ref	Receptor
	43	PRoW Ref: 141/022
Transport	44	Road users travelling along the unnamed road
Commercial	45	Lionheart Industrial Estate

5.3.48. **Table 5-16** below lists the previously identified visual receptors, which will be scoped out of the assessment as per the justification set out below.

Table 5-16 - List of Visual Receptors Scoped Out of the Assessment

Receptor	Justification
Charlton Mires (Two properties)	These properties would be demolished as part of the Scheme. The effects of the removal of these properties will be considered as within the assessment of Landscape Character.
The Old Stable	This commercial receptor is located in close proximity to Residential Receptor: Broom House (Ref 1), which is of a higher sensitivity and a better representation of worst case scenario.
The Rocking Horse Café (formerly The Art Rock Café and Gallery)	This commercial receptor is located in close proximity to Residential Receptor: Rock Midstead Cottages and Rock Midstead Farmhouse (Ref 11), which are of a higher sensitivity and a better representation of worst case scenario.
Rock Moor House Bed and Breakfast	This commercial receptor is located in close proximity to Residential Receptor: Rock Moor House (Ref 14), which are of a higher sensitivity and a better representation of worst case scenario.

Sensitive receptors

5.3.49. The sensitive receptors identified for the Landscape and Visual Assessment are detailed within **Appendix H** and illustrated on **Figure A13: Visual Receptor Plan** in **Appendix A**.

POTENTIAL IMPACTS

Construction

5.3.50. The construction of the Scheme would include temporary works such as vegetation removal, soil stripping, material storage mounds, plant movements, temporary lighting and machine activity to build structures, earthworks and the road surfaces. Three locations for temporary site compounds have been identified, with a maximum of two being used for the construction of the Scheme. The three temporary site compounds locations include the Main Compound, Lionheart Enterprise Park Compound and Charlton Mires Site Compound. The Scheme may result in the following construction impacts:

Landscape

- Direct loss of landscape features such as hedges, trees and agricultural land adjacent to the existing route of the A1 through the construction of the Scheme;
- Demolition of property at Charlton Mires;
- Alteration to topography due to the proposed raised junction embankment (Charlton Mires Junction and construction of the accommodation bridge at either Broxfield or Heckley Fence);
- Temporary alteration to field boundaries including vegetation loss;
- Temporary alteration to natural or cultural heritage features of interest;
- Reduction of tranquillity within those areas associated with the construction works (including vehicle movements along haulage roads and compounds); and
- Temporary localised landscape impacts from the presence of construction compounds and temporary spoil heaps.

Visual

- Temporary installation of construction compounds (three potential sites have been identified, although a maximum of two would be utilised), reducing visual amenity and restricting views of open skyline at within a close proximity;
- Temporary traffic management, movement and activity of construction plant likely to be visible above intervening vegetation and site hoarding;
- Temporary spoil heaps and introduction of embankments which are bare earth prior to plant establishment, reducing visual amenity;
- Alteration to topography due to the raised junction embankment (Charlton Mires Junction) and improvement works at the accommodation bridge, restricting visibility for close proximity receptors;
- Temporary lighting of works areas in areas previously unlit; and
- Alteration to vegetation including tree cover which would open up views across the local landscape.

Operation

5.3.51. At this stage of the Scheme, it is anticipated that the widening of the road, junction improvements and bridge works would result in operational effects for landscape and visual receptors as detailed below:

Landscape

- The widening of the existing A1 carriageway to the east, increasing its prominence within the landscape;
- Alteration to existing landform (cuttings and embankments), a raised junction (Charlton Mires Junction) and the proposed accommodation bridge;
- Alteration to field boundaries;
- Reduction of tranquillity within those areas associated with the Scheme through the introduction of movement and noise; and
- Diversion of PRoW (Heckley Fence option only).

Visual

- Increase in light pollution from vehicles at night around the newly proposed junction (Charlton Mires Junction); and

- Increased visual presence of the road and raised junction and bridge areas.

Accommodation bridge options

5.3.52. Construction of the proposed bridge at either Heckley Fence or Broxfield has the potential to result in adverse landscape and visual effects at sensitive receptors located close to each bridge. Such effects are expected to:

- Increase the visual presence of the A1 and bridge for close proximity receptors, due to changes in landform and vegetation loss;
- Reduction of tranquillity within those areas associated with the construction works at the bridge location and during operation; and
- Change in views for people walking along diverted PRoW (Heckley Fence option only).

5.3.53. Both options have the potential to generate significant adverse landscape and visual receptors because of changes to topography and anticipated vegetation loss. Due to the close proximity of both options, additional construction and operation impacts are limited to the following receptors:

Landscape

- 8c Charlton Ridge LCA
- 3c Rock LCA
- 6 North East Farmed Coastal Plain LCA
- 11 Charlton Ridge LCA

Visual

- People living in properties with eastern facing views (Receptors 3, 4, 5 & 8)
- People living in properties with western facing views (Receptor 9)
- People travelling along PRoW Ref: 129 / 005 (Receptor 28)
- People travelling along PRoW Ref: 129/022 and 129/014 (Receptor 32 and 35)
- People travelling along PRoW Ref: 110/013 (Receptor 33)
- People travelling along PRoW Ref: 110/004 (Receptor 34)
- People travelling along main roads (Receptor 37)

DESIGN, MITIGATION AND ENHANCEMENT MEASURES

5.3.54. Mitigation developed during the design may comprise the following measures, where appropriate:

- Minimise loss of existing vegetation;
- Replace existing woodland blocks, hedgerows and individual trees lost during the construction phase;
- Planting of native tree and shrub species in keeping with local landscape character;
- Introduce species-rich grassland to increase local biodiversity;
- Design to include landscape areas that provide habitat links between existing and proposed vegetation;
- Screen planting around junctions and embankments to mitigate views and punctuate the linear road landscape;
- Where possible, retain views to local landmarks (Heiferlaw Tower to the east, and Middlemoor and Wandylaw Moor Windfarms to the north-west) to help create a sense of place for drivers;
- Slacken and round off earthworks to reduce their abruptness in the landscape; and
- If necessary, introduce false cuttings to help provide screening.

5.3.55. The key mitigation planting could include:

- Woodland and shrub planting, with a choice of species reflecting local conditions;
- Improve connectivity between existing green infrastructure; and
- Linear belts of trees and shrubs to recreate boundaries lost during construction.

LIKELY SIGNIFICANT EFFECTS

5.3.56. The comparison of preliminary likely significant effects between the two accommodation bridge options are set out in **Table 5-17** below, based upon currently available information, professional judgement and methodology as set out in the Scoping Report in **Volume 2 (Appendix A)**. The assessment set out below includes the implementation of appropriate mitigation measures, however, these effects could change as the EIA progresses. Mitigation measures are outlined in the above section.

Table 5-17 - Preliminary Likely Significant Effects of the two accommodation bridge options

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
Landscape – character areas illustrated on Figure A11: Landscape Character Areas in **Appendix A**.				
8c Charlton Ridge LCA	Construction	Loss of vegetation and changes to landform at the chosen accommodation bridge location.	Significant effects at a local level, but not anticipated for the wider LCA.	
	Operation	Permanent change of landform.	Significant effects at a local level, but not anticipated for the wider LCA.	
3c Rock LCA	Construction	Loss of roadside and field boundary vegetation and changes to landform at the chosen accommodation bridge location	Significant effects at a local level, but not anticipated for the wider LCA.	
	Operation	New landscape features at the chosen accommodation bridge location.	Significant effects at a local level, but not anticipated for the wider LCA.	
6 North East Farmed Coastal Plain LCA	Construction	Loss of roadside and field boundary vegetation and changes to landform at chosen accommodation bridge location	Significant effects at a local level, but not anticipated for the wider LCA.	
	Operation	New landscape features including at chosen accommodation bridge location.	Significant effects at a local level, but not anticipated for the wider LCA.	

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
11 Charlton Ridge LCA	Construction	Loss of vegetation and changes to landform at the chosen accommodation bridge Location.	Significant effects at a local level, but not anticipated for the wider LCA.	
	Operation	Permanent change of landform.	Significant effects at a local level, but not anticipated for the wider LCA.	
Visual – viewpoint locations are illustrated on **Figure A10: Viewpoint Locations Plan** (**Appendix A**)				
People living in properties with eastern facing views (Receptors 3, 4, 5 & 8)	Construction	Loss of vegetation and changes to landform at the chosen accommodation bridge location would open up short and middle distance direct and oblique views towards the Scheme.	Yes	Yes
	Operation	Increased visual presence of the A1, due to change in landform at chosen accommodation bridge location.	Not anticipated.	Yes
People living in properties with western facing views (Receptor 9)	Construction	Close proximity direct and oblique towards the construction activities associated with the Scheme at chosen accommodation bridge location.	Yes	Yes
	Operation	Increased visual presence of the A1, due to change in landform at chosen accommodation bridge location.	Yes	Not Anticipated.
People travelling along PRoW Ref: 129 / 005 (Receptor 28)	Construction	Close proximity immediate views towards the construction activities associated with the accommodation bridge.	Yes	Yes
	Operation	Increased visual presence of the A1, due to change in landform at chosen accommodation bridge location.	Not anticipated	Not anticipated
People travelling	Construction	Close proximity direct and oblique towards the	Yes	No visual effects are anticipated as

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
along PRoW Ref: 129/022 and 129/014 (Receptor 32 and 35)		Construction activities associated with the Scheme.		the routes would be stopped up as part of the Scheme.
	Operation	Increased visual presence of the A1, due to change in landform at chosen accommodation bridge location.	Yes	
People travelling along PRoW Ref: 110/013 (Receptor 33)	Construction	Filtered middle distance direct and oblique views towards the Construction activities associated with Scheme.	Yes	Yes
	Operation	Increased visual presence of the A1, due to change in landform near the proposed accommodation bridge.	Yes	Yes This route would be diverted as part of the Scheme.
People travelling along PRoW Ref: 110/004 (Receptor 34)	Construction	Filtered middle distance direct and oblique views towards the Construction activities associated with the accommodation bridge.	Yes	Yes
	Operation	Increased visual presence of the A1, due to the change of landform at the chosen accommodation bridge.	Not anticipated.	Yes This route would be diverted as part of the Scheme.
People travelling along main roads (Receptor 37)	Construction	Close proximity direct views for people travelling at speed. Changes to landform and vegetation loss at chosen accommodation bridge location.	Yes	Yes
	Operation	Increased visual presence of the accommodation bridge due to changes in landform.	Not anticipated.	Not anticipated.

5.3.57. A summary of the preliminary likely significant effects (residual) for the whole Scheme including both accommodation bridge options are presented in **Table 5-18** below, based upon currently available information, methodology as set out in The Scoping Report in **Volume 2 (Appendix A**) and professional judgement, which is used in balancing the criteria through explanation and justification. However, these effects could change as the EIA progresses and the mitigation proposals are developed.

Table 5-18 - Summary of Preliminary Likely Significant Effects – landscape and visual

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Landscape				
8c Charlton Ridge LCA	Construction	Loss of vegetation and changes to landform at the chosen accommodation bridge location.	Minimise loss of existing vegetation	Significant effects at a local level, but not anticipated for the wider LCA.
	Operation	Permanent change of landform.	Replace and enhance vegetation lost during the construction phase and establish new planting on the landform around the chosen accommodation bridge location.	Significant effects at a local level, but not anticipated for the wider LCA.
3c Rock LCA	Construction	Loss of roadside and field boundary vegetation and changes to landform at the chosen accommodation bridge location and at Charlton Mires. Demolition of properties at Charlton Mires.	Minimise loss of existing vegetation.	Significant effects at a local level, but not anticipated for the wider LCA.
	Operation	New landscape features including Charlton Mires Junction and at the chosen accommodation bridge location, widening of the existing A1 alignment. Permanent loss of arable pasture to offline road section.	Replace and enhance vegetation lost during the construction phase and establish new planting on the landform around the accommodation bridge and Charlton Mires junction.	Significant effects at a local level, but not anticipated for the wider LCA.
38a Longframlington LCA	Construction	Construction activities in the Lionheart Compound would be experienced within the setting of a small portion of the northern edge of this LCA.	Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding.	Not anticipated.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
			Implement screening vegetation along site boundaries to the west and north.	
	Operation	Reinstatement of field.	No specific mitigation identified.	Not anticipated.
2a Lower Aln LCA	Construction	Construction of temporary built form with Lionheart Compound at a similar scale to the adjacent business centre.	Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding. Implement screening vegetation along site boundaries to the west and north.	Significant effects at a local level, but not anticipated for the wider LCA.
	Operation	Reinstatement of field.	No specific mitigation identified.	Not anticipated.
38b Longhorsley LCA	Construction	Construction of temporary compound and temporary land use change. Minimise loss of vegetation within field boundaries.	Minimise loss of existing vegetation.	Significant effects at a local level, but not anticipated for the wider LCA.
	Operation	Reinstatement of field.	No specific mitigation identified.	Not anticipated.
6 North East Farmed Coastal Plain LCA	Construction	Loss of roadside and field boundary vegetation and changes to landform at the chosen accommodation bridge location and at Charlton Mires. Demolition of properties at Charlton Mires.	Minimise loss of existing vegetation.	Significant effects at a local level, but not anticipated for the wider LCA.
	Operation	New landscape features including Charlton Mires Junction and at the chosen accommodation bridge location, widening of the existing A1 alignment. Permanent loss of	Replace and enhance vegetation lost during the construction phase and establish new planting on the landform around the accommodation bridge and Charlton Mires junction.	Significant effects at a local level, but not anticipated for the wider LCA.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		arable pasture to offline road section.		
11 Charlton Ridge LCA	Construction	Loss of vegetation and changes to landform at the chosen accommodation bridge location	Minimise loss of existing vegetation	Significant effects at a local level, but not anticipated for the wider LCA.
	Operation	Permanent change of landform.	Replace and enhance vegetation lost during the construction phase and establish new planting on the landform around the accommodation bridge.	Significant effects at a local level, but not anticipated for the wider LCA.
7 Lower Aln Valley LCA	Construction	Construction of temporary built form with Lionheart Enterprise Park Compound at a similar scale to the adjacent business centre.	Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding. Implement screening vegetation along site boundaries to the west and north.	Significant effects at a local level, but not anticipated for the wider LCA.
	Operation	Reinstatement of field.	No specific mitigation identified.	Not anticipated.
18 Longframlington / Shibottle Rolling Farmland LCA	Construction	Construction activities in the Lionheart Enterprise Park Compound would be experienced within the setting of a small portion of the northern edge of this LCA.	Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding. Implement screening vegetation along site boundaries to the west and north.	Not anticipated.
	Operation	Reinstatement of field.	No specific mitigation identified.	Not anticipated.
Visual				

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
People living in properties with north east facing views (Receptors 1 &2)	Construction	Filtered middle distance direct and oblique views towards the Construction activities associated with Scheme.	Minimise loss of existing vegetation along A1 alignment and close proximity access tracks	Yes
	Operation	Increased visual presence of the A1, due to widening along the current alignment.	Replace vegetation lost during construction phase to recreate filtering effect created by vegetation.	Not anticipated.
People living in properties with eastern facing views (Receptors 3, 4, 5 & 8)	Construction	Filtered middle distance direct and oblique views towards the Construction activities associated with Scheme.	Minimise loss of existing vegetation along A1 alignment.	Yes
	Operation	Increased visual presence of the A1, due to widening along the current alignment.	Replace vegetation lost during construction phase to recreate filtering effect created by vegetation.	Yes
People living in properties with close proximity eastern facing views (Receptors 6, 7 & 10)	Construction	Close proximity direct and oblique towards the Construction activities associated with the Scheme.	Minimise loss of existing vegetation along A1 alignment.	Yes
	Operation	Increased visual presence of the A1, due to widening along the current alignment.	Replace and enhance vegetation lost during construction phase to recreate and enhance filtering effect created by vegetation.	Yes
People living in properties with western facing views (Receptor 9)	Construction	Close proximity direct and oblique towards the Construction activities associated with the Scheme.	Minimise loss of existing vegetation along A1 alignment and close proximity access tracks. Limit construction traffic passing the properties to social hours.	Yes

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
			Use downlighters on any temporary lighting.	
	Operation	Increased visual presence of the A1, due to widening along the current alignment and construction of the accommodation bridge.	Replace and enhance vegetation lost during construction phase to recreate and enhance filtering effect created by vegetation.	Yes
People living in properties with filtered western facing views (Receptor 11 & 14)	Construction	Close proximity direct and oblique towards the Construction activities associated with the Scheme.	Minimise loss of existing vegetation along A1 alignment and close proximity access tracks. Limit construction traffic passing the properties to social hours. Use downlighters on any temporary lighting.	Yes
	Operation	Increased visual presence of the A1, due to widening along the current alignment.	Replace and enhance vegetation lost during construction phase to recreate and enhance filtering effect created by vegetation.	Not anticipated.
People living in properties with close proximity views (Receptor 12)	Construction	Close proximity direct and oblique towards the construction activities associated with the Scheme.	Minimise loss of existing vegetation along A1 alignment and close proximity access track including PRoW Ref: 129/005. Limit construction traffic passing the properties to social hours. Use downlighters on any temporary lighting.	Yes
	Operation	Increased visual presence of the A1 and access track, due to widening along the current alignment.	Replace and enhance vegetation lost during construction phase to recreate and enhance filtering effect created by vegetation.	Not anticipated.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
People living in properties with close proximity western facing views (Receptor 13)	Construction	Close proximity direct and oblique towards the construction activities associated with the Scheme including the construction of Charlton Mires Junction	Minimise loss of existing vegetation along A1 alignment. Limit construction traffic passing the property to social hours. Use downlighters on any temporary lighting.	Yes
	Operation	Increased visual presence of the A1 and Charlton Mires junction, due to widening along the current alignment and demolition of existing property at Charlton Mires.	Replace and enhance vegetation lost during construction phase to filter views towards the newly created junction.	Yes
People living in properties with close proximity south western facing views (Receptors 15 & 16)	Construction	Close proximity unfiltered direct and oblique views toward the construction activities associated with the Scheme.	Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding. Minimise loss of vegetation along A1 alignment.	Yes
	Operation	Increased visual presence of the A1 due to widening along the current alignment.	Replace and enhance vegetation lost during construction phase to filter views towards the A1.	Not anticipated.
People living in properties with south eastern facing views (Receptor 17)	Construction	Middle distance direct and oblique towards the construction activities associated with the Scheme unfiltered by intervening vegetation.	Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding.	Yes
	Operation	Increased visual presence of the A1 due to widening along the current alignment.	Replace and enhance vegetation lost during construction phase to filter views towards the A1	Not anticipated.
People living in properties with long	Construction	Filtered long distance direct and oblique views towards the	Minimise loss of existing vegetation along A1 alignment.	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
distance eastern facing views (Receptors 18, 19, 20 and 21)		construction activities associated with Scheme.		
	Operation	Increased visual presence of the A1, due to widening along the current alignment.	Replace vegetation lost during construction phase to recreate filtering effect created by vegetation.	Not anticipated
People living in properties with south eastern facing views (Receptor 22)	Construction	Filtered long distance direct and oblique views towards the construction activities associated with the southern section of the Scheme.	Minimise loss of existing vegetation along A1 alignment.	Not anticipated
	Operation	Increased visual presence of the A1, due to widening along the current alignment.	Replace vegetation lost during construction phase to recreate filtering effect created by vegetation.	Not anticipated
People living in properties with north western facing views (Receptors 23 and 24)	Construction	Filtered middle distance direct and oblique views towards the construction activities associated with Scheme available above intervening vegetation.	Minimise loss of existing vegetation along A1 alignment.	Not anticipated
	Operation	Increased visual presence of the A1, due to widening along the current alignment.	Replace vegetation lost during construction phase to recreate filtering effect created by vegetation.	Not anticipated
People living in properties with views of the	Construction	Long distance direct and oblique views towards the construction activities associated with temporary compound and the Scheme	Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding.	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Lionheart Compound (Receptor 41)		available above intervening vegetation.		
	Operation	Reinstatement of field.	No specific mitigation identified.	Not anticipated
People living in properties with views of the Main Compound (Receptors 46, 47, 48, 49, 50, 51 and 52)	Construction	Middle distance direct and oblique views towards the construction activities associated with temporary compound available above intervening vegetation.	Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding. Minimise loss of site boundary vegetation.	Not anticipated
	Operation	Reinstatement of field and boundary vegetation.	No specific mitigation identified.	Not anticipated
People travelling along PRoW Ref: 112/008 and 112/009 (Receptors 25 and 26)	Construction	Close proximity views of construction activities for a short section of these PRoW.	Where possible, minimise loss of existing vegetation.	Yes
	Operation	Increased visual presence of road including access improvements (at West Linkhall) for a short section of these PRoW at close proximity.	Replace existing roadside vegetation with new tree planting to mitigate views.	Yes
People travelling along PRoW Ref: 129/04 (Receptor 27)	Construction	Close proximity immediate views towards the construction activities associated with the Scheme.	Minimise loss of existing vegetation along A1 alignment and close proximity access tracks. Clear separation between construction traffic and pedestrian routes. Use downlighters on any temporary lighting.	Yes.
	Operation	Increased visual presence of the A1, due to widening along the current alignment.	Replace and enhance vegetation lost during construction phase to	Yes

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
			recreate and enhance filtering effect created by vegetation.	
People travelling along PRoW Ref: 129 / 005 (Receptor 28)	Construction	Close proximity immediate views towards the construction activities associated with the Scheme.	Minimise loss of existing vegetation along A1 alignment and along footpath. Clear separation between construction traffic and pedestrian routes. Use downlighters on any temporary lighting.	Yes
	Operation	Increased visual presence of the A1, due to widening along the current alignment and improved surfacing to the existing route of the PRoW.	Replace and enhance vegetation lost during construction phase to recreate and enhance filtering effect created by vegetation.	Not anticipated.
People travelling along PRoW Ref: 129/009 and 110/003 (Receptors 29)	Construction	Filtered direct and oblique towards the construction activities associated with the Scheme.	Minimise loss of existing vegetation along A1 alignment.	Not anticipated
	Operation	Increased visual presence of the A1 and access track, due to widening along the current alignment.	Replace and enhance vegetation lost during construction phase to recreate and enhance filtering effect created by vegetation.	Not anticipated.
People travelling along PRoW Ref: 110/003 (Receptors 30)	Construction	Middle distance direct and oblique views towards the construction activities associated with Scheme.	Minimise loss of existing vegetation along A1 alignment.	Not anticipated.
	Operation	Increased visual presence of the A1, due to widening along the current alignment.	Replace vegetation lost during construction phase to recreate filtering effect created by vegetation.	Not anticipated.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
People travelling along PRoW Ref: 110/010 (Receptors 31)	Construction	Middle distance direct and oblique views towards the construction activities associated with Scheme.	Minimise loss of existing vegetation along A1 alignment.	Not anticipated.
	Operation	Increased visual presence of the A1, due to widening along the current alignment.	Replace vegetation lost during construction phase to recreate filtering effect created by vegetation.	Not anticipated.
People travelling along PRoW Ref: 129/022 and 129/014 (Receptor 32 and 35)	Construction	Close proximity direct and oblique towards the Construction activities associated with the Scheme.	Minimise loss of existing vegetation along A1 alignment. Use downlighters on any temporary lighting.	Yes
	Operation	Increased visual presence of the A1, due to widening along the current alignment and construction of accommodation bridge.	Replace and enhance vegetation lost during construction phase to recreate and enhance filtering effect created by vegetation.	Yes
People travelling along PRoW Ref: 110/013 (Receptor 33)	Construction	Filtered middle distance direct and oblique views towards the Construction activities associated with Scheme.	Minimise loss of existing vegetation along A1 alignment.	
	Operation	Increased visual presence of the A1, due to widening along the current alignment and change in landform near the accommodation bridge.	Replace vegetation lost during construction phase to recreate filtering effect created by vegetation.	Not anticipated.
People travelling along PRoW Ref: 110/004 (Receptor 34)	Construction	Filtered middle distance direct and oblique views towards the Construction activities associated with Scheme.	Minimise loss of existing vegetation along A1 alignment and close proximity access tracks	Yes

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
	Operation	Increased visual presence of the A1, due to widening along the current alignment.	Replace vegetation lost during construction phase to recreate filtering effect created by vegetation.	Yes
People travelling along PRoW Ref: 129/006 (Receptor 36)	Construction	Direct and oblique towards the construction activities associated with the Scheme.	Minimise loss of existing vegetation along A1 alignment and close proximity access track including PRoW Ref: 129/005.	Yes
	Operation	Increased visual presence of the A1 and access track, due to widening along the current alignment.	Replace and enhance vegetation lost during construction phase to recreate and enhance filtering effect created by vegetation.	Not anticipated.
People travelling along PRoW Ref: 141/013 and 141/002 (Receptors 42 and 43)	Construction	Short distance direct and oblique views towards the construction activities associated with temporary compound and the Scheme available above intervening vegetation.	Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding.	Yes
	Operation	Reinstatement of field and boundary vegetation.	No specific mitigation identified.	Not anticipated
People travelling along PRoW Ref: 422/020 (Receptor 53)	Construction	Middle distance views towards the construction activities associated with temporary compound available above intervening vegetation.	Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding. Minimise loss of site boundary vegetation.	Not anticipated
	Operation	Reinstatement of field and boundary vegetation.	No specific mitigation identified.	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
People visiting or working at Eshott Airfields (Receptor 54)	Construction	Short distance direct and oblique views towards the construction activities associated with Main Compound and the Scheme available above intervening vegetation.	Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding.	Not anticipated
	Operation	Reinstatement of field and boundary vegetation.	No specific mitigation identified.	Not anticipated
People travelling along main roads (Receptor 37)	Construction	Close proximity direct views for people travelling at speed for people travelling at speed. Demolition of property at Charlton Mires and removal of roadside vegetation would temporarily open up views.	Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding.	Yes
	Operation	Increased visual presence of road due to the road widening, construction of bridge and junction improvements.	Replace vegetation lost during the construction phase with linear tree and shrub planting.	Not anticipated.
People travelling along local roads with views of the Main Scheme Area (Receptors 38, 39 and 40)	Construction	Close proximity direct views for people travelling at speed for people travelling at speed.	Minimise loss of existing vegetation along A1 alignment	Not anticipated.
	Operation	Increased visual presence of road due to the road widening and junction improvements.	Replace vegetation lost during the construction phase with linear tree and shrub planting.	Not anticipated.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
People travelling along local roads with views of the Lionheart Compound (Receptor 44)	Construction	Close proximity direct views for people travelling at speed for people travelling at speed.	Minimise loss of existing vegetation along site boundaries. Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding.	Not anticipated.
	Operation	Reinstatement of field and boundary vegetation.	No specific mitigation identified.	Not anticipated
People travelling along local roads with views of the Main Compound (Receptor 55)	Construction	Close proximity direct views for people travelling at speed for people travelling at speed.	Minimise loss of existing vegetation along site boundaries. Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding.	Not anticipated.
	Operation	Reinstatement of field and boundary vegetation.	No specific mitigation identified.	Not anticipated
People working or visiting Lionheart Industrial Estate (Receptor 45)	Construction	Views for workers and visitors of the construction activities.	Minimise loss of existing vegetation along site boundaries. Keep site areas tidy and free from clutter, use low level directional lighting and erect site hoarding.	Not anticipated.
	Operation	Reinstatement of field and boundary vegetation.	No specific mitigation identified.	Not anticipated

FURTHER WORK FOR THE EIA

5.3.58. A **detailed level** assessment of potential impacts on landscape character and visual receptors during the construction and operational phases of the Scheme will be undertaken in accordance with the methodology set out in accordance with the guidance provided in IAN 135/10 Landscape and Visual Effects Assessment (**Ref 5.3.1**), and the Guidelines for Landscape and Visual Impact Assessment (Third Edition) (GLVIA), published by the Landscape Institute and IEMA (2013) (**Ref 5.3.2**).

5.3.59. In addition to the assessment detailed in the Scoping Report (**Volume 2, Appendix A, Chapter 8 Landscape and Visual Amenity**), and in response to the Scoping Opinion (refer to **Volume 2, Appendix B, Section 4.3**), the following will be carried out for the EIA:

- The study area will be reviewed and potentially refined further during the winter assessment, scheduled March 2019;
- The ES will review and consider the effects of the Scheme on the Local LCAs identified within the Scoping Report and this PEIR; and
- Throughout the development of landscape strategy and within the EIA the landscape mitigation and enhancement measures will be refined and clearly distinguished where they avoid or reduce potentially significant effects.

5.4 CULTURAL HERITAGE

INTRODUCTION

5.4.1. This section considers the implications of the Scheme on cultural heritage during construction and operation and details any potentially significant effects. This section considers the Main Scheme Area and a potential compound location within it at Charlton Mires. The Main Compound and the Lionheart Enterprise Park Compound are also considered.

EXISTING BASELINE KNOWLEDGE

5.4.2. The following data sources have been used to inform the baseline:

- Historic England's National Heritage List (NHLE);
- Northumberland Historic Environment Record (HER); and
- Historic Landscape Characterisation (HLC) Data

5.4.3. A review of the above sources identified two below ground heritage assets within the Scheme Footprint including one SM and one non-designated heritage asset. There are also two built heritage assets within the Scheme; one Grade II Listed Building and one non-designated heritage asset.

5.4.4. A review of non-designated heritage assets and HLC within 500 m of the Scheme Footprint and designated heritage assets within 1 km of the Scheme Footprint have been undertaken. As a result of this review, and through consultation with Historic England, the assessment area has been extended to include Alnwick Park and Garden and the designated assets contained within it.

5.4.5. Within 500 m of the Scheme Footprint there are 23 below-ground heritage assets which include SMs and non-designated heritage assets. There are 49 built heritage assets comprising Listed Buildings, a Conservation Area, a Registered Park and Garden and non-designated heritage assets (see **Figure A14: Designated Heritage Assets** and **Figure A15: Non-designated Heritage Assets** in **Appendix A**).

5.4.6. No World Heritage Sites or Registered Battlefields have been identified within 1 km of the Scheme Footprint.

5.4.7. Overall, there are 106 heritage assets within 1 km of the Scheme (see **Figure A14: Designated Heritage Assets** and **Figure A15: Non-designated Heritage Assets** in **Appendix A**). These comprise:

- Seven SMs;
- 54 Listed Buildings;
- One Conservation Area;
- One Registered Park and Garden; and
- 43 non-designated heritage assets.

5.4.8. A full gazetteer of heritage assets is presented in **Appendix I** of this PEIR.

Below ground archaeological remains and earthworks

Main Scheme Area

5.4.9. Within the Main Scheme Area there are two below ground heritage assets, these are:

- NHLE1018499: Prehistoric Burial Mound, 420 m north west of East Linkhall; and
- HER 5033: Stone Cists and tumulus.

5.4.10. The Scheme Footprint contains one SM, a Prehistoric Burial Mound (NHLE 1018499) and abuts two SMs (NHLE 1018348 and 1006500), it also contains one non-designated heritage asset; these are listed above and shown on **Figure A14: Designated Heritage Assets** and **Figure A15: Non-designated Heritage Assets** (**Appendix A**). The Prehistoric Burial mound (NHLE 1018499) is in the form of a "bowl barrow" which is thought to date from the Late Neolithic to the Late Bronze Age, it can occur either in isolation or as a part of a group or cemetery. An excavation at the site in the late 19th century revealed a cist burial within the mound, it contained buried human remains and glass bead. It is believed that further burials remain intact within the mound. The non-designated asset of the stone cists (HER 5033) lies within the Scheme Footprint and comprises of two cists which contained small bones, an inhumation burial, and a spear or flat riveted knife-dagger.

5.4.11. Abutting the Scheme Footprint are the scheduled remains of a shrunken medieval village known as North Charlton Medieval Village and Open Field System (NHLE 1018348). The SM extends to both the east and west side of the Scheme, and the existing A1 is not included in its boundary. The A1 represents a later addition to the landscape and its construction very likely has removed any remains within the existing road footprint. To the south of North Charlton lies the SM Camp at West Linkhall (NHLE 1006500) which comprises of an earthwork complex (see **Figure A14: Designated Heritage Assets** in **Appendix A**).

5.4.12. Within 500 m of the Scheme Footprint lie the remaining SMs and 18 below ground non-designated heritage assets. The SMs from the Prehistoric period comprise the Ellsnook round barrow (NHLE 1006564) which is of Bronze Age date and lies less than 10 m west of the Scheme Footprint. The second Prehistoric Scheduled Monument is an Iron Age defended settlement in Camp Plantation (NHLE 1017955) which lies 425 m north of the Scheme Footprint. The non-designated heritage asset includes two flint flakes from Charlton Mires which are thought to be of Neolithic or Bronze Age date (HER 5062); a polished stone axe hammer (HER 5029) which contains an hour glass perforation and traces of an Iron Age Camp (HER 4420) which is believed to be non-defensive. There is also the Iron Age defended Settlement of Heiferlaw (NHLE 1014080) which lies 500 m to the west of the Scheme, it comprises a circular enclosure with ramparts and internal features. To the west of the A1 is the Heiferlaw tower house, 230 m north east of Holywell (NHLE 1014061), which is also designated as a Grade I Listed Building.

5.4.13. There is no evidence of the Roman period within 1 km of the Scheme; this is most likely due to the Romans only being present as far as the Antonine Wall before retreating to Hadrian's Wall. The area is thought to be largely untouched during the movement forwards and retreat backwards, in part due to its location so far east, with the Antonine Wall being further to the north-west.

5.4.14. There is evidence for the early medieval period from the Rock Conservation Area which has the potential to originate from between AD600 – AD1100, which is prior to the Norman invasion. The name Rock is from Anglo-Saxon origins but also French origins so there is also potential for the village to have been developed Post-Conquest. To date, it is believed that the Norman foundations which cover the village are based on an earlier settlement pattern (**Ref 5.4.1**).

5.4.15. The Late Medieval period, within 500 m, can be characterised by deserted medieval villages including Linkhall (HER 5055), Charlton Hall (5054), Broxfield (HER 5650), Heckley (HER 4430) and Denwick (HER 5711). Little is known about Linkhall and Charlton Hall Medieval Village, but it is believed that Heckley was established by AD1147 with records for Broxfield starting in AD1267 and for Denwick in AD1289.

5.4.16. The Post-Medieval period saw the rise in the prominence of the Percy family within Northumberland, they are responsible for the SM of Heiferlaw Tower House (NHLE 1014061) which lies 400 m west of the Scheme Footprint. Other heritage assets from this period include the Charlton Burn Limekiln (HER 5056) and two battle sites from 1093 where the English Army defeated the Scottish Army. The battle of Alnwick took place during November 1093 and resulted in the King of Scotland being killed on the 13 November 1093, two sites remain (HER 4488 and 24250) these are to the south of the Scheme.

5.4.17. The modern period is represented through the heritage assets associated within WWII, an underground sub-zero station is situated within the interior of the Heiferlaw defended settlement, its presence is indicated on the surface by some settling of the earth infill. This area is also under the SM number of (NHLE 1014080).

5.4.18. A Geophysical survey has been undertaken of the Scheme Footprint, and was completed in February 2019. The preliminary findings of the works show a low density of anomalies of potential archaeological in origin, however further analysis of the data is required. The completed survey report will be considered in the ES.

Charlton Mires Compound

5.4.19. There are no designated or non-designated below-ground heritage assets within the area of the potential compound at Charlton Mires.

5.4.20. Geophysical surveys were undertaken of the Scheme and completed in February 2019. The preliminary findings of the works show a low density of anomalies of potential archaeological in origin, however further analysis of the data is required. The completed survey report will be considered in the ES.

Lionheart Enterprise Park Compound

5.4.21. Part of the compound area at Lionheart Enterprise Park has already been subject to archaeological evaluation as part of an earlier planning application (Ref. 16/04691/FUL), consisting of a geophysical survey (**Ref 5.4.2**) followed by targeted trial trenching (**Ref 5.4.3**). Three phases of geophysical survey have been undertaken, covering approximately 7 ha of the proposed compound area (which totals approximately 14 ha). The geophysical surveys identified several possible soil-filled features. The trial trenching consisted of seven 25 m by 2 m trenches and one 50 m by 2 m trench. The trenching identified furrow type features and drains of negligible value.

Main Compound

5.4.22. There are two non-designated assets recorded in the inner study area (500 m). A Mesolithic flint scatter (HER 11356) was recorded during a field walking survey near West Moor Farm, approximately 200 m to the west of the compound boundary. Approximately 450 m to the south is a cropmark of a double ditched enclosure (HER 11359) identified through aerial photography.

Historic buildings, registered park and garden and conservation area

Main Scheme Area

5.4.23. Within the Main Scheme Area, one non-designated built heritage asset has been identified. This is the Post-Medieval Milepost north of Shipperton Bridge (A1), (HER 16878).

5.4.24. Within 500 m of the Scheme Footprint there are a further 27 Listed Buildings and 17 non-designated heritage assets. The Listed Buildings include one Grade I listed building and 26 Grade II. The Grade I Listed Building is Heiferlaw Tower (NHLE 1304282 (also designated as an SM)) which was a lookout tower for Alnwick Abbey and can be dated to 1470-89. Other listed heritage assets include several mileposts, none which lie within the Scheme, residential properties and a war memorial. Two Grade II Listed Heritage assets are currently excluded from the Scheme Footprint but are surrounded by it; Patterson Cottage (NHLE 1371080) and Dovecote to East of Heckley Fence Farmhouse with Attached Wall (NHLE 1371059).

5.4.25. Within 1 km of the Scheme there are a further 13 Listed Buildings, one of which is Grade II*, the remaining 13 are Grade II. The Grade II* Listed Building is Charlton Hall (NHLE 1042002) which is a late 18th century country house. The Grade II Listed Buildings include domestic, agricultural and commercial buildings.

5.4.26. Within the 500 m of the Scheme Footprint there is one Grade I Registered Park and Garden which is in Alnwick and known at the Alnwick Garden (NHLE 1001041). This is an extensive landscape park which developed from a series of medieval deer parks surrounding Alnwick Castle. It was developed between 1750 and 1786 for the first Duke of Northumberland.

5.4.27. There is one Conservation Area within 500 m of the Scheme Footprint, this is the Rock Conservation Area. The settlement of Rock is thought to have been established between the AD 600 - 1100, although most likely to be after the Norman Invasion of 1066. The earliest records reflect this time as well.

Charlton Mires Compound

5.4.28. There are no designated or non-designated above ground heritage assets within the area of the compound at Charlton Mires.

Lionheart Enterprise Park

5.4.29. Within 500 m of the Lionheart Enterprise Park Compound area there is one Grade II Listed Building which is Greensfield Moor Farmhouse (NHLE1042019), this is to the west of the compound. Within 1 km of the Compound area there are three Grade II Listed Buildings, all of which are associated with Alnwick cemetery, the North Chapel (NHLE 1237596), Lodge and Gates (NHLE 1372336) and the South Chapel (NHLE 1052196).

Main Compound

5.4.30. Within the Main Compound Footprint there is one Grade II Listed Milepost (NHLE 1371021) which is likely to be mid-19th century in date.

5.4.31. The Grade II Listed Building of Thirston Newhouses Farmhouse (NHLE 1156136) lies within 500 m of the Main Compound Footprint, this is thought to be from the early 18th century. The non-designated heritage asset of Felshott (NHLE 19365) also lies within 500 m of the Main Compound Footprint; this house was formerly the Pineapple Inn and built in the 19th century.

5.4.32. Within 1 km of the Main Compound Footprint there are seven listed buildings, four of which are associated with Felton Park. The listed buildings comprise one Grade II* and six Grade II buildings. The Grade II* building is a Greenhouse located 120 m east of Felton Park with a potting shed at the rear (NHLE 1154561). The Greenhouse was restored in 2015 as part of a Historic England project.

Historic landscapes

Main Scheme Area

5.4.33. Information about Historic Landscapes is derived from the Northumberland HLC. A total of 15 Historic Landscape types are recorded in the inner study area (500 m) around the Scheme and are of low importance:

- Small Irregular Fields by Settlement: 17th to mid-18th century;
- Reorganised Piecemeal Enclosure: 17th to mid-18th century;
- Other Irregular Fields: 17th to mid-18th century;
- Piecemeal Enclosure: 17th to mid-18th century;
- Designed Landscape: Parkland landscape created from the 17th century onwards;
- Surveyed Enclosure (Erratic Edged, Straight Edged and Wavy-Edged): Mid-18th to 19th century;
- Other Small Surveyed Fields: Mid-18th to 19th century;
- Reorganised Piecemeal Enclosure: Pre-1860;
- Enclosed Lowland Moorland: Pre-1860;
- Road: Pre-1860;
- Late 19th Century Fields;
- Late 19th Century Woodland;
- Other 20th Century Fields;
- 20th Century Settlement; and
- 20th Century Woodland.

5.4.34. There is a high potential for the presence of hedgerows within the Scheme which meet the criteria of Historic Importance, as set out in the Hedgerow Regulations Act 1997. Any hedgerows identified as being of Historic Importance would be of low to medium importance as defined in DMRB Volume 11 Section 3 Part 2 HA208/07 Annex 5 table 5.1 and Annex 7 table 7.1 (**Ref 5.4.4**).

Charlton Mires Compound

5.4.35. Within the area of Charlton Mires the Historic Landscape type is Surveyed Enclosure Straight which originates from the mid-18th to 19th century.

Lionheart Enterprise Park Compound

5.4.36. The Historic Landscape Character of the Lionheart Enterprise Park Compound and much of the inner study area (500 m) is Piecemeal Enclosure: 17th to mid-18th century of low importance. Also contained within the inner study area is Woodland: Pre-1860s and Active Industry: 20th Century of low importance.

5.4.37. The Compound occupies an area characterised as Surveyed Enclosure (Wavy Edged) Mid-18th to 19th century of low importance. The inner study area (500 m) contains the following character types:

- Piecemeal Enclosure: 17th to mid-18th century;
- Piecemeal Enclosure: 20th century;
- Surveyed Enclosure (Erratic Edge): mid-18th to 19th century;
- Surveyed Enclosure (Wavy Edged): 20th century;
- Fields Regular: 20th century;
- Woodlands: Pre-1860;
- Settlement: Pre-1860; and
- Airfield: 20th century.

Sensitive receptors

Within the Scheme Footprint

There is one SM, one Listed Building and three non-designated heritage assets within the Scheme Footprint. They are summarised below in **Table 5-19**. The level of importance of the sensitive receptors has been determined using guidance set out in DMRB Volume 11 Section 3 Part 2 HA208/07 (**Ref 5.4.4**).

Table 5-19 - Sensitive Receptors within the Scheme Footprint

Heritage Asset Type	Asset Name	Level of Importance	Location
Scheduled Monument	NHLE 1018499: Prehistoric burial mound, 420 m north-west of East Linkhall	High Importance	Main Scheme Area
Non-designated	HER 5033: Strone Cists and Tumulus identified in the late 1800's	High Importance	Main Scheme Area
Grade II Listed Buildings	NHLE: 1371021: Milepost approximately 55 metres south-west of Thurston New Houses farmhouse	Medium Importance	Main Compound
Non-designated	Two flint flakes from Charlton Mires which is likely to be from the Neolithic or Early Bronze Age of medium importance	Medium Importance	Main Scheme Area
Non-designated	HER 16878: Milepost north of Shipperton Bridge (A1) with inscription details for Alnwick and Belford	Low Importance	Main Scheme Area
[Geophysical Survey Anomalies – potential archaeology]	[Geophysical Survey Anomalies]	Unknown	Main Scheme Area

Outside of the Scheme Footprint

5.4.38. Within 500 m of the Scheme Footprint, there are a further four SMs, 29 Listed Buildings, one Conservation Area, one Registered Park and Garden and 36 non-designated heritage assets. These assets could potentially be indirectly impacted as a result of the Scheme.

5.4.39. In addition to this, there is potential for further impact upon the setting of heritage assets within 1 km of the Scheme Footprint. **Table 5-20** lists the sensitive receptors within 500 m and 1 km of the Scheme Footprint.

Table 5-20 - Sensitive Receptors within 500 m and 1 km of the Scheme Footprint

Heritage Asset Type	Asset Name	Level of Importance	Location
Scheduled Monument	NHLE 1018348: North Charlton Medieval Village and Open Field system NHLE 1006500: Camp at West Linkhall NHLE 1017955: Iron Age defended settlement in Camp Plantation, 350 m north-west of North Charlton Mill; NHLE 1006564: Ellsnook round barrow, 175 m north east of Heiferlaw Bridge; NHLE 1014061: Heiferlaw tower house, 230 m north east of Holywell (also designated as a Grade I Listed Building); and NHLE 1014080: Heiferlaw defended settlement and Second World War Zero station, 100 m north of Holywell.	High Importance	Main Scheme Area
Grade I Listed Buildings	NHLE 1304282: Heiferlaw Tower (also designated as a Scheduled Monument)	High Importance	Main Scheme Area
Grade II* Listed Buildings	NHLE 1042002: Charlton Hall; NHLE 1154561: Greenhouse 120 m east of Felton Park with Potting Shed at Rear	High Importance	Main Scheme Area Main Compound
Grade II Listed Buildings	51 Grade II Listed Buildings	Medium Importance	39 – Main Scheme Area 4 – Lionheart Enterprise Park 8 – Main Compound
Conservation Areas	Rock Conservation Area	Medium Importance	Main Scheme Area
Registered Park and Garden	Grade I Alnwick Castle	High Importance	Main Scheme Area

Unknown Archaeological Remains

5.4.40. Other sensitive receptors include currently unknown and potential buried or surface archaeological remains (particularly from the Prehistoric, Medieval and Post-Medieval periods).

POTENTIAL IMPACTS

Below ground heritage assets and earthworks

Construction Effects

Main Scheme Area and Charlton Mires Compound

5.4.41. The construction works that have the potential to impact upon any remains present include ground levelling, topsoil stripping, the removal of existing road surfaces, construction of temporary compounds and haulage roads, and the installation of infrastructure items such as manholes, culverts or chambers, utilities cables, drainage pipes, detention basins and so forth. Any form of landscaping, including the planting of trees for screening, also has the potential to disturb buried archaeological remains. All direct impacts on buried archaeological remains would be permanent and irreversible.

5.4.42. Those below-ground assets which have been identified within the Scheme Footprint have potential to be partially or wholly disturbed as a result of those construction activities listed above. These include the Scheduled Prehistoric burial mound, located 420 m north-west of Linkhall (NHLE 1018499) and of national importance. There is also a potential for buried remains associated with the Scheduled Camp at West Linkhall (NHLE 1006500) and North Charlton medieval village and open field system (NHLE 1018348) to extend within the Scheme Footprint. The boundaries of these abut the Scheme Footprint. Any remains that are directly associated with these designated areas would be of national importance. Below ground remains associated with a stone cist and tumulus (HER 5033) also have the potential to be impacted, any remains found associated with the stone cist would be as significant as those associated with the Prehistoric Burial Mound (NHLE 1018499).

5.4.43. The baseline data suggest that there is potential for hitherto unknown remains associated with the Prehistoric period onwards to survive below the ploughed soil in undisturbed ground. Findspots (artefacts that have been identified and subsequently removed) are often good indicators of archaeological potential and include the Bronze Age burial (HER 5033) within the Scheme Footprint. There is potential that findspots are associated with further buried archaeological remains associated with prehistoric funerary activity of national importance. Similarly, the findspot of worked flint from Charlton Mires (HER 5062) could indicate the presence of further buried archaeological assets in this area of regional importance.

5.4.44. The evidence within the study area also demonstrates a high potential for buried remains of medieval date within the Scheme Footprint of local to regional importance.

Lionheart Enterprise Park Compound

5.4.45. Previous archaeological investigations at the Lionheart Enterprise Park Compound indicate a low potential for buried archaeological remains within the site, although the whole area has not been evaluated.

Main Compound

5.4.46. There is a potential for hitherto unknown remains from the Prehistoric period at the Main Compound at West Thirston due to the proximity of a scatter of Mesolithic flint (HER 11356) to the site and the cropmark of a double ditched enclosure (HER 11359) of regional importance. There is also a potential for medieval and post-medieval remains associated with agriculture of local to regional importance.

Operational Effects

Main Scheme Area and Charlton Mire Compound

5.4.47. There is a potential for adverse effects on the setting of buried assets during the operation of the Scheme from a loss of an element of the setting, or from visual intrusion resulting from the combination of the introduction of new structures, materials and movement and a degradation of tranquillity caused by the increased proximity of the Scheme to the receptor. This would only occur, however, where the setting is judged to contribute to the importance of the asset.

5.4.48. The operation of the Scheme may result in a change in local drainage patterns due to the installation of a new highways drainage system. As a result, changes in the groundwater levels could result in the decomposition or destruction of below ground archaeological remains and deposits. The Scheduled Prehistoric burial mound, located 420 m north-west of Linkhall (NHLE 1018499) is located near a detention basin, and is therefore recognised as at risk.

Main Compound and Lionheart Enterprise Park Compound

5.4.49. There would be no operational impacts of the Scheme in these areas as the Compounds would be removed after construction and the land reinstated.

Historic buildings, registered park and garden and conservation area

Construction Effects

Main Scheme Area including Charlton Mires Compound

5.4.50. It is anticipated that construction would have a direct impact on the non-designated Milepost located within the Scheme Footprint (HER 16878) of the Main Scheme Area, as the widening of the carriage may require its relocation or complete removal.

5.4.51. Noise caused by machinery and passing construction traffic in addition to the presence of visually intrusive Charlton Mires Compound is highly likely to result in a temporary adverse impact on the setting of Grade II Listed Patterson Cottage (NHLE 1371080) and West Linkhall Farmhouse (NHLE 1298856) as they all lie within 25 m of the Scheme Footprint. The construction of the bridge option at Heckley Fence could impact on the setting of Grade II Dovecote to East of Heckley Fence Farmhouse with Attached Wall (NHLE 1371059) and the Broxfield Bridge Option could impact on the setting of Heckley House (NHLE 1042044). The construction and use of access tracks and easements could also result in temporary adverse effects on the setting on the following Grade II Listed Buildings due to their close proximity:

- Milepost 40 metres north of entrance to Heckley House (NHLE 1153486);
- Smithy at South East Corner of Main Farm Building Group (NHLE 1303729);
- Barn and Engine House on North Side of Main Farm Building Group (NHLE 1041755); and
- Limekiln South of Kiln Plantation 700 metres south east of Rock Midstead.

5.4.52. The construction phase may also have a temporary adverse impact on built heritage assets in the wider area due to changes in their setting. Assets that could potentially be impacted include the Grade I Listed and Scheduled Heiferlaw Tower (NHLE 1304282 / NHLE 1014061), the Scheduled WWII Zero Station (NHLE 1014080), the Grade I Alnwick Park and Garden (NHLE 1001041) and the 42 designated heritage assets contained within it (consisting of 12 Grade I, 2 Grade II* and 28 Grade II Listed Buildings). All of these assets are of national importance. Construction works may

also result in temporary adverse impacts on the remaining 41 Grade II Listed Buildings and Rock Conservation Area which are of regional importance.

5.4.53. Non-designated built heritage assets which could see a temporary adverse impact during construction due to changes in setting comprise three World War II pillboxes (HER 19874, 19874 and 19936), the Spread Eagle Public House (HER 22436) and a second Milepost (HER 16836). The significance of these assets and the contribution of the setting to the significance would require further assessment, however they are likely to be of local to regional importance.

Lionheart Enterprise Park Compound

5.4.54. There would be a potential impact on four Grade II listed buildings of regional importance located around the Lionheart Enterprise Park Compound during the construction phase due to a change in setting.

Main Compound

5.4.55. The construction phase at the Main Compound may have a direct impact on a Grade II Listed Milepost (NHLE 1371021), although a recent site visit failed to locate the asset in this location. There is also a potential for indirect effects on one Grade II* listed building of national importance and seven Grade II listed buildings of regional importance. There is also one non-designated built heritage asset, Felshott (HER 19365), although this property has lost its historic elements and is therefore of no higher than local importance.

Operational Effects

Main Scheme Area including Charlton Mires Compound

5.4.56. There is a potential for adverse impacts on the setting of built heritage assets located around the Scheme by a combination of visual intrusion resulting from the introduction of new structures, materials and movement and a degradation of tranquillity caused by the increased proximity of the Scheme once in operation. The two Grade II listed buildings located alongside the existing highway (Patterson Cottage (NHLE 1371080) and West Linkhall Farmhouse (NHLE 1298856)), are recognised as being potentially sensitive receptors due to their close proximity, although the level of impact is not known until the setting assessment is completed. The operation of the bridge option at Heckley Fence could impact on the setting of Grade II Dovecote to East of Heckley Fence Farmhouse with Attached Wall (NHLE 1371059) and the Broxfield Bridge Option could impact on the setting of Heckley House (NHLE 1042044). There is also potential for adverse impacts on the non-designated Spread Eagle Public House (HER 22436) due to a permanent change in setting.

5.4.57. There is a potential for adverse impacts on designated and non-designated built heritage assets in the wider area due to a change in setting, however the level of impact is determined by the contribution of the setting to the importance of the asset. This would be determined though further assessment. Assets potentially impacted include the Grade I Listed and Scheduled Heiferlaw Tower (NHLE 1304282 / NHLE 1014061), the Scheduled WWII Zero Station (NHLE 1014080), the Grade I Alnwick Park and Garden (NHLE 1001041) and the 42 designated heritage assets contained within it (consisting of 12 Grade I, 2 Grade II* and 28 Grade II Listed Buildings). These assets are of national importance. There may be impacts during operation on the remaining 41 Grade II Listed Buildings and Rock Conservation Area which are of regional importance.

5.4.58. There is a potential for the subsidence of built heritage assets as a result of any changes in the local hydrology as a result of the Scheme.

Main Compound and Lionheart Enterprise Park Compound

5.4.59. There would be no impacts on the setting of built heritage assets around the Lionheart and Main Compound during operation of the Scheme as the sites would have ceased to be used for this purpose and land reinstated.

Historic landscape

Construction Effects

5.4.60. The construction of the Scheme would result in the partial loss of some elements of the Historic Landscape, however as the construction is being undertaken largely within the existing highway boundary the effects are anticipated to be minor. The main effects are predicted to arise from a loss of a number of locally important field boundaries that are potentially protected under the Hedgerows Regulations Act 1997. The Northumberland HLC identifies the presence of field boundaries associated with both piecemeal private enclosure and Parliamentary Enclosure, spanning the 17th to 19th centuries.

Operational Effects

5.4.61. No impacts on the historic landscape are anticipated during the operational period as a result of the Scheme.

Accommodation bridge options

5.4.62. The construction of the proposed bridge at either Broxfield or Heckley Fence has the potential to affect nearby sensitive receptors during both the construction and operational phases as a result of a change in setting, or through disturbance of unknown archaeological remains.

5.4.63. The Heckley Fence option has the potential to indirectly impact the Grade II Dovecote to the east of Heckley Fence Farmhouse and its attached wall (NHLE 1371059), located approximately 30 m west of the Scheme boundary. The Dovecote is of the 18th century and linked by the wall, included in the listing, to the farmhouse on the west. The topography lies relatively flat from the Dovecote to the current A1 and can be seen from the highway. The heritage asset is of medium value, however the contribution of the setting to value has not yet been assessed. During construction, there is also likely to be a noticeable increase in noise and visual intrusion, all resulting in adverse impact on the asset's setting. During the operational phase, there would be adverse impacts on the setting due to the visual intrusion of the bridge itself, which is anticipated to have a substantial impact on the immediate setting of the Dovecote. There are also lesser impacts anticipated associated with the potential increase in noise, vibration, pollution and lighting from the occasional use of agricultural vehicles using the bridge. The magnitude of impact for both the construction and operation phases is currently unknown until the setting assessment has been completed, however it is anticipated to be moderate to major adverse.

5.4.64. The Broxfield option is located approximately 180 m east of the Grade II listed Heckley House (NHLE 1042044), which is of medium value. The house is late 18th century with a 19th century rear wing attached. The house is facing to the south with no windows to the east, toward the A1. The land to the east of the house slopes away steeply towards the A1 which substantially limits the view from the highway back towards the heritage asset. The views from the heritage asset back towards the highway are partially screened by vegetation. There is a potential for temporary adverse impacts during construction phase due to changes in its setting. The impacts would arise from an increase in visual intrusion and noise, associated with the construction works. There are also potential impacts

during operation associated with a visual intrusion of the bridge itself, along with the potential for a slight increase in noise, vibration, pollution and lighting from the occasional agricultural vehicle using the bridge due to traffic being closer. However, the topography and existing screening is anticipated to reduce the visual impacts. A full assessment of the contribution of the setting to value has not yet been undertaken, however it is anticipated to be minor to moderate adverse for both the construction and operation phase.

5.4.65. Both options have the potential to directly impact below ground archaeology, this may cause damage or destruction to this finite resource. Any below-ground works would be of major adverse impact.

5.4.66. Both options have the potential to impact Grade II heritage assets which lie within close proximity to the current A1, they are both rural buildings within, largely, rural settings. The Heckley Fence option is in close proximity to the Grade II Dovecote and is anticipated to have the greater visual impact, in addition to an increase in noise, lighting, vibration, and pollution, during both construction and operation. The Broxfield option to the south would also potentially impact the setting of a Grade II building (Heckley House), however the asset is located further away. Visually, there is less likely to be an impact due to the building facing south and the presence of some screening from vegetation to the east.

DESIGN, MITIGATION AND ENHANCEMENT MEASURES

Construction

Below-Ground Archaeological Remains and Earthworks

5.4.67. Although there are nationally important SMs within and adjacent to the Scheme (NHLE 1018499, 1006500 and 1018348), direct impacts on the designations would be minimised as far as possible through the exclusion of the designated area from the Scheme Footprint and any additional construction activities. These would be defined and set out in a CEMP. This would avoid harm to these assets as they are subject to statutory protection under the Ancient Monuments and Archaeological Areas Act 1979 (**Ref 5.4.5**). Where this is not possible, ways to ensure preservation in-situ would be explored, in consultation with Historic England. If disturbance is unavoidable, then a programme of archaeological evaluation in the form of geophysical survey and potentially targeted trial trench evaluation should be implemented to determine the presence, extent and level of survival of the assets. Geophysical survey work would be undertaken in adherence to a Section 42 licence, issued by Historic England. Intrusive works would require Scheduled Monument Consent from Historic England.

5.4.68. A Non-intrusive archaeological investigation in the form of a geophysical survey is being undertaken in the areas off the existing highway in the Scheme Footprint. This may be followed by a programme of pre-construction trial trenching to determine the presence, extent, significance, and level of survival of buried heritage assets. The extent of any investigation would be agreed with the County Archaeologist at NCC at the appropriate stage. As required archaeological watching briefs have taken place during any pre-construction geotechnical ground investigations trial pits / trenches.

5.4.69. The results of these investigations can be used to devise a suitable programme of mitigation where applicable. Mitigation measures in addition to the investigation recommended would be devised in consultation with the County Archaeologist at NCC and Historic England.

5.4.70. For the ridge and furrow earthworks, a Level I earthwork survey would be undertaken in accordance with Historic England guidelines. Earthwork surveys would be programmed to occur before any trial trenching or other invasive investigations take place.

Historic Buildings

5.4.71. Construction may result in the removal and reinstatement of one milepost (HER 16878). It is proposed that this asset is subject to photographic recording prior to the start of construction to create a permanent record of its existing setting. This would be followed by the careful removal of the asset and its safe storage during construction and conservation, as appropriate, to prevent deterioration in its condition. On completion of construction, the milepost would be reinstated as close as possible to its original location to maintain its relationship with the road. Any mitigation would be devised in consultation with Historic England and the Milestone Society.

5.4.72. The construction phase at the Main Compound may have a direct impact on a Grade II Listed Milepost (NHLE 1371021), although a recent site visit failed to locate the asset in this location. If located, mitigation measures should be implemented to ensure the heritage asset is protected and preserved throughout the construction phase, and would be outlined in a CEMP.

Setting of Heritage Assets

5.4.73. There is a potential for temporary adverse impacts on heritage assets due to a change in the setting during construction and for permanent adverse impacts during operation of the Scheme. As the measures which could be used to mitigate the impacts are the same, they are discussed together below. Any mitigation measures to be applied during the construction phase would be outlined in a CEMP.

Historic Landscapes

5.4.74. The DCO would need to be granted before any sections of field boundaries likely to be protected under the Hedgerows Regulations Act 1997 are removed and any archaeological mitigation would be devised in consultation with NCC. This is likely to take the form of archaeological excavation and recording of sections through the boundaries.

Operation

Below-Ground Archaeological Remains, Earthworks and Historic Buildings

5.4.75. Any direct physical adverse impacts on below ground archaeological remains, earthworks and historic buildings would occur during the construction phase and no mitigation measures would be required for the operation stage of the Scheme.

Setting of Heritage Assets

5.4.76. Historic England guidelines (**Ref 5.4.6**) for mitigation of the impact of a development on the setting of a heritage asset (including historic landscapes) suggest that in the first instance impacts are best mitigated for either by the relocation of the development or changes to its design. Where relocation of the development is not possible, good design alone may be capable of reducing the harm. Paragraph 39 of the guidelines states:

5.4.77. ’Options for reducing the harm arising from development may include the repositioning of a development or its elements, changes to its design, the creation of effective long-term visual or acoustic screening, or management measures secured by planning conditions or legal agreements.

For some developments affecting setting, the design of a development may not be capable of sufficient adjustment to avoid or significantly reduce the harm, for example where impacts are caused by fundamental issues such as the proximity, location, scale, prominence or noisiness of a development. In other cases, good design may reduce or remove the harm, or provide enhancement. Here the design quality may be an important consideration in determining the balance of harm and benefit'.

5.4.78. Where attributes of a development affecting setting may cause some harm to significance and cannot be adjusted, screening may have a part to play in reducing harm. As screening can only mitigate adverse impacts, rather than removing impacts or providing enhancement, it ought never to be regarded as a substitute for well-designed developments within the setting of heritage assets. Screening may have as intrusive an effect on the setting as the development it seeks to mitigate, so where it is necessary, it too merits careful design.

5.4.79. Enhancement may be achieved by actions including:

- Removing or re-modelling an intrusive building or feature;
- Replacement of a detrimental feature by a new and more harmonious one;
- Restoring or revealing a lost historic feature or view;
- Introducing a wholly new feature that adds to the public appreciation of the asset;
- Introducing new views (including glimpses or better framed views) that add to the public experience of the asset; or
- Improving public access to, or interpretation of, the asset including its setting.

5.4.80. Mitigation measures to reduce the harm on the setting and opportunities for enhancement in setting would be devised in consultation with the County Archaeologist and Conservation Officers at NCC and Historic England.

LIKELY SIGNIFICANT EFFECTS

5.4.81. The comparison of preliminary likely significant effects between the two accommodation bridge options are set out in **Table 5-21** below, based upon currently available information and professional judgement. These effects could change as the EIA progresses. Mitigation measures are outlined in the above section.

Table 5-21 - Preliminary Likely Significant Effects of the two accommodation bridge options

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
Grade II Listed Building Dovecote to East of Heckley Fence Farmhouse with Attached Wall (NHLE 1371059)	Construction	During construction there is potential for temporary impacts of the setting of heritage asset with a potential for significant effects. This is due to visual alterations to the landscape through changes in movement and the building of new structures. There is also potential for degradation of noise due to movement of	Not anticipated	Yes

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
		construction vehicles and plant. The level of effect will be determined by the magnitude of impact, which is currently under ongoing assessment. The impacts are anticipated to be temporary and the effects removed once construction is completed.		
	Operation	There is potential for impacts to the setting of the heritage asset with a potential for significant effect. This is likely to be a result of visual alterations to the landscape due to new structures and movement, there is also potential for degradation in noise due to traffic movement. The impacts would be permanent. The assets impacted is of medium value, however the contribution of the setting to the value has not yet been assessed. The level of effect will be determined by the magnitude of impact, which is currently under ongoing assessment.	Not anticipated	Yes
Grade II Listed Building Heckley House (NHLE 1042044).	Construction	During construction there is potential for temporary impacts of the setting of heritage asset with a potential for significant effects. This is due to visual alterations to the landscape through changes in movement and the building of new structures. There is also potential for degradation of noise due to movement of construction vehicles and plant. The level of effect will be determined by the magnitude of impact, which is currently under ongoing assessment. The impacts are anticipated to be temporary and the effects removed once construction is completed.	Yes	Not anticipated
	Operation	There is potential for impacts to the setting of the heritage asset with a potential for significant effect. This is likely to be a result of visual alterations to the landscape due to new structures and movement, there is also potential for degradation in noise due to traffic movement. The impacts would be permanent. The assets impacted is of medium value, however the contribution of	Yes	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
		the setting to the value has not yet been assessed. The level of effect will be determined by the magnitude of impact, which is currently under ongoing assessment.		

5.4.82. A summary of the preliminary likely significant effects is presented in **Table 5-22** below, based upon currently available information and professional judgement. However, these effects could change as the EIA progresses.

5.4.83. Potential direct impacts on above or below-ground archaeology and historic landscapes during the construction phase would be negated wherever possible through mitigation measures such as preservation by record or preservation in situ. However, it is anticipated that significant effects may remain.

5.4.84. During construction there is also potential significant residual effects as a result of partial or full loss of hedgerows of historic importance, if identified.

5.4.85. Potential significant residual effects are expected as a result of indirect and direct adverse impacts on the setting of designated heritage assets and historic landscapes during both the construction and operational phases of the Scheme. The significance of these effects, together with the assets that could be impacted, would be known following the completion of a setting assessment.

5.4.86. Following the implementation of mitigation measures such as good design, screening and enhancement, the adverse impact on the setting of assets may be reduced although not be removed completely. However, this will be determined through the detailed assessments as part of the EIA.

Table 5-22 - Summary of Preliminary Likely Significant Effects – cultural heritage

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Designated Heritage Assets Within the Scheme Footprint				
One Scheduled Monument: Prehistoric burial mound (NHLE 1018499)	Construction	Potential for construction works to result in irreversible damage or loss of the designated asset, and unknown below-ground remains associated within it, with a large adverse effect. There is also potential for temporary moderate adverse effect due to a change to the setting.	Mitigation through preservation in-situ is the preferred option, with best practice measures set out in a CEMP to manage working in proximity to designated assets. If disturbance is unavoidable, then permission would be required from the Secretary of State for to undertake preservation by record.	Yes
	Operation	Setting could be permanently harmed by a combination of visual intrusion resulting from the introduction of new structures, materials and movement and a degradation of tranquillity caused by increases in traffic noise with slight to moderate adverse effects. The introduction of the detention basin may result in a permanent change to the setting.	Unknown until further assessment has been completed, but likely to include landscape planting.	Not anticipated
One Grade II Listed Milepost (Milepost approximately 55 m	Construction	Potential for construction works at the Main Compound to result in damage or loss of the designated asset, and potential temporary	Best practice measures set out in a CEMP would manage working in	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
south-west of Thurston New Houses Farmhouse; NHLE 1371021)		adverse change to the setting with moderate to large adverse effects. Site walkover in 2018 failed to locate the milepost.	proximity to designated assets to ensure no damage or loss of the asset.	
	Operation	No impacts or effects are predicted following the completion of the construction phase.	None required	Not anticipated
Non-Designated Heritage Assets Within Scheme Footprint				
Non-designated built heritage asset: One Milepost (HER 16878)	Construction	Potential for construction works to result in damage or loss of the designated asset, and potential temporary adverse change to the setting. Assessment to determine the value and condition of the heritage asset is ongoing to establish the magnitude of impact. Based on the current information, the effects are predicted to be slight adverse.	Best practice measures in a CEMP would manage working in proximity to designated assets.	Not anticipated
	Operation	Setting could be permanently harmed by a combination of visual intrusion resulting from the introduction of new structures, materials and movement and a degradation of tranquillity caused by increases in traffic noise with a slight to moderate adverse effect. Assessment to determine the value and condition of the heritage asset is ongoing to establish the magnitude of impact. Based on the current information, the effects are predicted to be slight adverse.	Unknown until further assessment has been completed, but likely to include landscape planting.	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Three below ground heritage assets: Two Stone Cists and tumulus (HER 5033)	Construction	Construction works could lead to ground disturbance resulting in full or partial loss of buried archaeological assets. Any loss would be of major significance due to any remains being found being of high importance.	Preservation in-situ or preservation through record.	Yes
	Operation	No impacts are predicted to below-ground heritage assets during the operation stage. No significant effects anticipated.	N/A	N/A
Hedgerows of Historic Importance	Construction	Potential for ground work to result in the full or partial loss of a number of locally important historic field boundaries that are likely to be protected under the Hedgerows Regulations Act 1997 with moderate adverse effects.	Preservation in-situ or reinstatement.	Yes
	Operation	There is unlikely to be any impact during the operational period.	N/A	N/A
Historic Landscape	Construction	Potential for construction works to result in full or partial loss of historic landscape with moderate adverse effect.	None appropriate.	Yes.
	Operation	Setting could be permanently harmed by a combination of visual intrusion resulting from the introduction of new structures, materials and movement and a degradation of tranquillity caused by increases in traffic noise.	Unknown until further assessment has been completed, but likely to include landscape planting.	Not anticipated
Heritage Assets outside of Scheme Footprint				
Grade II Listed Building Dovecote to East of Heckley Fence	Construction	During construction there is potential for temporary impacts of the setting of heritage asset with a potential for significant effects. This	Best practice measures set out in a CEMP would manage working in	Yes

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Farmhouse with Attached Wall (NHLE 1371059)		is due to visual alterations to the landscape through changes in movement and the building of new structures. There is also potential for increased noise due to movement of construction vehicles and plant. The level of effect will be determined by the magnitude of impact, which is currently under ongoing assessment. The impacts are anticipated to be temporary and the effects removed once construction is completed.	proximity to designated assets to ensure no damage or loss of the asset.	
	Operation	There is potential for impacts to the setting of the heritage asset from the Heckley Fence option, with potential for a significant effect. This is likely to be a result of visual alterations to the landscape due to introduction of new structures. There would also be some impacts due to an increase in agricultural traffic movement occasionally using the road. The impacts would be permanent. The assets impacted is of medium value, however the contribution of the setting to the value has not yet been assessed. The level of effect will be determined by the magnitude of impact, which is currently under ongoing assessment.	Unknown until further assessment has been completed to establish the contribution of the setting to the value of the asset and the magnitude of impact, but measures to mitigate effects could include landscape planting.	Yes
Grade II Listed Building Heckley House (NHLE 1042044).	Construction	During construction there is potential for temporary impacts of the setting of heritage asset with a potential for significant effects. This is due to visual alterations to the landscape through changes in movement and the building	Best practice measures set out in a CEMP would manage working in proximity to designated assets to ensure no	Yes

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		of new structures. There is also potential for increased noise due to movement of construction vehicles and plant. The level of effect will be determined by the magnitude of impact, which is currently under ongoing assessment. The impacts are anticipated to be temporary and the effects removed once construction is completed.	damage or loss of the asset.	
	Operation	There is potential for impacts to the setting of the heritage asset from the operation of the Broxfield option with a potential for significant effect. This is likely to be a result of visual alterations to the landscape due to introduction of new structures. There would also be some impacts due to an increase in agricultural traffic movement occasionally using the road. The impacts would be permanent. The assets impacted is of medium value, however the contribution of the setting to the value has not yet been assessed. The level of effect will be determined by the magnitude of impact, which is currently under ongoing assessment.	Unknown until further assessment has been completed to establish the contribution of the setting to the value of the asset and the magnitude of impact, but measures to mitigate effects could include landscape planting.	Yes
Designated Heritage Assets, Non-designated above ground assets and historic landscapes in the wider landscape	Construction	During construction there is potential for impacts of the setting of heritage assets and historic landscapes within the wider landscape, with a potential for significant effects. This is due to visual alterations to the landscape through changes in movement and the building of new structures. There is also potential for	Unknown at this point but landscape screening is likely.	Unknown, awaiting further assessment and design details.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		degradation of noise due to movement of construction vehicles and plant. The level of effect will be determined by the magnitude of impact, which is currently under ongoing assessment. The impacts are anticipated to be temporary and the effects removed once construction is completed.		
	Operation	There is potential for impacts to the setting of heritage assets and historic landscapes within the wider landscape with a potential for significant effect. This is likely to be a result of visual alterations to the landscape due to new structures and movement, there is also potential for degradation in noise due to traffic movement. The impacts would be permanent. The assets impacted range from low to large value, based on their designation. The level of effect will be determined by the magnitude of impact, which is currently under ongoing assessment.	Unknown at this point but landscape screening is likely.	Unknown, awaiting further assessment and design details.
Designated and non-designated below ground heritage assets and earthworks in the wider landscape	Construction	During construction there is potential for impacts of the setting of below ground heritage assets and earthworks with a potential for significant effect. This is due to visual alterations to the landscape through changes in movement and the building of new structures. There is also potential for degradation of noise due to movement of construction vehicles and plant. The impacts and effects are predicted to be higher for the SMs as they are of high, national	Unknown at this time.	Unknown, awaiting further assessment and design details.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		value, however further assessment is required to determine the contribution of the setting to the significance of the heritage assets.		
	Operation	Potential permanent adverse impacts with significant effects upon buried archaeological remains in the wider landscape through changes in hydrology resulting from a change in drainage and water levels in and around the Scheme.	A robust surface water drainage system would be provided.	Unknown, awaiting further assessment and design details.

FURTHER WORK FOR THE EIA

5.4.87. A detailed level of assessment on the cultural heritage impacts during construction and operation of the Scheme will be undertaken in accordance with the methodology set out in the DMRB Volume 11, Section 3, Part 2, HA208/07 "Cultural Heritage" (**Ref 5.4.4**). It will discuss the value of the heritage assets and their settings and their cultural heritage significance.

5.4.88. A geophysical survey, to identify any potential buried archaeological remains within the Scheme Footprint, has recently been completed. The results will be analysed and incorporated into the ES and appropriate mitigation considered and recommended in consultation with NCC.

5.4.89. A map regression exercise to identify additional heritage assets and potentially Historically Important Hedgerows will be undertaken.

5.4.90. There will be consultation with Historic England and NCC's Conservation Team to ensure that all designated and non-designated assets surrounding the Scheme which constitute a sensitive receptor have been identified and assessed.

5.4.91. A review of the ZTV models developed for the Landscape and Visual Assessment will be undertaken to assist in the assessment of effects on sensitive receptors.

5.4.92. A programme of mitigation appropriate to the Scheme will be developed in consultation with NCC and Historic England to reduce harm and to provide enhancements.

5.4.93. The ES will assess the potential impacts upon historic assets during the construction and operation of the Scheme. This will include consideration of the impact upon the setting of all heritage assets, including buried archaeological remains. The ES will also assess potential impacts as a result of alterations to drainage patterns on the survival of buried archaeological remains in the wider landscape.

5.4.94. Monitoring to measure the success of any mitigation and enhancement measures will be considered as part of the EIA.

5.4.95. In response to the Scoping Opinion provided by the Inspectorate (**Volume 2, Appendix B, Section 4.4**), the ES will also include a review of the Visual Envelope Plan to identify any additional designated assets in a 2 km and 5 km area which could be impacted through a change in setting. Any heritage assets identified will be assessed in adherence to the Historic England guidance (**Ref. 5.4.6**).

5.5 BIODIVERSITY

INTRODUCTION

5.5.1. This section considers the implications of the Scheme on biodiversity during construction and operation and details any potentially significant effects.

EXISTING BASELINE KNOWLEDGE

5.5.2. The baseline for the Scheme has been determined and appraised through a combination of desk-based study and field surveys within select study and survey areas. The Scoping Report, set out in **Volume 2**, **Appendix A** details the baseline, which was derived from a review existing survey effort and results available at the time of writing and included:

- Options Selection Stage EAR;
- Extended Phase 1 habitat survey;
- Bat roost potential survey;
- Badger *Meles meles* survey;
- Wintering Bird Survey;
- Breeding Bird survey;
- Great Crested Newt (GCN) *Triturus cristatus* Environmental DNA (eDNA) and Habitat Suitability Index (HSI) survey; and
- Water vole *Arvicola amphibius* and otter *Lutra lutra* survey.

5.5.3. In addition to those surveys annotated above, a survey to corroborate the results of the original extended Phase 1 habitat survey, and badger survey, are required to be undertaken in 2019, owing to changes in Scheme Footprint and the time elapsed since the original habitat survey was completed (i.e. over 2 years). The extended Phase 1 habitat survey will encompass the entirety of the Scheme and will therefore include the proposed Charlton Mires Site Compound.

5.5.4. The extended Phase 1 habitat survey will additionally encompass land of the proposed Lionheart Enterprise Park Compound. The results of this survey will inform any requirement for further protected species surveys which will require completion in 2019.

5.5.5. The Main Compound was previously subject to an extended Phase 1 habitat survey in 2016 (within the Options Selection Stage EAR). Protected species surveys were subsequently completed here as part of the A1 in Northumberland: Morpeth to Felton scheme assessment.

5.5.6. Survey areas for respective survey types have been informed by best practice guidelines / methodologies for each feature type, DMRB guidance (Volumes 10 & 11) (**Ref 5.5.1 & 5.5.2)** and IAN 130/10 (**Ref 5.5.3)**, and guidelines from CIEEM (**Ref 5.5.4** and **5.5.5)**. Consideration has also been given to the likely EZoI applicable to the anticipated impacts of the Scheme. Full justification of study areas employed during surveys will be presented within the ES.

Designated Sites

5.5.7. Statutory European sites[8] or internationally designated sites have been identified within 10 km (30 km for European sites where bats are one of the qualifying interests, as prescribed within DMRB Volume 11, Section 4, Part 1) **(Ref 5.5.6)** and are presented within Table 5-23 and shown on **Figure A16: Statutory European Sites or Internationally Designated Sites within 10 km** in **Appendix A**.

5.5.8. A Habitat Regulations Assessment (HRA) Screening Assessment is currently being prepared to take account of potential impacts to the Northumbrian Coast Ramsar / SPA, the North Northumberland Dunes SAC, the River Tweed SAC, Newham Fen SAC, and Berwickshire and North Northumberland Coast SAC, given potential hydrological or air quality links between these sites and the Scheme. It is currently anticipated there would be no impact upon European Sites, however, any such findings and evidence would be fully incorporated within the EIA and subject to a standalone HRA: Screening Assessment.

5.5.9. UK statutory designated sites are those sites which are designated under UK domestic legislation such as the Wildlife and Countryside Act 1981 (as amended) **(Ref 5.5.7)**, which includes SSSI. UK non-statutory designated sites are those sites which are applied at the local level, and are not underpinned by legislation, for example LWS. Non-statutory designated sites are detailed within **Table 5-23** below and presented within **Figure A17**: **Non-Statutory Designated Sites** in **Appendix A**.

5.5.10. Search radii (10 km and 30 km respectively) have been implemented following best practice guidelines and are not anticipated to change, however, a review of information from other disciplines will be undertaken during the EIA process and may necessitate the implementation of a larger EZoI with which to assess statutory designated sites (for example in relation to air quality, noise, or hydrology).

Table 5-23 - Statutory and non-statutory designated sites

Site Name	Reason for Designation	Distance from the Scheme Footprint
Statutory designated sites		
North Northumberland Dunes SAC	Annex I habitats as primary selection: Embryonic shifting dunes; 'Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes')'; 'Fixed coastal dunes with herbaceous vegetation ('grey dunes')';	6.3 km east of Main Scheme Area

[8] Which are those designated under international Conventions and European Directives – principally Ramsar Sites, Special Areas of Conservation (SAC) and Special Protection Areas (SPA)

Site Name	Reason for Designation	Distance from the Scheme Footprint
	Dunes with *Salix repens ssp. argentea* (*Salicion arenariae*); and Humid dune slacks. Annex II Species as primary selection: *Petalwort Petalophyllum ralfsii*	
Newham Fen SAC	Annex I habitats as primary selection: Alkaline fens	6.6 km north of Main Scheme Area
River Tweed SAC	Annex I habitats as primary selection: Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation. Annex II Species as primary selection: Atlantic salmon *Salmo salar*; and Otter *Lutra lutra*. Annex II Species as qualifying feature: Sea lamprey *Petromyzon marinus*; Brook lamprey *Lampetra planeri*; and River lamprey *Lampetra fluviatilis*.	9.4 km west of Main Scheme Area
Northumbria Coast SPA and Ramsar site	Annex I species during the breeding season: Little tern *Sterna albifrons*. Annex I species over winter: Purple Sandpiper *Calidris maritima*. Turnstone *Arenaria interpres*	5.6 km east of Main Scheme Area
Berwickshire and North Northumberland Coast SAC	Annex I habitats as primary selection: Mudflats and sandflats not covered by seawater at low tide; Large shallow inlets and bays; Reefs; and Submerged or partially submerged sea caves. Annex II Species as primary selection: Grey seal *Halichoerus grypus*.	6.1 km east of Main Scheme Area
Hulne Park Local Nature Reserve (LNR)	Mature woodland and grassland habitats.	1.5 km west of Main Scheme Area
River Coquet and Coquet Valley Woodlands (SSSI)	River Coquet is an unmodified fast-flowing upland river supporting characteristic wildlife.	580 m north of Main Compound

Site Name	Reason for Designation	Distance from the Scheme Footprint
	Woodlands near to the river are Ancient Woodland sites.	
Non-statutory designated sites		
Coquet River Felton Park Local Wildlife Site (LWS)	Parkland site connecting with the River Coquet.	580 m north of Main Compound
Ratcheugh Crag – Pepper Moor (LWS)	Whin grassland.	2.0 km east of Main Scheme Area

Habitats

5.5.11. An extended Phase 1 habitat survey of the Scheme was undertaken in June 2016 (see **Figure A18: Phase 1 Habitat Survey** in **Appendix A**) (**Ref 5.5.8**) including the Main Compound, identifying broad habitat types and included an evaluation of the potential to support protected and/or notable species to ascertain further survey needs. The survey undertaken in 2016 was completed against a previous Scheme design, and is not the design to be assessed within the ES.

5.5.12. The following habitats identified as Habitats of Principal Importance (HPI) and / or listed within the Local Biodiversity Action Plan (LBAP) were identified within the 500 m buffer around the Scheme:

- Arable farmland (field margins only);
- Broadleaved semi-natural woodland;
- Broadleaved/mixed/coniferous plantation woodland;
- Dense/continuous, and scattered scrub;
- Dry heath/acid grassland mosaic (lowland heath only);
- Species-poor hedge with trees;
- Species-poor intact hedge;
- Species-poor defunct hedge;
- Species-rich intact hedge;
- Scattered broadleaved trees;
- Standing water (e.g. ponds); and
- Running Water (e.g. ditches, streams).

5.5.13. Other habitats identified, and not subject to listing under a bespoke action plan, included amenity grassland, bracken, improved grassland, introduced shrub, marshy grassland, poor semi-improved grassland, and tall ruderal.

Protected and / or Notable Species

5.5.14. Since completion of the Scoping Report, further surveys have been completed to update and inform the baseline presented within this PEIR. The desk study and initial 2016 surveys identified signs of, or potential for, the presence of protected and / or notable species within the relevant study areas. Subsequently, a number of protected species surveys have been completed during 2018. Due to land access restrictions, full baseline results for some features have unable to be collected during 2018 and further survey is required in 2019 to provide a comprehensive baseline to appraise and present within the ES.

5.5.15. Protected species surveys have been completed at the proposed Main Compound, and have included, but not limited to, badger survey, bat transect surveys, and bird surveys. General mitigation measures (e.g. cognisance of potential presence of nesting birds within hedgerows during bird nesting season) and best practice would be enforced during the set-up and operation of the compound, with land subject to pre-works/construction surveys prior to set-up. The results of these surveys will influence any requirements for bespoke mitigation.

Further Surveys

5.5.16. As stated above, due to land access restrictions, further survey of some features is required in 2019. A summary of desk study and pre-2018 results, 2018 surveys and results, and requirements for further survey in 2019 is provided within **Table 5-24** below.

Table 5-24 - Summary of surveys completed to date and requirements for further survey in 2019

Receptor/Survey	Pre-2018 Surveys and Results	2018 Surveys and Results	Further Survey Requirement in 2019
Extended Phase 1 Habitat Survey	A Biological Desk Study was undertaken along with a Phase 1 Habitat Survey in 2016 for the main Scheme (excluding the Lionheart Enterprise Park Compound, but inclusive of the Charlton Mires Site Compound). A total of 24 different habitats were recorded, including seven priority habitats (listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 (**Ref 5.5.9**). The proposed Main Compound, south of the Scheme, was surveyed in 2016 and subsequently ground-truthed in 2017.	No survey of the Scheme undertaken in 2018.	Extended Phase 1 habitat survey is required on the proposed Lionheart Enterprise Park Compound to fully appraise the location of habitats present and potential to support protected and/or notable species. A re-survey of the entirety of the Scheme encompassing the revised red-line boundary, is required in 2019 to ensure baseline information is relevant, given the duration since the original survey was undertaken. The survey will encompass the

Receptor/Survey	Pre-2018 Surveys and Results	2018 Surveys and Results	Further Survey Requirement in 2019
			Scheme and an appropriate buffer (i.e. 250 m)
National Vegetation Classification (NVC)	No survey completed	An NVC survey was completed during 2018 of areas of those habitats with potential increased botanical significance– e.g. woodlands, health/grass mosaics, or those included within the UK/Northumberland BAP lists, and to identify Groundwater Dependent Terrestrial Ecosystems (GWDTE). Survey areas were selected through interrogation of the 2016 Phase 1 habitat survey results. NVC habitat types recorded included UK and Northumberland BAP listed habitats, including: W8 – *Fraxinus excelsior – Acer campestre – Mercurilais perennis* woodland W10 - *Quercus robur – Pteridium aquilinum – Rubus fruticosus* woodland Additionally, habitats with potential groundwater dependency were also recorded, including: MG9 – *Holcus lanatus – Deschmapsia cespitosa* grassland MG10 – *Holcus lanatus – Juncus effusus* rush pasture M23 – *Juncus effusus/acutifloris – Galium palustre* rush pasture	Not anticipated although further survey may be required following the completion of the extended Phase 1 habitat re-survey in respect of the Scheme Footprint variation.

Receptor/Survey	Pre-2018 Surveys and Results	2018 Surveys and Results	Further Survey Requirement in 2019
Badger	Badger setts have been identified within a 250 m buffer from the Scheme during previous survey visits, however, given the sensitive nature of information on the species, their location is not defined here.	No survey undertaken in 2018.	A targeted badger survey will be completed in 2019 amongst suitable habitat along the Scheme. Dependent on the results of the extended Phase 1 habitat survey, additional survey of the Lionheart Enterprise Park Compound may be required.
Bat	The desk study identified 57 bat roosts within 5 km of the Scheme. These comprised 15 common pipistrelle roosts, 14 soprano pipistrelle roosts; one unidentified pipistrelle species roost, four whiskered bat / Brandt's bat roosts, 13 Natterer's bat roosts, seven brown long-eared bat roosts and three roosts associated with unidentified bat species. Bat Roost Potential (BRP) surveys undertaken in 2016 identified buildings, structures and trees along the Scheme survey corridor. Subsequently, those buildings, trees, and structures identified	Surveys completed in 2018 have included transect surveys, both BCT and Defra transects; and dusk emergence and dawn re-entry surveys of buildings with BRP. A total of 11 buildings have been subject to emergence and re-entry surveys in 2018. To date three roosts have been identified across the Scheme comprising low numbers of bats (either single bats or five or fewer bats). Full analysis of survey results is still to be completed and will be presented within the ES.	Further dusk emergence and / or dawn re-entry surveys of buildings are required during 2019. BCT and Defra transect surveys will continue during 2019. Aerial tree-climbed inspection of trees

Receptor/Survey	Pre-2018 Surveys and Results	2018 Surveys and Results	Further Survey Requirement in 2019
	were subject to dusk emergence and/or dawn-re-entry surveys appropriate to the level of BRP assessment, to determine roost presence. To ascertain landscape scale effects on bats, transect surveys using both Bat Conservation Trust (BCT) (**Ref 5.5.10**) and Defra transect survey methodologies have been employed during 2018.		identified with BRP will be undertaken of those trees located under the Scheme Footprint and within 50 m. Should evidence of bat use/roosts be discovered, or features on trees be unable to be adequately surveyed during aerial inspection, these will be subject to dusk emergence and/or dawn re-entry surveys to qualify bat presence / use. The above surveys are required in order to obtain a full baseline to inform the ES.
Great Crested Newt	The desk study identified two records of GCN from between 1983 and 2005 from	Presence/absence surveys were completed at six ponds in 2018 with no evidence of GCN recorded.	Further surveys, both eDNA and

Receptor/Survey	Pre-2018 Surveys and Results	2018 Surveys and Results	Further Survey Requirement in 2019
	Environmental Records Information Centre (ERIC) North East, within the 2 km search radius. eDNA surveys undertaken in 2016 returned negative results for all waterbodies surveyed within a 250 m survey corridor.	A single pond (B6) was subject to eDNA survey in 2018, with results initially indicating an absence of GCN at the pond.	presence/absence surveys, are required of two ponds during 2019 in order to obtain a full baseline to inform the ES.
Otter, Water Vole	The desk study identified a sole record of a water vole within the 2 km search radius. Water vole surveys undertaken during 2016 and 2017 identified evidence of water vole in several watercourses located across the Scheme. Information provided by ERIC North East indicates four records of otter in the study area. Otter surveys undertaken in 2016 found no otter field signs within 250 m of the Scheme.	Surveys undertaken during 2018 failed to identify any signs or evidence of water vole or otter activity, however, a number of watercourses were unable to be accessed due to land restrictions.	Further survey for the presence of water vole activity at those watercourses unable to be accessed during 2018 will be undertaken during 2019; in order to obtain a full baseline to inform the ES. Whilst further survey was deemed unrequired following the 2016 survey, surveyors will be cognisant of the signs of otter whilst

Receptor/Survey	Pre-2018 Surveys and Results	2018 Surveys and Results	Further Survey Requirement in 2019
			undertaking water vole surveys in 2019.
Breeding Birds	Breeding bird surveys were undertaken during 2016, recording a total of 84 species of birds. Five species recorded are listed on Schedule 1 of the Wildlife and Countryside Act (1981) including barn owl; brambling *Fringilla montifringilla*; common crossbill *Loxia curvirostra*; fieldfare *Turdus pilaris*; and redwing *Turdus iliacus*. Additional bird species recorded encompassed those listed as amber or red on the Birds of Conservation Concern (BoCC) list, as LBAP species or those referenced within the NERC Act.	No surveys undertaken in 2018	Not anticipated – given the limited Scheme Footprint and the widespread nature of the habitats in the area, further breeding birds surveys were scoped out of future surveys.
Barn Owl	ERIC North East provided three records of barn owl within the desktop study area, although exact locations were not available. Additionally, a single barn owl was recorded during breeding bird surveys undertaken in 2016.	Vantage point surveys and inspections of potential roost sites across the Scheme were completed in 2018, identifying a number of features with potential for use as roosting/nesting spots. Incidental observations of barn owl were recorded by surveyors during other surveys (e.g. bat surveys) and a confirmed barn owl roost location was incidentally recorded, with pellets and feathers located at the base of a tree.	Further vantage point surveys are scheduled for 2019 in order to obtain a full baseline to inform the ES.

Receptor/Survey	Pre-2018 Surveys and Results	2018 Surveys and Results	Further Survey Requirement in 2019
Wintering Birds	Wintering bird surveys were completed during the winter of 2016 / 2017, with an assemblage typical of farmland and arable habitats recorded. Species included birds listed on Schedule 1 of the Wildlife and Countryside Act (1981); BoCC list, or LBAP, including: Twite *Linaria flaviostris*; pink-footed goose *Anser brachyrhynchus*; herring *gull Larus argentatus;* redwing; lapwing *Vanellus vanellus*; less black-backed gull *Larus fuscus*; golden plover *Pluvialis apricaria*; fieldfare; and starling *Sturnus vulgaris*.	No surveys undertaken in 2018	Not anticipated – given the limited Scheme Footprint and the widespread nature of the habitats in the area, further wintering bird surveys were scoped out of future surveys.
Reptiles	No records of reptiles were returned during the desk study assessment. Habitats recorded during the Extended Phase 1 habitat survey were appraised for the potential to support reptiles and eight sites identified for undertaking presence/absence surveys.	Presence/absence surveys utilising artificial refugia have been completed on seven sites of suitable habitat to support reptiles during 2018, with seven survey visits completed during the active reptile season. No evidence of reptiles was recorded during any of the surveys.	Due to land access restrictions in 2018, survey of a single site immediately adjacent east of the existing carriageway is required during 2019 – comprising seven survey visits, to obtain a full baseline to inform the ES.

Receptor/Survey	Pre-2018 Surveys and Results	2018 Surveys and Results	Further Survey Requirement in 2019
Red Squirrel	The desk study returned 65 records of red squirrel from ERIC North East. Several woodlands were identified from the 2016 extended Phase 1 habitat data with potential to support red squirrel.	Survey for red squirrel was completed at woodland locations across the Scheme during 2018. A single drey was recorded within a woodland block adjacent to the Scheme although it was not possible to determine whether this was a grey or red squirrel drey.	Not currently anticipated
Terrestrial Invertebrates	The desk study undertaken as part of the Extended Phase 1 Habitat Survey identified one notable terrestrial invertebrate species, the dingy skipper *Erynnis tages*. In cognisance of a lack of notable / protected invertebrate species records returned during the desk study, and factoring in the prevailing habitat types bounding the Scheme, namely arable and grazing fields, it is further targeted terrestrial invertebrate surveys have been scoped out	No survey undertaken in 2018.	Not currently anticipated
Fish and aquatic invertebrates (including White-clawed Crayfish)	The desk study undertaken as part of the Extended Phase 1 Habitat survey identified 11 invertebrate species listed as priority species or those subject to legal protection (e.g. European protected species). With watercourses and bodies located across the Scheme with the potential to support species including white-clawed crayfish *Austropotamobius pallipes* and yellow mayfly *Potamathus luteus*.	A scoping walkover survey of watercourses across the Scheme was undertaken in 2018 to inform requirements for further targeted fish and aquatic invertebrate surveys.	Aquatic invertebrate and fish (electrofishing) surveys are required of watercourses identified during the watercourse scoping survey, and will be

Receptor/Survey	Pre-2018 Surveys and Results	2018 Surveys and Results	Further Survey Requirement in 2019
	Watercourses across the survey area were additionally considered suitable to support a range of fish species, with desk study results returning records of seven species listed as priority species or those subject to legal protection (e.g. European protected species) including Atlantic Salmon *Salmo salar* and bullhead *Cotus gobio*.		undertaken in 2019 in order to obtain a full baseline to inform the ES.
Brown hare	Incidental sightings of brown hare have been recorded during survey visits throughout 2018. ERIC North East additionally returned records of brown hare for the study area. Habitats present across the Scheme provide suitable habitat to support the species and their presence is confirmed for much of the survey area.	No survey undertaken in 2018.	Not currently anticipated

POTENTIAL IMPACTS

Construction

5.5.17. The potential impacts of construction on ecological features may include the following:

- Direct habitat loss, fragmentation of habitats due to construction of the Scheme and land made available to facilitate construction - the extent of location of habitat loss is yet to be quantified but will be fully outlined within the ES;
- Temporary and permanent damage to retained habitats as a result of, for example, accidental pollution, discharge of materials or hydrological effects. This may include temporary reduction in water quality in relation to the installation of new culverts or extension of existing culverts;
- Impacts upon trees / woodland through compaction of soils, dust, or storage of materials.
- Permanent loss of resting and sheltering places of protected and / or priority species may occur as a result of construction of the Scheme, for example including:
    - Loss of bat roosts - e.g. buildings, structures, trees;
    - Loss of badger setts;
    - Loss of water vole burrows; and
    - Loss of bird nesting / roosting locations, particularly barn owl.
- Potential for accidental mortality / injury to protected and/or priority species as a result of construction activities, including:
    - Entrapment in voids or excavations;
    - Direct impact with machinery or vehicles during earthworks or vehicle movements;
    - Vegetation clearance works; and
    - General construction activities
- Temporary direct and indirect adverse effects on legally protected and / or priority species may occur due to general construction site activities through severance, fragmentation, and reduction in habitat quality, with potential disturbance and displacement of species a result; and
- Temporary indirect disturbance to species and retained habitats through noise, light, dust, and vibration associated with construction activities; and
- Potential spread of invasive species through construction affiliated works or vehicle/personnel movements.

Operation

5.5.18. The effects on ecological features, which would potentially occur as a result of operation of the Scheme include:

- Permanent indirect disturbance to species (e.g. bats) from increased levels of light, noise, and pollution;
- Permanent fragmentation / severance of existing roadside habitat as a result of construction of the Scheme - e.g. through lighting use; impacts from pollution events, etc.;
- Direct mortality of individuals through traffic collision;
- Polluted road run-off affecting the water environment, roadside ditches, and watercourses crossed by the Scheme; and
- Permanent, indirect adverse impacts on vegetation adjacent to the A1 from polluted spray resulting from road traffic.

Accommodation bridge options

5.5.19. Both bridge options would result in the permanent and temporary loss of HPI, including hedgerows, during the construction phase. Operational impacts to HPI may result through the sporadic use of the PRoW, primarily by agricultural vehicles, and may result in pollution through spray or run-off.

5.5.20. The Heckley Fence option would be located approximately 100 m from a pond to the west (B1; Jacobs, 2017). Whilst great crested newts were found to be absent from the pond in 2016 (eDNA survey), construction and operational phases have the potential to result in indirect impacts to the waterbody as a result of pollution events. Additionally, the Heckley Fence bridge would also require the re-routing of a drainage ditch currently located along a field boundary edge, directly beneath the proposed bridge location.

5.5.21. The Broxfield option would cross Denwick Burn, resulting in the direct permanent loss of watercourse habitat, potential severance of fish passage and impacts to riparian species such water vole (if present) during the construction phase. Operational impacts may occur as a result of pollution events through the sporadic use of the PRoW, primarily by agricultural vehicles, as discussed above.

5.5.22. Primarily, the differences in impacts arise as a result of the differences in type and quantity of habitat loss and the species they support.

DESIGN, MITIGATION AND ENHANCEMENT MEASURES

5.5.23. Avoidance and mitigation measures will be explored during the EIA, however, based upon the current known ecological baseline and assumed potential impacts resulting from the Scheme, assumed design and enhancement measures may include the following:

- The Scheme will seek reduced net loss of biodiversity and seek to maximise biodiversity outcomes and work towards a target of no net loss in line with Highways England objectives. The primary focus will be to work towards no net loss of priority habitats. A Biodiversity Net Gain assessment could be undertaken and compensatory habitat would be fully considered during Scheme design, with a target to reduce net loss of biodiversity, seeking net gains where possible, in line with the NPPF (2018) (**Ref 5.5.11**);
- Enhancement of existing habitats through appropriate management practices, or through planting of native species of local provenance, with the aim of connecting habitats to improve wildlife movement through the landscape and maintain functionality of habitats;
- Reinstatement of damaged habitats through management practices and using native species, where required; and
- Design will, as a minimum, maintain connectivity for wildlife passage with aims to improve passage and reduce mortality, for example through inclusion of underpasses or overpasses at known crossing points, or use of wildlife-friendly infrastructure to prevent entrapment or risk of collision with vehicles. This will also include sympathetic culvert design, to maintain fish, water vole, and otter passage (e.g. inclusion of ledges) passage.

5.5.24. The mitigation detailed below represents general mitigation principles and measures. **Table 5-26** below provides potential mitigation for features directly. The mitigation strategy is an iterative process and will be developed further during the impact assessment.

Construction

5.5.25. Mitigation during construction will likely include the following general measures as a minimum:

- Protected species licences (for example bats, badger, GCN, otter and water vole) will be applied for in advance of construction activities. Works would subsequently adhere to any bespoke working methodologies prescribed within a licence or supporting documentation as well as compensatory measures (e.g. badger sett) if required;
- Licensing will, where required, include details of compensatory features required to address the loss of breeding / resting / sheltering features as a result of the Scheme (for example, the erection of bat boxes in appropriate habitat / locations to compensate for the loss of a roost);
- Where licensing is not required (i.e. for species not subject to protective legislature), precautionary working methods would be employed for works with the potential to impact upon priority, or otherwise notable, species;
- A CEMP will be prepared and adhered to for the duration of works. The CEMP will include a variety of environmental topics including, but not limited to, pollution prevention, drainage and water management including drainage strategy and pollution prevention plan, Control of Substances Hazardous to Health (COSHH) management and storage, soil storage and movement, traffic management, low-level lighting and ecological sensitivities, including sensitive ecological periods, stand-off distances / exclusion zones and procedures for safeguarding biodiversity. Measures to reduce impacts on air quality will also be set out in the CEMP. The CEMP will also include biosecurity protocols to prevent the spread of invasive species or otherwise harmful pathogens, such as implementation of cleaning stations for plant / machinery and site workers (clothing and boots);
- A CEMP will, as standard, be accompanied by Protected Species Method Statement (PSMSs) appropriate to species (e.g. badger, bats, GCN, water vole, red squirrel) and receptors likely to be encountered during construction works. The PSMSs will be pertinent to each species receptor, detailing known locations of activity (e.g. locations of setts, or roosts), any mitigation that must be enacted or enforced prior to works; and any bespoke working methods required during construction. The PSMSs will additionally stipulate any requirements for protected species licensing, that must be in place prior to any construction associated activity;
- A CEMP and any conditions mandated by protected species licensing will be overseen by a suitably experienced Ecological / Environmental Clerk of Works (ECoW) for the duration of the construction. The ECoW would monitor construction activities for compliance against a CEMP and licencing requirements and advise throughout construction. The ECoW would additionally undertake regular Toolbox Talks (TBT) to site personnel highlighting relevant ecological (e.g. legal obligations regarding GCN and other wildlife) or environmental issues on site and procedures to be adopted (where required);
- Implementation of measures to maintain commuting routes for protected species during the construction period, such as preventing blocking of underpasses or culverts to passage;
- Appropriate exclusion zones around areas of invasive species to avoid spread or propagation;
- Vegetation removal would be programmed outside the bird breeding season (approximately March to September), where possible. Any vegetation removal undertaken outside this period would require a pre-clearance inspection for nesting birds by a suitably experienced ecologist. Where an active nest / or nesting activity is found an appropriately sized exclusion zone would be enforced around the area until such time that the nest becomes inactive (i.e. eggs hatch and chicks fledge the nest, the nest fails);

- Vegetation removal would also be cognisant of the potential for roosting bats, with any trees subject to felling to be subject to a full assessment of bat roost potential, and where required, subject to further detailed inspection or survey; and
- Directional lighting would be used to reduce adverse impacts upon fauna - for example foraging and commuting bats.
- Drainage features would be constructed early in the construction period to reduce pollution of water resources.
- Where appropriate, compensatory habitat to address permanent or temporary loss of habitats, including commuting, nesting and foraging habitats. For aquatic environments, this may also involve improvements to existing aquatic habitats through clearance of channels to improve passage, or include native planting.

5.5.26. Where considered necessary with the information available to date, mitigation bespoke to certain features has been provided within **Table 5-26.**

Operation

5.5.27. Design and enhancement measures detailed above, would seek to minimise and, where possible, enhance biodiversity during operation.

5.5.28. Installation of crossing points (where required) for species (e.g. badger, bats) to improve connectivity and reduce mortality risk.

5.5.29. Landscape design to improve connectivity of suitable supporting habitats for species and discourage crossing of the road. This may be achieved through woodland planting, tree lines and linear corridors away from the road network.

5.5.30. Monitoring of protected and / or notable species may be required to determine operational effects upon receptors and identify further mitigation measures or enhancements to be deployed post-construction. Any monitoring requirements would likely be detailed as a requirements of protected species licensing.

5.5.31. Drainage incorporated in to the Scheme design would include dry detention basins to filter out sediment from water leaving the road prior to outfall into local watercourses.

5.5.32. If required, culvert design to allow inclusion of natural bed, to maintain a substrate that may support aquatic fauna.

LIKELY SIGNIFICANT EFFECTS

5.5.33. The comparison of preliminary likely significant effects between the two accommodation bridge options are set out in **Table 5-25** below, based upon currently available information and professional judgement. Following implementation of appropriate mitigation measures, no significant residual biodiversity effects are anticipated during construction and operation of the Scheme. However, these effects could change as the EIA progresses. Mitigation measures are outlined in the above section.

Table 5-25 - Preliminary Likely Significant Effects of the two accommodation bridge options

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
HPI and other habitats (excluding aquatic habitats)	Construction	Temporary and permanent loss of habitat within the footprint of the bridge. Largely comprising arable farmland and improved grassland, but also including habitats of greater importance including hedgerows, woodland, and semi-improved grassland.	Not anticipated, once compensatory habitats are established and matured.	Not anticipated, once compensatory habitats are established and matured.
	Operation	Potential for sporadic traffic pollution from events - spray, run-off, etc. through use by agricultural/recreational vehicles, with potential for permanent modification of floral community through changes in pollutant/nutrient deposition levels.	Not anticipated. Mitigation for impacts on Air Quality and Water Environment would also protect ecological features.	Not anticipated. Mitigation for impacts on Air Quality and Water Environment would also protect ecological features.
Watercourses and Ponds	Construction	Permanent loss or damage of habitat watercourse and temporary disruption of local watercourses and drainage patterns. Construction activities close to watercourses may also result in the spread of invasive species. Accidental pollution and discharge of materials into watercourses may result in a reduction in water quality, adversely impacting aquatic ecology (e.g. reducing oxygen content, or increasing turbidity) and potentially decreasing biodiversity. This includes Denwick Burn, which falls within the footprint of the Broxfield	Not anticipated, providing habitat compensation is afforded and best practice is adopted. Mitigation for impacts on Water Environment would also protect ecological features.	Not anticipated provided habitat compensation is afforded and best practice is adopted. With respect to the pond to the west, likely significant effects aren't anticipated, mitigation and best practice for impacts on Water Environment would also protect ecological features.

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
		option. A single field boundary ditch is located directly beneath the Heckley Fence option which would be permanently lost and require diversion/replacement. Additionally, a single pond is located within close proximity to the west.		
	Operation	Increased traffic pollution from spray, run-off and emissions from the road may result in possible permanent changes in aquatic ecology and reduction in water quality.	Not anticipated. Mitigation and best practice for impacts on Water Environment would also protect ecological features.	Not anticipated. Mitigation and best practice for impacts on Water Environment would also protect ecological features.
Bats	Construction	Permanent and temporary loss of foraging and commuting habitat.	Not anticipated.	Not anticipated.
	Operation	Increased risk of mortality through vehicle collision as a result of road widening.	Not anticipated.	Not anticipated.
Water vole	Construction	Potential for mortality and/or temporary disturbance of water vole during construction activities. Potential for impacts upon water vole due to pollution events to watercourses, resulting from construction activities.	Not anticipated	Not anticipated
	Operation	Due to the widening of the carriageway there would be an inherent increased potential risk of mortality through traffic collision, associated with water vole crossing the carriageway.	Not anticipated	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
Breeding birds	Construction	Permanent and temporary loss of nesting habitat. Severance of territories (fragmentation and dispersal) as a result of habitat clearance works. Dispersal effects associated with construction affiliated operations – personnel movements and noise.	Not anticipated.	Not anticipated.
	Operation	Functional loss of nesting habitats in close proximity to the road due to increased traffic noise and light. Increased potential risk of mortality through traffic collision, associated with birds crossing the carriageway.	Not anticipated.	Not anticipated.
Wintering birds	Construction	Permanent loss of foraging or roosting habitat used by wintering birds. Dispersal effects associated with construction affiliated operations – personnel movements and noise.	Not anticipated.	Not anticipated.
	Operation	Functional loss of foraging or roosting habitats in close proximity to the road due to increased traffic noise and light. Increased potential risk of mortality through traffic collision, associated with birds crossing the carriageway.	Not anticipated.	Not anticipated.
Barn Owl	Construction	Permanent loss and/or damage to habitat used for foraging. Temporary disturbance due to increased noise and light. Potential loss of and/or temporary disturbance to	Not anticipated	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
		nesting/roosting sites as a result of construction.		
	Operation	Permanent disturbance effects associated with road traffic light and noise. Increased potential risk of mortality through traffic collision, associated with birds crossing the carriageway.	Not anticipated	Not anticipated
Aquatic Invertebrates	Construction	Permanent loss of habitat and a potential temporary reduction in water quality, incurring adverse effects. Construction activities may result in accidental pollution events of watercourses / waterbodies. During construction, aquatic invertebrates may be directly impacted by proposed culvert construction and existing culvert extension. Other impacts may include direct mortality of, and/or disturbance to, invertebrates through, for example, acoustic or physical changes in hydrology.	Not anticipated	Not anticipated
	Operation	The use of the road upon completion may result in changes in aquatic floral community and a periodic reduction in water quality from increased pollution/nutrient deposition. Drainage may also modify water quality through introduction of pollutants.	Not anticipated	Not anticipated
Fish	Construction	Permanent loss of habitat and a potential temporary reduction in water quality, incurring adverse effects.	Not anticipated	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
		Construction activities may result in accidental pollution events of watercourses/waterbodies. During construction, fish may be directly impacted by proposed culvert construction and existing culvert extension. Other impacts may include direct mortality of, and/or disturbance to fish through, for example, acoustic or physical changes in hydrology.		
	Operation	The use of the road upon completion may result in changes to the aquatic floral community and a periodic reduction in water quality from increased pollution/nutrient deposition. Drainage may also modify water quality through introduction of pollutants.	Not anticipated	Not anticipated
Invasive Species	Construction	Construction activities may result in the spread of invasive species. Permanent beneficial effect through removal of invasive species within works area.	Not anticipated. No invasive species recorded within bridge footprint to date.	Not anticipated. No invasive species recorded within bridge footprint to date.

5.5.34. A summary of the preliminary likely significant effects is presented in **Table 5-26** below, based upon currently available information and professional judgement. However, these effects could change as the EIA progresses.

Table 5-26 - Summary of Preliminary Likely Significant Effects - biodiversity

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Statutory and non-statutory designated sites	Construction	None anticipated	Drainage features would be constructed early in the construction period to reduce pollution of water resources. Measures to reduce impacts on air quality will be set out in the CEMP.	Not anticipated. Mitigation for impacts on air quality and the water environment would also protect ecological features.
	Operation	Increased traffic pollution and spray, run-off, and emissions from the road may result in possible permanent modification of floral community through changes in pollutant / nutrient deposition levels.	Best practice drainage design would be incorporated to reduce pollution – i.e. inclusion of dry detention basins	Not anticipated. Mitigation for impacts on the water environment would also protect ecological features.
HPI and other habitats (excluding aquatic habitats)	Construction	Temporary and permanent loss of habitats within the Scheme Footprint as a result of construction activities. Largely comprising arable farmland and improved grassland, but also including habitats of greater importance including hedgerows, woodland, and semi-improved grassland. Habitat improvement as a result of compensatory planting or enhancement measures.	Habitat creation to compensate for loss of habitat. Implementation of appropriate measures set out within a CEMP to detail timing of works to avoid sensitive ecological periods, such as bird nesting (depending on location), stand-off distances/exclusion zones (for woodland and trees), and measures to avoid accidental pollution.	Not anticipated, once compensatory habitats are established and matured.
	Operation	Increased traffic pollution and spray, run-off, and emissions from	Best practice drainage design would be incorporated to reduce	Not anticipated. Mitigation for

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		the road may result in possible permanent modification of floral community through changes in pollutant / nutrient deposition levels.	pollution – i.e. inclusion of dry detention basins	impacts on Water Environment would also protect ecological features.
Watercourses	Construction	The Scheme would include the installation and extension of culverts where it crosses watercourses. Construction of the culverts would result in the permanent loss and damage of habitat, and temporary disruption of local watercourses and drainage patterns. Construction activities in close proximity to water may also result in the spread of invasive species. Accidental pollution and discharge of materials into watercourses may result in a reduction in water quality, adversely impacting aquatic ecology (e.g. reducing oxygen content, or increasing turbidity), and potentially decreasing biodiversity.	If required, culvert design to allow inclusion of natural bed, which would be less disruptive to the aquatic environment. . Where appropriate, compensatory habitat to address permanent or temporary loss of habitats. This may also involve improvements to existing aquatic habitats through clearance of channels to improve passage, or include native planting. Implementation of appropriate measures set out within a CEMP that details measures to avoid and reduce impacts to watercourses from construction activities – including (but not limited to) a drainage strategy, and pollution prevention plan.	Not anticipated
	Operation	Increased traffic pollution and spray, run-off, and emissions from the road may result in possible permanent changes in aquatic ecology and reduction in water quality.	Best practice drainage design would be incorporated to reduce pollution – i.e. inclusion of dry detention basins.	Not anticipated. Mitigation for impacts on Water Environment would also protect ecological features

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Badger	Construction	The Scheme Footprint and general construction activities may result in: Temporary increased risk of mortality / injury to badger during works in proximity to know badger sett locations; and Permanent loss of foraging habitat, such as scrub and grassland that is found across the Scheme and within known badger territories.	Obtaining development licences from Natural England which would include measures to protect badgers during construction and potentially compensatory setts, where required. Implementation of appropriate measures set out within a CEMP to ensure protection measures, which may include exclusion zones to construction activity, covering of trenches / voids overnight, installation of crossing points to maintain connectivity and reduce mortality risk. Preparation and adherence to a bespoke PSMS, appended to the CEMP, to safeguard badger during construction.	Not anticipated.
	Operation	Due to the widening of the carriageway there would be an inherent increased potential risk of mortality through traffic collision, associated with badger crossing the carriageway.	Installation of crossing points (where required) to improve connectivity and reduce mortality risk. In addition, installation of fencing and planting, to encourage and channel movement through underpasses.	Not anticipated.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Bats	Construction	The Scheme and general construction activities may result in the permanent loss of bat roosts. There is potential for accidental damage of roosts leading to mortality / injury of bats during works. There is potential for temporary disturbance of roosting bats and potential for permanent functional loss of roost due to proximity to construction area as a result of increased noise, light and vibration, including possible night working. Likely permanent loss of foraging (e.g. woodland, and grasslands) and commuting habitat (primarily in relation to linear habitats, such as hedgerows). Permanent severance of flight paths through removal of linear habitats (hedgerows and tree lines).	Compensatory roosting features, which may include the installation of bat boxes within trees or the creation of stand-alone roost features close to the original roost. Development licence from Natural England for disturbance and / or destruction of roosts, which would detail mitigation and compensation. Compensatory habitat to address the loss of commuting and foraging habitat. A CEMP to detail timing of works and use of a low-level lighting scheme, which include information on directional lighting and measures to reduce light spill (such as shields or guards). Preparation and adherence to a bespoke PSMS to safeguard bats and their roosts, appended to the CEMP.	Not anticipated.
	Operation	Due to the widening of the carriageway there would be an inherent increased potential risk of mortality through traffic collision, associated with bats crossing the carriageway.	Installation of crossing points (where required) to improve connectivity and reduce mortality risk. Installation of hop-overs to facilitate movement from one side of the carriageway to the other and reduce risk of mortality.	Not anticipated.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Great Crested Newt	Construction	The Scheme and general construction activities within 500 m of known GCN ponds would result in permanent loss of terrestrial habitat and temporary damage to habitats within the construction footprint, for example as a result of vegetation clearance to provide access. Construction activities may also result in the temporary risk to the mortality / injury of newts.	Development licence from Natural England where trapping and removal of newts from a works area may be required, prior to commencement of construction. Newts to be translocated to an agreed and appropriate receptor site. A Precautionary Working Method Statement (PWMS) would include the provision of a TBT to contractors, to make them aware of their legal obligations regarding GCN (and other wildlife). Potential requirement for compensatory habitat creation in close proximity to known GCN ponds and, where possible, improving connectivity between ponds; including sympathetic design of SuDS features to encourage use by GCN. A CEMP to detail timing considerations of construction works, with reference to actions in any PWMS. A CEMP to be supported by a bespoke PSMS to safeguard GCN.	Not anticipated.
	Operation	Due to the widening of the carriageway there would be an inherent increased potential risk of	Where appropriate, installation of fencing to prevent encroachment of GCN into maintenance working	Not anticipated.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		mortality through traffic collision, associated with GCN crossing the carriageway. There is also potential risk of entrapment within drains or other drainage features.	areas, escape ladders and modified openings to reduce risk of entrapment in the drainage system.	
Water Vole	Construction	Potential for mortality and / or temporary disturbance of water vole during construction activities. Potential for impacts upon water vole as a result of pollution events to watercourses, resultant from construction activities.	Potential for compensatory habitat through improvements to watercourses crossed by the Scheme and design of SuDS features for use by water vole (providing connectivity and suitable planting). A CEMP to detail timing considerations of works, exclusion buffers, and preparation of a bespoke PSMS to safeguard water vole during construction.	Not anticipated.
	Operation	Due to the widening of the carriageway there would be an inherent increased potential risk of mortality through traffic collision, associated with water vole crossing the carriageway.	Culvert design to maintain passage through inclusion of mammal shelves and/ or underpasses. Planting to encourage use of mitigation features and discourage crossing the road.	Not anticipated.
Red Squirrel	Construction	The Scheme may result in the permanent loss and / or damage of habitat used, or with potential for use, either drey building or foraging, by red squirrel.	Potential for compensatory habitat creation and landscaping with the aim to, as a minimum, maintain but seek to improve connectivity between suitable supporting habitats.	Not anticipated.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		The Scheme may result in fragmentation and loss of connectivity between habitat with potential to support red squirrel. The Scheme may result in the direct loss of, or disturbance to dreys.	Requirements for development licencing for the destruction or disturbance to dreys and need for precautionary methods of work to facilitate construction. A CEMP to detail appropriate exclusion buffers for works with a bespoke PSMS included with a CEMP.	
	Operation	Due to the widening of the carriageway there would be an inherent increased potential risk of mortality through traffic collision, associated with red squirrel crossing the carriageway.	Landscape design to improve connectivity of suitable supporting habitats and discourage crossing of the road. This may be achieved through woodland planting, tree lines and linear corridors away from the road network.	Not anticipated.
Breeding Birds	Construction	The Scheme and general construction activities would result in: permanent loss of nesting and foraging habitat during site clearance works, including hedgerows, scrub, woodlands, trees and grassland. Severance of territories (fragmentation and dispersal) as a result of habitat clearance works. Dispersal effects associated with construction affiliated operations – personnel movements and noise.	Potential need to provide compensatory habitat to provide nesting habitat for birds. A CEMP to detail timing of site clearance works to avoid the bird nesting season and define approach to facilitate works during nesting bird season. A bespoke PSMS will be included within a CEMP.	Not anticipated.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
	Operation	The increase in the road corridor would extend the range of potential disturbance into new areas of habitat and may discourage birds from nesting in habitats close to the road network (functional loss of nesting habitat), due to increased traffic noise and light. Due to the widening of the carriageway there would be an inherent increased potential risk of mortality through traffic collision, associated with birds crossing the carriageway.	Use of screen planting to reduce disturbance impacts. Potential for compensatory habitat creation depending on species impacted and the level of impact.	Not anticipated.
Wintering Birds	Construction	The Scheme and general construction activities would result in: Permanent loss of foraging habitat used by wintering birds; Permanent loss of roosting habitat used by wintering birds; and Temporary loss or damage of habitat that falls within a construction compound. Dispersal effects associated with construction affiliated operations – personnel movements and noise.	Potential need to provide compensatory habitat to provide roosting habitat for birds. A CEMP to detail sensitive works approach to facilitate works during wintering bird season. A bespoke PSMS will be included within the CEMP.	Not anticipated
	Operation	The increase in the road corridor would extend the range of potential disturbance into new areas of	Use of screen planting to reduce the disturbance impacts. Potential for compensatory habitat creation	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		habitat and may discourage birds from roosting or foraging in habitats close to the road network (functional loss of roosting or foraging habitat), due to increased traffic noise and light. Due to the widening of the carriageway there would be an inherent increased potential risk of mortality through traffic collision, associated with birds crossing the carriageway.	depending on the species impacted and the level of impact.	
Barn Owl	Construction	The Scheme and general construction activities would result in: Permanent loss and / or damage to habitat used for foraging; and Temporary disturbance due to increased noise and light. Potential loss of and / or temporary disturbance to nesting / roosting sites as a result of construction.	Requirements for compensatory habitat to be discussed with Natural England. A CEMP to detail timing of works and use of directional lighting to avoid and / or reduce in-direct impacts. A bespoke PSMS will be included within the CEMP to safeguard barn owl during construction.	Not anticipated
	Operation	Traffic along the Scheme may introduce disturbance effects associated with road traffic light and noise. Due to the widening of the carriageway there would be an	Landscape design to shield, where possible, habitats of value to foraging barn owl adjacent to the road network through creation of hedgerows and tree lines, or use of fencing where appropriate.	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		inherent increased potential risk of mortality through traffic collision, associated with birds crossing the carriageway.		
Aquatic Invertebrates	Construction	The Scheme may result in the permanent loss and / or damage to supporting habitat. Construction activities may result in accidental pollution events of watercourses / waterbodies. During construction, aquatic invertebrates may be directly impacted by proposed culvert construction and existing culvert extension. This may result in permanent loss of habitat and a potential temporary reduction in water quality, incurring adverse effects. Other impacts may include direct mortality of, and / or disturbance to invertebrates through, for example, acoustic or physical changes in hydrology.	Potential for compensatory habitat creation. Impacts to aquatic habitats may be addressed through enhancements and improvements to watercourses. Implementation of appropriate measures set out within a CEMP to outline measures to prevent impacts to watercourses, for example through run-off or discharge.	Not anticipated
	Operation	Operation of the Scheme may result in changes in aquatic floral community and a periodic reduction in water quality from increased pollution / nutrient deposition.	Best practice drainage design would be incorporated to reduce pollution – i.e. inclusion of dry detention basins	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		Drainage may also modify water quality through introduction of pollutants.		
Fish	Construction	The Scheme may result in the permanent loss and / or damage to supporting habitat. Construction activities may result in accidental pollution events of watercourses / waterbodies. During construction, fish may be directly impacted by proposed culvert construction and existing culvert extension. This may result in permanent loss of habitat and a potential temporary reduction in water quality, incurring adverse effects. Other impacts may include direct mortality of, and / or disturbance to fish through, for example, acoustic or physical changes in hydrology.	Potential for culvert design to allow inclusion of natural beds to encourage fish use. Where low water levels are expected, potential installation of baffles or similar features to aid fish passage. Implementation of a CEMP to address impacts to water quality and inclusion of a PSMS in order to safeguard fish during construction.	Not anticipated.
	Operation	Operation of the Scheme may result in changes to the aquatic floral community and a periodic reduction in water quality from increased pollution / nutrient deposition.	Best practice drainage design would be incorporated to reduce pollution – i.e. inclusion of dry detention basins	Not anticipated
Brown Hare	Construction	The Scheme Footprint and general construction activities may result in: Temporary increased risk of mortality / injury to brown hare	Precautionary methods of working to be implemented and a PSMS to be included within the CEMP in	Not anticipated.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		during works – e.g. through collision with machinery or vehicles, entrapment within excavations; and Permanent loss of foraging and sheltering habitat, such as scrub and grassland that is found across the Scheme.	order to safeguard brown hare during construction.	
	Operation	Due to the widening of the carriageway there would be an inherent increased potential risk of mortality through traffic collision, associated with brown hare crossing the carriageway.	Targeted landscape design to discourage crossing of roads within selected areas.	Not anticipated.
Invasive Species	Construction	Construction activities may result in the spread of invasive species. Permanent beneficial effect through removal of invasive species within works area.	Identification of invasive species, buffer zones around invasive species areas, treatment or removal of invasive species prior to commencement of construction. Biosecurity requirements will be defined within the CEMP to avoid the spread or introduction of invasive species.	Not anticipated.

FURTHER WORK FOR THE EIA

5.5.35. A detailed level assessment of potential impacts on biodiversity during the construction and operational phases of the Scheme will be undertaken in accordance with the methodology set out in the Guidelines for Ecological Impact Assessment (**Ref. 5.5.5)**, and IAN 130/10 Ecology and Nature Conservation: Criteria for Impact Assessment (**Ref 5.5.3)**, which supplements the DMRB Volume 11, Section 3, Part 4 "Ecology and Nature Conservation" (**Ref 5.5.12**).

5.5.36. In addition to the assessment detailed in the Scoping Report (**Volume 2, Appendix A, Chapter 10 Biodiversity**), and in response to the Scoping Opinion (refer to **Volume 2, Appendix B, Section 4.5**), the following will be carried out for the EIA:

- Establish the EZoI to be adopted within the impact assessment. Justification of Zones of Influence will be fully addressed within the ES;
- To ensure the Scheme supports Highways England's target of reducing net loss of biodiversity by 2020 and achieving no net loss by 2025, an assessment in relation to biodiversity no net loss will be completed;
- An updated desk study of publicly accessible sources will be undertaken as part of the ES to confirm that all receptors that require assessment are captured within the relevant study areas. An assessment will also be made to confirm whether the desk study needs to be extended in any areas, in response to design alterations;
- Confirmation will be sought from relevant consultees (including Natural England and the Forestry Commission) regarding the potential impacts upon Ancient Woodland as a result of the Scheme. A justification for the Zone of Influence will be provided within the ES to assess any indirect effects on ancient woodland;
- Further review of baseline information presented by the original surveyors and review of updated baseline survey results;
- Additional field surveys as per those prescribed in this PEIR; and
- Determination of monitoring requirements, to measure the success of any mitigation and enhancement measures required as a result of the Scheme.

5.6 ROAD DRAINAGE AND THE WATER ENVIRONMENT

INTRODUCTION

5.6.1. This section considers the implications of the Scheme on road drainage and the water environment during construction and operation and details any potentially significant effects.

5.6.2. A consultation meeting with the Environment Agency and NCC as LLFA was held on 1 November 2018. At this meeting additional baseline information was provided and the proposed methodology was discussed and agreed including climate change allowances for detailed assessments and assessment methodologies for each watercourse crossing.

EXISTING BASELINE KNOWLEDGE

5.6.3. The following data sources have been consulted to inform the baseline review:

- Environment Agency's online Flood Map for Planning (**Ref 5.6.1**);
- Environment Agency's online Flood Risk from Surface Water map (**Ref 5.6.2**);
- Environment Agency's online Flood Risk from Reservoirs map (**Ref 5.6.3**);
- Environment Agency's Catchment Data Explorer (**Ref 5.6.4**);
- Environment Agency's Northumbria River Basin Management Plan (**Ref 5.6.5**);
- Ordnance Survey (OS) mapping (**Ref 5.6.6**);
- Multi-Agency Geographic Information for the Countryside (MAGIC) online mapping (**Ref 5.6.7**);
- Options Selection Stage EAR (**Ref 5.6.8**);
- NCC Level 1 Strategic Flood Risk Assessment (SFRA) (**Ref 5.6.9**);
- British Geological Survey (BGS) Geology of Britain Viewer (**Ref 5.6.10**);
- BGS Geoindex online database (**Ref 5.6.11**); and
- Highways Agency (now England) Drainage Data Management System (HADDMS) (**Ref 5.6.12**).

5.6.4. No baseline monitoring or surveys have been undertaken to inform the baseline conditions. Refer to **Figure A19: Water Constraints Plan** in **Appendix A**.

Surface Water Features

Main Scheme area including Charlton Mires Compound

5.6.5. Review of OS mapping (**Ref 5.6.6**) indicates that the Scheme alignment crosses or is located in close proximity to 16 watercourses within 0.5 km. The majority of the watercourses flow in an approximate west to east direction, except the White House Burn which flows in a north east to south-west direction. None of the watercourses identified within 0.5 km of the Scheme are classified as a main river. All of the watercourses are classified as ordinary watercourses under the jurisdiction of NCC as LLFA.

5.6.6. All watercourses within 0.5 km of the Scheme alignment form part of the Northumbria Rivers Basin District (**Ref 5.6.5**).

5.6.7. The ecological, chemical and hydromorphological quality of a number of the watercourses and tributaries within 0.5 km is assessed by the Environment Agency in accordance with the objectives of the Water Framework Directive (WFD). The overall objective of the WFD is to ensure the effective co-ordination of water environment policy and regulation across Europe. The main aims of the legislation are to ensure that all surface water and groundwater reaches 'good' status (in terms of ecological and chemical quality and water quantity, as appropriate), promote sustainable water use,

reduce pollution and contribute to the mitigation of flood and droughts. **Table 5-27** shows the WFD classifications based on a review of the Environment Agency's Catchment Data Explorer (**Ref 5.6.4**) (as assessed in 2016) for the watercourses within 0.5 km of the Scheme, or that receive flow from watercourses within this area.

Table 5-27 - Water Framework Directive Classifications

Watercourses	Chemical	Ecological	Hydromorphological
Denwick Burn	Good	Poor	Not designated artificial or heavily modified
White House Burn	Good	Poor	Not designated artificial or heavily modified
Unnamed tributary of Kittycarter Burn	Good	Poor	Not designated artificial or heavily modified
Shipperton Burn	Good	Good	Not designated artificial or heavily modified
Charlton Burn	Good	Good	Not designated artificial or heavily modified

5.6.8. A review of OS mapping (**Ref 5.6.6**) indicates that there are approximately ten other surface water features (ponds) within 0.5 km of the Scheme, as shown on **Figure A19: Water Constraints Plan** in **Appendix A**. They have no known designations, and their quality and ecological value is currently unclear. This will be assessed further in the EIA. The surface water ponds are located within predominantly rural areas and have no known significant recreational value or value within the economy.

5.6.9. A review of OS mapping (**Ref 5.6.6**) indicates that there is an unnamed covered reservoir within 0.5 km of the Scheme. It is located approximately 0.1 km to the west of the existing A1 near Craggy Wood. Although the covered reservoir is not visible on satellite imagery, due to the spatial constraints around the site it is likely that the reservoir will be small in size. As a result, it is assumed that there is no risk associated with the potential failure of the reservoir to the Scheme.

5.6.10. There are no surface water abstractions within 0.5 km of the Scheme.

5.6.11. Information regarding the existing drainage infrastructure has been obtained from a review of the HADDMS online database (**Ref 5.6.12**) provides a summary of the information regarding the existing drainage infrastructure and their location is shown in **Table 5-28** and **Figure 5-4** below.

Table 5-28 - Existing drainage infrastructure

Outfall	HADDMS Reference	Receiving Watercourse
1	NU1915_6357b	Denwick Burn
2	NU1916_3914a	Tributary of Denwick Burn
3	NU1916_2162a	Denwick Burn
4	NU1916_1668c	Denwick Burn
5	NU1818_3778c	White House Burn
6	NU1721_5701b	Tributary of Kittycarter Burn
7	NU1720_8163a	Tributary of Kittycarter Burn
8	NU1721_0697a	Shipperton Burn

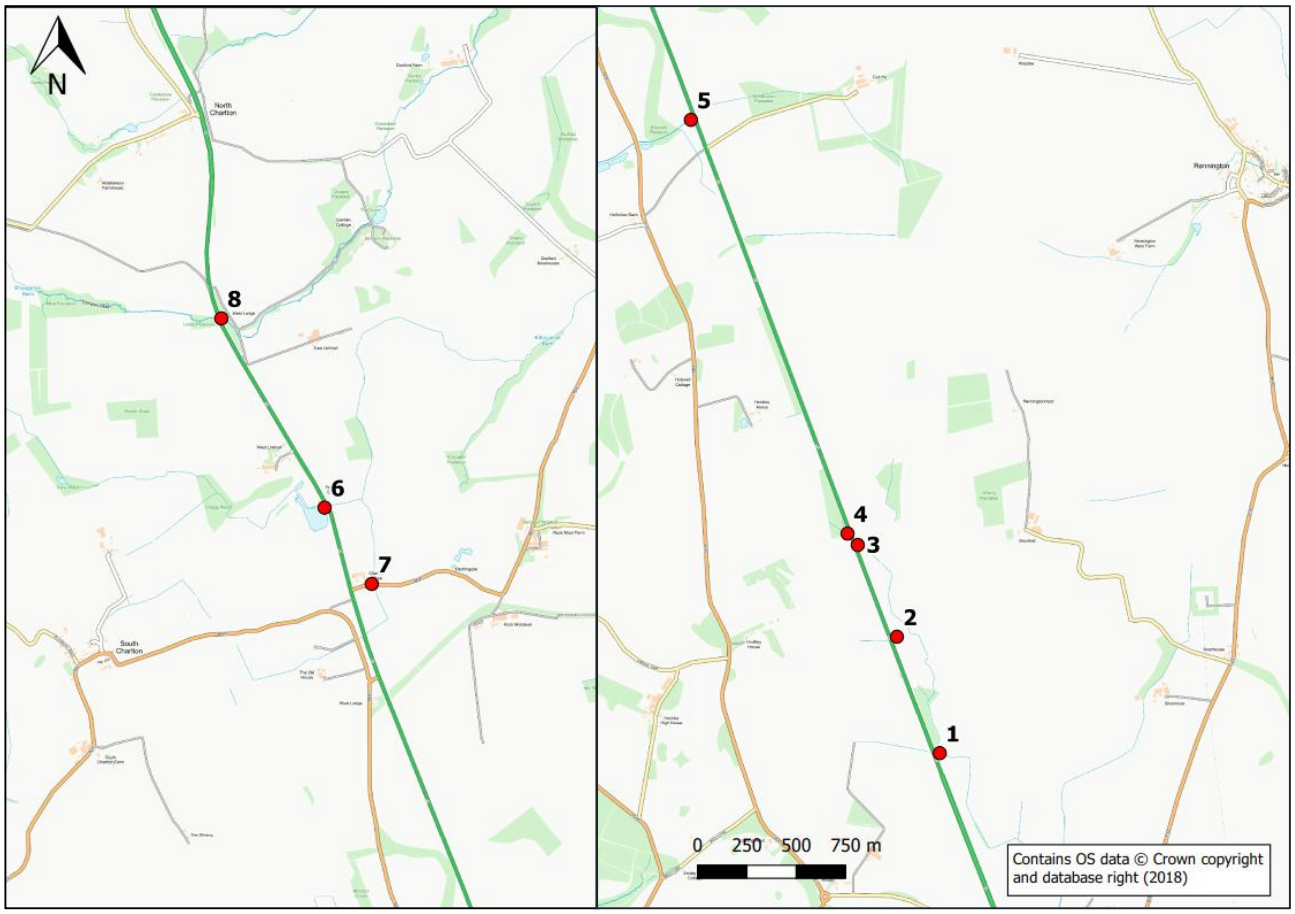

Figure 5-4 - Location of existing outfalls

Main Compound

5.6.12. A review of OS mapping (**Ref 5.6.6**) indicates that the Main Compound is located in close proximity to one watercourse; an unnamed tributary of the Thirston Burn which flows along the northern boundary of the Compound and forms part of the Northumbria Rivers Basin District (**Ref 5.6.5**). The Thirston Burn discharges into the River Coquet approximately 4 km downstream of the compound. The River Coquet is designated as a main river and therefore under the jurisdiction of the Environment Agency. The River Coquet is also part of the River Coquet and Coquet Valley Woodlands SSSI.

5.6.13. Ecological and chemical quality of the unnamed tributary of the Thirston Burn are assessed by the Environment Agency in accordance with the objectives of the WFD. Review of the Environment Agency's Catchment Data Explorer (**Ref 5.6.4**) (2016 results) indicates that the unnamed tributary forms part of the Longdike Burn (tributary of River Coquet) WFD catchment and has an overall quality of 'moderate', with ecological quality assessed as 'moderate' and chemical quality assessed as 'good'.

5.6.14. A review of OS mapping (**Ref 5.6.6**) indicates that there is one other surface water feature located within 0.5 km of the Main Compound. A surface water pond is located approximately 0.4 km to the south-east of the Compound. There are no known designations, and its quality and ecological value is currently unclear. This will be assessed further in the EIA. The surface water pond is located within a predominantly rural area and has no known significant recreational value or value within the economy.

Lionheart Enterprise Park Compound

5.6.15. A review of OS mapping (**Ref 5.6.6**) indicates that the Lionheart Enterprise Park Compound is located in close proximity to two watercourses within 0.5 km; the Willow Burn to the north of the compound and the Cawledge Burn to the south. The watercourses flow in a south-west to north east direction and both discharge into the River Aln. Both are classified as ordinary watercourses under the jurisdiction of NCC as LLFA.

5.6.16. The two watercourses form part of the Northumbria Rivers Basin District (**Ref 5.6.5**).

5.6.17. Ecological and chemical quality of the Cawledge Burn are assessed by the Environment Agency in accordance with the objectives of the WFD. Review of the Environment Agency's Catchment Data Explorer **(Ref 5.6.4**) (2016 results) indicates an overall quality of 'good', with both ecological and chemical quality assessed as 'good'.

5.6.18. The Willow Burn is located in the Aln from Edlingham Burn to tidal limit WFD catchment. Review of the Environment Agency's Catchment Data Explorer (**Ref 5.6.4**) (2016 results) indicates an overall quality of 'poor', with ecological quality assessed as 'poor' and chemical quality assessed as 'good'. A review of OS mapping (**Ref 5.6.6**) indicates that there are no other surface water features located within 0.5 km of the Compound.

Groundwater Features

Main Scheme area including Charlton Mires Compound

5.6.19. A review of the BGS mapping (**Ref 5.6.10**) indicates that the Scheme is primarily underlain by bedrock geology of the Yoredale group comprising limestone argillaceaceous rocks and sandstone. Review of the Environment Agency's aquifer data (**Ref 5.6.7**) indicates that the bedrock geology is

classified as Secondary A Aquifer, described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. The area located approximately 1 km to the north-west and areas approximately 0.8 km to the west of the Scheme boundary are classified as Principal Aquifers. Principal Aquifers are described as layers of rock or drift deposits that have high intergranular and / or fracture permeability meaning they usually provide a high level of water storage. They may support water supply and / or river base flow on a strategic scale.

5.6.20. A review of the BGS mapping (**Ref 5.6.10**) indicates that superficial deposits are mostly till with small areas of glacial sand and gravel located to the north and south ends of the study area.

5.6.21. A review of the Environment Agency's Aquifer data (**Ref 5.6.7**) indicates that the till is classified as a Secondary (Undifferentiated) Aquifer and the glacial sand and gravel is classed as a Secondary A Aquifer.

5.6.22. A high-level review of historic borehole scans (**Ref 5.6.11**) within the study area indicates groundwater depths of between one and five metres.

5.6.23. Information obtained from the Environment Agency during consultation identified three licenced groundwater abstractions and two unlicensed groundwater abstractions within 1 km of the Scheme. These have been identified on **Figure A19: Water Constraints Map** in **Appendix A**.

Main Compound

5.6.24. A review of the BGS mapping (**Ref 5.6.10**) indicates that the Main Compound is underlain by bedrock geology of the Stainmore Formation consisting of mudstone, siltstone and sandstone.

5.6.25. A review of the Environment Agency's aquifer data (**Ref 5.6.7**) indicates that the bedrock geology is classified as a Secondary A Aquifer, described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

5.6.26. A review of the BGS mapping (**Ref 5.6.10**) indicates that superficial deposits are Glaciofluvial deposits consisting of sand and gravel.

5.6.27. A review of the Environment Agency's aquifer data (**Ref 5.6.7**) indicates that the superficial deposits are classified as a Secondary A Aquifer.

Lionheart Enterprise Park Compound

5.6.28. A review of the BGS mapping (**Ref 5.6.10**) indicates that the Lionheart Enterprise Park Compound is underlain by bedrock geology of the Alston Formation comprising limestone, sandstone, siltstone and mudstone.

5.6.29. A review of the Environment Agency's aquifer data (**Ref 5.6.7**) indicates that the bedrock geology is classified as a Secondary A Aquifer, described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

5.6.30. A review of the BGS mapping (**Ref 5.6.10**) indicates that superficial deposits underlying the compound consist of Glaciofluvial deposits (Devensian) consisting of sand and gravel.

5.6.31. A review of the Environment Agency's aquifer data (**Ref 5.6.7**) indicates that the superficial deposits are classified as a Secondary A Aquifer.

Flooding

Main Scheme area including Charlton Mires Compound

5.6.32. A review of the Environment Agency's Flood Map for Planning (Rivers and Sea) (**Ref 5.6.1**) indicates that the majority of the Scheme alignment is located within 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, there are small areas of Flood Zone 3 located at the southern section of the study area to the north-west of Denwick, and to the east of Shipperton Bridge, where the risk of flooding from fluvial sources is greater than 1 in 100 in any year (see **Figure A19: Water Constraints Map** in **Appendix A**). The identified fluvial flood risks are associated with the following watercourses:

- The Denwick Burn which discharges into the River Aln to the south; and
- The Shipperton Burn which eventually discharges into the Long Nanny.

5.6.33. The NCC Level 1 SFRA (**Ref 5.6.9**) indicates significant flooding within the North East Northumberland river catchments from fluvial and pluvial sources since 1744. A number of significant flood events are attributed to the River Aln which is located downstream of the study area.

5.6.34. A review of the Environment Agency Flood Risk from Surface Water map (**Ref 5.6.2**) 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. The Flood Risk from Surface Water map can also indicate fluvial flood risk from watercourses with a catchment of less than c.3 km² that are too small to be mapped on the Environment Agency Flood Map for Planning.

5.6.35. A review of the Highways England HADDMS (**Ref 5.6.12**) indicates that there are no historical high severity flood events recorded within the Scheme alignment.

5.6.36. A review of the Environment Agency Flood Risk from Reservoirs map (**Ref 5.6.3**) indicates that the Scheme is not at risk of flooding from potential failure of reservoirs located upstream of the study area.

Main Compound

5.6.37. A review of the Environment Agency's Flood Map for Planning (Rivers and Sea) (**Ref 5.6.1**) indicates that the Main Compound is located within 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.

5.6.38. A review of the Environment Agency's Flood Risk from Surface Water map (**Ref 5.6.2**) indicates that the compound is at low risk of flooding from surface water sources.

Lionheart Enterprise Park Compound

5.6.39. A review of the Environment Agency's Flood Map for Planning (Rivers and Sea) (**Ref 5.6.1**) indicates that the Lionheart Enterprise Park Compound area is located within 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. There is a small area of the Compound located in the high-risk Flood Zone 3, where the risk of

flooding from fluvial sources is greater than 1 in 100 in any year. The identified fluvial flood risk is confined to the land immediately adjacent to and is associated with the Cawledge Burn.

5.6.40. A review of the Environment Agency's Flood Risk from Surface Water map (**Ref 5.6.2**) indicates that the Compound is at low risk of flooding from surface water sources. The land immediately adjacent to the Cawledge Burn is at a medium risk of surface water flooding.

POTENTIAL IMPACTS

Construction

5.6.41. The construction of the Scheme and associated Compounds may result in the following impacts upon surface water features, groundwater features and flood risk:

- Temporary increased pollution risks from spillage of fuels or other harmful substances that may migrate to local surface water and groundwater receptors;
- Temporary increased sedimentation within watercourses caused by surface water runoff from areas of bare earth, construction materials such as aggregate and stockpiles of topsoil;
- Temporary adverse impacts to the hydromorphological, chemical and ecological quality of watercourses associated with works within or in close proximity to watercourses such as the installation and alteration of culverts and outfalls as well as realignment of watercourses, including longer-term changes associated with sediment deposition; and
- Increased flood risk associated with temporary works within areas of fluvial flood storage, works to existing watercourse alignments and culverts, and associated with changes to catchment permeability and hydrology.

Operation

5.6.42. The operation of the Scheme may result in the following impacts upon surface water features, groundwater features and flood risk:

- Permanent polluted surface water runoff containing silts and hydrocarbons that may migrate or be discharged to surface water features or groundwater resources via the proposed highway drainage system;
- Permanent adverse impact to the hydromorphological and ecological quality of water features associated with 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;
- Permanent adverse impacts to catchment hydrology caused by 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;
- Increased rates and volumes of surface water runoff from an increase in impermeable area or changes to the existing drainage regime leading to a potential permanent increase in flood risk; and
- Permanent increased flood risk to the Scheme and to people and property elsewhere caused by displacement of flood water storage or crossing of watercourses thus impacting flood flow conveyance.

Accommodation bridge options

5.6.43. The Broxfield option would have potential impacts to the Denwick Burn, as it crosses the watercourse through a small existing culvert under the public right of way track. The Heckley Fence option crosses a small ditch to the west of the A1 alignment. During the site walkover, it was noted

that the ditch discharges into a culvert that runs south adjacent to the A1 alignment and discharges into Denwick Burn. There is also a small culvert underneath the A1 that collects surface water runoff from the agricultural land to the east of the A1 and connects into the culvert to the west of the A1. Both options have the potential to impact the hydromorphological and ecological quality of the watercourses and have permanent adverse impacts to catchment hydrology caused by the introduction of a barrier to natural overland flow and changes to natural catchment dynamics associated with any proposed watercourse diversions. The impacts would be more significant for the Heckley Fence option in comparison to the Broxfield option due to number of culverts located in close proximity to the proposed accommodation bridge.

DESIGN, MITIGATION AND ENHANCEMENT MEASURES

Construction

5.6.44. A CEMP would include method statements for the proposed works, details of materials to be used, and an emergency response plan. It would contain measures to protect both surface and groundwater quality, and other water resource aspects. Examples of likely measures include locating topsoil stores away from the banks of watercourses and covering or seeding topsoil stores to prevent sediment from entering watercourses. Other measures are likely to include designating areas for washing equipment such as concrete wagons and concrete pumps and storing construction plant, equipment, fuels, oils and other chemicals away from watercourses or surface water drainage systems.

5.6.45. During the construction phase, consideration would be given to potential impacts to catchment hydrology and flow within existing watercourses. Temporary diversions may need to be established prior to undertaking the works to maintain existing catchments and flow regimes. Temporary drainage systems may also be required to capture, manage and attenuate flow prior to discharge to prevent increased flood risk.

Operation

5.6.46. The following design, mitigation and enhancement measures will be developed further during the EIA process.

5.6.47. A robust surface water drainage system would be provided as part of the Scheme design, to ensure discharge from the Scheme does not increase flood risk elsewhere up to and including the 1 in 100 (1%) annual probability rainfall event, allowing for climate change effects. Consultation with NCC as the LLFA will be undertaken to confirm the proposed surface water drainage system and climate change allowances;

5.6.48. The Scheme may offer an opportunity for betterment, for example if attenuation can be introduced in areas where attenuation is currently not provided prior to discharge. This will be clarified as the design progresses and within the EIA in line with further consultation with NCC and the Environment Agency;

5.6.49. 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 would be required as part of the Scheme design. Multi-stage proposals that maximise passive treatment through the use of SuDS would be considered. The preliminary surface water drainage system includes filter drains and grassed detention basins to provide treatment through sedimentation. If it is deemed necessary, swales and reed beds could be

incorporated into the design to achieve sufficient sediment and pollutant removal. This will be assessed further during the EIA;

5.6.50. Isolated sections of the Scheme are identified to be at risk of surface water flooding. This is 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 in the design to maintaining these overland flow paths and localised raising of ground levels to mitigate the potential impact of surface water flooding on the highway and to its users. The works also present an opportunity to reduce existing surface water flood risk to the highway alignment through enhancement of the existing drainage system. This will be clarified as the design progresses;

5.6.51. Construction of new culverts, the widening of existing highway culverts and watercourse diversions as part of the Scheme design would maintain hydraulic capacity and, where possible, explore opportunities to provide betterment. New crossings of watercourses and new watercourse channels would 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 (plus 25% as agreed with the Environment Agency), be designed in accordance with DMRB guidance, and be sensitive to ecological requirements; and

5.6.52. Parts of the Scheme are located within the high-risk Flood Zone 3. Any loss of fluvial flood storage would be compensated on a like-for-like basis, as part of the Scheme design, 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.

LIKELY SIGNIFICANT EFFECTS

5.6.53. The comparison of preliminary likely significant effects of the Scheme between the two bridge options are set out in **Table 5-29** below, based upon currently available information and professional judgement. Following implementation of appropriate mitigation measures, no significant residual effects are anticipated during construction and operation of the Scheme. However, these effects could change as the EIA progresses. Mitigation measures are outlined in the above section.

Table 5-29 - Preliminary Likely Significant Effects of the two accommodation bridge options

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
Denwick Burn	Construction	Pollution risks from spillage of fuels or other harmful substances that may migrate to Denwick Burn.	Not anticipated	Not anticipated
		Increased sedimentation caused by surface water runoff from areas of bare earth, construction materials such as aggregate and stockpiles of topsoil.	Not anticipated	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
		Impacts to the hydromorphological, chemical and ecological quality associated with the alteration of culverts, including longer-term changes associated with sediment deposition.	Not anticipated	Not anticipated
	Operation	Permanent impact to the hydromorphological and ecological quality of water features associated with works within the Denwick Burn such as the alteration of the existing culvert as well as any realignment of watercourses.	Not anticipated	Not anticipated
Unnamed watercourse at Heckley Fence	Construction	Pollution risks from spillage of fuels or other harmful substances that may migrate to watercourses.	None	Not anticipated
		Increased sedimentation caused by surface water runoff from areas of bare earth, construction materials such as aggregate and stockpiles of topsoil.	None	Not anticipated
		Impacts to the hydromorphological, chemical and ecological quality associated with the construction of bridges/culverts and the alteration of culverts (including from the stopping up of existing access track crossing Denwick Burn), including longer-term changes associated with sediment deposition.	None	Not anticipated
	Operation	Permanent impact to the hydromorphological and ecological quality of water features associated with works within the unnamed watercourse such as the installation or alteration of culverts/bridges as well as any	None	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
		potential realignment of watercourses.		
Groundwater resources	Construction	Pollution risks from spillage of fuels or other harmful substances that may migrate to local groundwater receptors.	None	Not anticipated
Flood risk receptors (including the proposed highway, residential receptors and agricultural land)	Construction	Increased flood risk associated with temporary works within areas of fluvial flood storage, works to existing watercourse alignments and culverts, and associated with changes to catchment permeability and hydrology.	Not anticipated – consultation with the EA will be required to ensure adequate mitigation measures are in place as the bridge is located in Flood Zone 3.	Not anticipated
	Operation	Increased flood risk to the Scheme and to people and property elsewhere caused by displacement of flood water storage or crossing of watercourses thus impacting flood flow conveyance.	Not anticipated	Not anticipated
		Permanent impacts to catchment hydrology caused by 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.	Not anticipated	Not anticipated

5.6.54. It is unlikely that all potential impacts during the construction phase can be fully mitigated due to the proximity of the works to the identified surface water features, including in-channel works associated with the culverts and outfalls. However, potential impacts during construction are likely to be temporary with no permanent adverse effect, and not likely to be significant.

5.6.55. The Main Compound is located in close proximity to a tributary of the River Coquet, classified as a SSSI. It is unlikely that there would be a significant impact to the River Coquet during the construction phase, with appropriate mitigation measures in place.

5.6.56. With the implementation of mitigation measures during the operation phase, some of which would be integrated into the Scheme design, residual effects as a result of operation are not likely to be significant.

5.6.57. A summary of the preliminary likely significant effects of the Scheme is presented in **Table 5-30** below, based upon currently available information and professional judgement. However, these effects could change as the EIA progresses.

Table 5-30 - Summary of Preliminary Likely Significant Effects – road drainage and the water environment

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Watercourses	Construction	Pollution risks from spillage of fuels or other harmful substances that may migrate to local surface water receptors.	Implementation of measures outlined in a CEMP such as pollution controls. For example, appropriate storage of hazardous materials and the control of washdown water.	Not anticipated
		Increased sedimentation within watercourses caused by surface water runoff from areas of bare earth, construction materials such as aggregate and stockpiles of topsoil.	Implementation of measures outlined in a CEMP such as silt pollution controls and locating topsoil stores away from the banks of watercourses.	Not anticipated
		Impacts to the hydromorphological, chemical and ecological quality of watercourses associated with works within or in close proximity such as the installation and alteration of culverts and outfalls as well as realignment of watercourses, including longer-term changes associated with sediment deposition.	Temporary diversions may need to be established prior to the works to maintain existing catchments and flow regimes.	Not anticipated
	Operation	Polluted surface water runoff containing silts and hydrocarbons may migrate or be discharged to surface water features via the proposed highway drainage system.	A robust treatment system would be included as part of the surface water drainage system.	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		Permanent impact to the hydromorphological and ecological quality of water features associated with works within or in close proximity to water features such as the installation and alteration of culverts and outfalls as well as realignment of watercourses.	The culverts, outfalls and watercourse realignments would be designed to be sensitive to ecological requirements.	Not anticipated
Groundwater resources	Construction	Pollution risks from spillage of fuels or other harmful substances that may migrate to local groundwater receptors.	Implementation of measures outlined in a CEMP such as pollution controls. For example, appropriate storage of hazardous materials and the control of washdown water.	Not anticipated
	Operation	Polluted surface water runoff containing silts and hydrocarbons that may migrate or be discharged to groundwater resources via the proposed highway drainage system.	A robust treatment system would be included as part of the surface water drainage system.	Not anticipated
Flood risk receptors (including the proposed highway, residential receptors and agricultural land)	Construction	Increased flood risk associated with temporary works within areas of fluvial flood storage, works to existing watercourse alignments and culverts, and associated with changes to catchment permeability and hydrology.	Temporary drainage systems may also be required to capture, manage and attenuate flow prior to discharge to prevent increased flood risk.	Not anticipated
	Operation	Increased flood risk to the Scheme and to people and property elsewhere caused by displacement of flood water	New watercourse crossings and new watercourse channels would maintain the capacity of the channel, ensure no increased flood risk up to the 1 in 100-	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		storage or crossing of watercourses thus impacting flood flow conveyance.	year event considering the potential effects of climate change. Any loss of fluvial flood storage would be compensated on a like-for-like basis to ensure no increased risk of flooding up to the 1 in 100-year event considering the potential effects of climate change.	
		Permanent impacts to catchment hydrology caused by 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.	New watercourse channels would maintain the capacity of the channel; and ensure no increased flood risk up to the 1 in 100-year event considering the potential effects of climate change. A robust surface water drainage system would be provided to ensure discharge from the Scheme does not increase flood risk elsewhere up to and including the 1 in 100 (1%) annual probability rainfall event, allowing for climate change effects.	Not anticipated
		Increased rates and volumes of surface water runoff from an increase in impermeable area or changes to the existing drainage regime leading to a potential increase in flood risk.	A robust surface water drainage system would be provided to ensure discharge from the Scheme does not increase flood risk elsewhere up to and including the 1 in 100 (1%) annual probability rainfall event, allowing for climate change effects.	Not anticipated

FURTHER WORK FOR THE EIA

5.6.58. A detailed level assessment of potential impacts on the road drainage and the water environment during the construction and operational phases of the Scheme will be undertaken in accordance with the methodology set out in DMRB HD45/09 Volume 11, Section 3, Part 10 “Road Drainage and the Water Environment” (**Ref 5.6.3**).

5.6.59. In addition to the assessment detailed in the Scoping Report (**Volume 2, Appendix A, Chapter 11 Road Drainage and Water Environment**), and in response to the Scoping Opinion (refer to **Volume 2, Appendix B, Section 4.6**), the following will be carried out for the EIA:

- Further consultation will be undertaken with the Environment Agency and NCC to ensure appropriate mitigation and potential enhancement measures are recommended, including within the surface water drainage system.
- Further consultation will be undertaken with the Environment Agency regarding the hydromorphological aspects of the Scheme, to ensure an appropriate methodology is used.

5.7 GEOLOGY AND SOILS

INTRODUCTION

5.7.1. This section considers the implications of the Scheme on soils and geology during construction and operation phases and details any potentially significant effects.

5.7.2. At the time of writing, there is no recent ground investigation data available. Ground investigation works have been completed and the draft factual report was prepared and issued in January 2019. An ALC survey is proposed to be completed in early 2019.

EXISTING BASELINE KNOWLEDGE

5.7.3. The following data sources have been consulted to inform the baseline review:

- ALC 1:250,000 scale series provisional map for North East Region (**Ref 5.7.1**);
- Cranfield Soil and Agrifood Institute Soilscapes database (**Ref 5.7.2**);
- A1 in Northumberland: Alnwick to Ellingham Preliminary Sources Study Report (PSSR), Highways Agency Geotechnical Data Management System (HAGDMS) No. 29384 (**Ref 5.7.3**);
- A1 in Northumberland. Morpeth to Felton. PSSR. HAGDMS No. 29386. (**Ref 5.7.4**);
- British Geological Survey (BGS) Minerals UK Onshore Mineral Resource Maps Northumberland Tyne and Wear (**Ref 5.7.5**);
- Natural England Magic Database (**Ref 5.7.6**);
- Natural England's National Character Area (NCA) profile, No. 14 Tyne, and Wear Lowlands (**Ref 5.7.7**);
- DMRB Volume 11, Section 3 Part 11 Soils and Geology, DMRB Volume 11, Section 3 Part 6 Land Use (Agricultural Land only) and DMRB Volume 11, Section 2 Part 5 HA 205/08 Assessment and Management of Environmental Effects (**Ref 5.7.8**); and
- Defra and Environment Agency Contaminated Land Report 11 (CLR 11) Model Procedures for the Management of Land Contamination (**Ref 5.7.9**)

5.7.4. The following sensitive receptors have been identified with respect to soils and geology:

- Human health: Construction workers, adjacent site users (visitors / workers) future site users and below ground maintenance workers;
- Controlled Waters: Surface watercourses, groundwater (Secondary A Aquifers); and
- Soils: ALC Grade 3 (undifferentiated) soils, peat.

Soil Quality

5.7.5. The study area lies within a predominantly agricultural area (see **Figure A1: Scheme Location Plan** in **Appendix A**). Outside of developed areas, surface ground conditions are anticipated to comprise topsoil and subsoil of varying depths.

5.7.6. Agricultural land is classified into five categories (Grades 1 - 5) according to versatility of the soil and suitability for growing crops. The top three grades, Grade 1, 2 and 3a, are referred to as 'Best and Most Versatile' land. The soils associated with the Scheme and surrounding agricultural land are primarily classified as Grade 3 – Moderate quality (undifferentiated) (Ref 5.7.1). An ALC survey will be carried out to inform the assessment and to sub-divide agricultural land into distinct grades. Further details of the soil properties within the study area, as described by the Cranfield Soil and Agrifood Institute Soilscapes database (**Ref 5.7.2**), are provided in **Table 5-31.**

Geology

Made Ground

Main Scheme Area, including Charlton Mires Site Compound

5.7.7. BGS maps do not show the presence of made ground within the study area, however, made ground is anticipated to be present in developed areas such as beneath the existing carriageway and farmsteads. Given the current agricultural use of the Charlton Mires Compound, shallow ground conditions are anticipated to comprise topsoil.

5.7.8. The PSSR (**Ref 5.7.3**) states there are historical ponds and quarries within the study area which are no longer present. These may represent localised areas of made ground because of historical infilling with soil or waste material, or may have been infilled because of natural processes such as sedimentation over time.

5.7.9. Available BGS historical records for the study area do not record the presence of made ground.

Lionheart Enterprise Park Compound

5.7.10. BGS maps do not show the presence of made ground within the study area, given its current use as a highways depot a limited thickness of made ground is anticipated to be present.

Main Compound

5.7.11. BGS maps do not show the presence of made ground within the study area, given the current agricultural use shallow ground conditions are anticipated to comprise topsoil.

5.7.12. Available BGS historical records for the study area record topsoil (possible made ground) to a depth of 0.3 m below ground level.

Superficial Deposits

Main Scheme Area, including Charlton Mires Site Compound

5.7.13. Superficial deposits are shown on BGS maps to be present beneath most of the study area, except for:

- The area near Heckley House and Heckley Fence;
- To the east of South Chorlton Bog; and
- To the north of East Linkhall.

5.7.14. The southern section of the study area, between Alnwick and Rock Nab is shown to be predominantly underlain by Glacial Till. The most southern extent of the study area is shown to be underlain by Alluvium and there are also small pockets of Alluvium shown near Rock Nab and along the access track to Rock South Farm. A localised area of peat, associated with 'South Charlton Bog', is shown to be present beneath the existing carriageway to the east of South Charlton Bog.

Table 5-31 - Soil properties within the study area

	Southern extent of Scheme Footprint to Rock Nab	Rock Nab northern extent of Scheme Footprint	Lionheart Enterprise Park Compound	Main Compound	Charlton Mires Site Compound	Study area to west of Linkhall Access Track
Soil Description	Soilscape 17: Slowly permeable seasonally wet acid loamy and clayey soils.	Soilscape 6: Freely draining slightly acid loamy soils	Soilscape 6: Freely draining slightly acid loamy soils	Soilscape 18: Slowly permeable seasonally wet slightly acidic but base-rich loamy and clayey soils	Soilscape 17: Slowly permeable seasonally wet acid loamy and clayey soils.	Soilscape 18: Slowly permeable seasonally wet slightly acidic but base-rich loamy and clayey soils
Texture	Loamy and clayey	Loamy	Loamy	Loamy and clayey	Loamy and clayey	Loamy and clayey
Drainage	Impeded drainage	Freely draining	Freely draining	Impeded drainage	Impeded drainage	Impeded drainage
Fertility	Low	Low	Low	Moderate	Low	Moderate
Habitats	Seasonally wet pastures and woodlands	Neutral and acid pastures and deciduous woodlands: acid communities such as bracken and gorse in the uplands	Neutral and acid pastures and deciduous woodlands: acid communities such as bracken and gorse in the uplands	Seasonally wet pastures and woodlands	Seasonally wet pastures and woodlands	Seasonally wet pastures and woodlands
Landcover	Grassland with some arable and forestry	Arable and grassland	Arable and grassland	Grassland and arable some woodland	Grassland with some arable and forestry	Grassland and arable some woodland
Carbon	Medium	Low	Low	Low	Medium	Low

	Southern extent of Scheme Footprint to Rock Nab	Rock Nab northern extent of Scheme Footprint	Lionheart Enterprise Park Compound	Main Compound	Charlton Mires Site Compound	Study area to west of Linkhall Access Track
Water Protection	Main risks are associated with overland flow from compacted or poached fields. Organic slurry, dirty water, fertiliser, pathogens and fine sediment can all move in suspension or solution with overland flow or drain water.	Groundwater contamination with nitrate; siltation and nutrient enrichment of streams from soil erosion is certain from these soils.	Groundwater contamination with nitrate; siltation and nutrient enrichment of streams from soil erosion is certain from these soils.	Main risks are associated with overland flow from compacted or poached fields. Organic slurry, dirty water, fertiliser, pathogens and fine sediment can all move in suspension or solution with overland flow or drain water.	Main risks are associated with overland flow from compacted or poached fields. Organic slurry, dirty water, fertiliser, pathogens and fine sediment can all move in suspension or solution with overland flow or drain water.	Main risks are associated with overland flow from compacted or poached fields. Organic slurry, dirty water, fertiliser, pathogens and fine sediment can all move in suspension or solution with overland flow or drain water.

5.7.15. The northern section of the study area, between Rock Nab and North Charlton, is shown to be predominantly underlain by Glaciofluvial deposits comprising sands and gravels. Small localised areas of Alluvium are also shown to be present in the northern section of the study area.

5.7.16. The Charlton Mires Site Compound, to the south-east of Charlton Mires, is shown to be largely underlain by Alluvium, with Glacial Till towards the eastern extent.

Lionheart Enterprise Park Compound

5.7.17. The Lionheart Enterprise Park Compound is shown to be predominantly underlain by glaciofluvial deposits comprising sand and gravel and cohesive glacial till towards the southern extent of the study area.

Main Compound

5.7.18. The Main Compound is shown to be predominantly underlain by Glacial Till.

Bedrock Geology

Main Scheme Area, including Charlton Mires Site Compound

5.7.19. The BGS maps show the underlying bedrock to comprise sedimentary strata of Lower Carboniferous age comprising marine deposits of the Alston Formation, Tyne Limestone Formation and the Scremerston Coal Member. These consist of a succession of limestone, mudstone, siltstone and sandstone with occasional coal seams within the Scremerston Coal Member.

5.7.20. The BGS maps show the bedrock underlying the Charlton Mires Site Compound to comprise sedimentary strata of Carboniferous age comprising the Alston Formation, consisting of limestone, sandstone siltstone and mudstone.

Lionheart Enterprise Park Compound

5.7.21. The BGS maps show the underlying bedrock to comprise sedimentary strata of Carboniferous age comprising limestone and undifferentiated limestone, sandstone, mudstone and siltstone of the Alston Formation.

Main Compound

5.7.22. The BGS maps show the underlying bedrock to comprise sedimentary strata of Carboniferous age comprising the Yordale Group, consisting of limestone, sandstone and mudstone.

Mining

Main Scheme Area including Charlton Mires Site Compound

5.7.23. It is stated within the PSSR (**Ref 5.7.3**) that the study area is not affected by recorded underground or opencast mining, nor are there future mining operations planned. However, the route is underlain by coal seams; although these have no record of being mined, the possibility that there are mine workings within these seams cannot be ruled out.

Lionheart Enterprise Park Compound

The study area lies within a Coal Authority Coal Mining Reporting Area, the redline boundary does not lie within a Development High Risk Area however a Development High Risk Areas is shown be present to the south of the redline boundary, within the 250 m buffer of the study area.

Main Compound

5.7.24. The study area lies within a Coal Authority Coal Mining Reporting Area, but not within a Development High Risk Area.

Mineral resources

5.7.25. Minerals UK Onshore Mineral Resource Maps Northumberland Tyne and Wear (**Ref 5.7.5**) indicates that there are potential mineral resources present within the study area (including the Compounds) comprising river sand and gravels, glacial sand and gravels, peat and coal.

Hydrogeology

Main Scheme Area, including Charlton Mires Compound

5.7.26. The underlying glaciofluvial deposits are classified by the Environment Agency as a Secondary A Aquifer, and the Glacial Till as a Secondary Aquifer (undifferentiated). The areas of peat and alluvium are classed as unproductive strata. The underlying bedrock is classified as a Secondary A Aquifer.

5.7.27. Within the Charlton Mires Site Compound the underlying Alluvium is classified by the Environment Agency as a Secondary A Aquifer and the Glacial Till in the eastern extent is classified by the Environment Agency as a Secondary A Aquifer (undifferentiated). The underlying bedrock is classified as a Secondary A Aquifer.

5.7.28. According to the Natural England Magic Database (**Ref 5.7.6**) the Main Scheme Area is not within a groundwater SPZ, nor is one present within 250 m. There are no records of licensed groundwater abstraction points within the study area.

Lionheart Enterprise Park Compound

5.7.29. The underlying Alluvium is classified by the Environment Agency as a Secondary A Aquifer. The Glacial Till in the eastern extent is classified by the Environment Agency as a Secondary A Aquifer (undifferentiated). The underlying bedrock is classified as a Secondary A Aquifer.

5.7.30. According to the Natural England Magic Database (**Ref 5.7.6**) the Lionheart Enterprise Park Compound is not within a groundwater SPZ, nor is one present within 250 m. There are no records of licensed groundwater abstraction points within the study area.

Main Compound

5.7.31. The underlying glaciofluvial deposits are classified by the Environment Agency as a Secondary A Aquifer, and the Glacial Till as a Secondary Aquifer (undifferentiated). The underlying bedrock is classified as a Secondary A Aquifer.

5.7.32. According to the Natural England Magic Database (**Ref 5.7.6**) the Main Compound is not within a groundwater SPZ, nor is one present within 250 m. There are no records of licensed groundwater abstraction points within the study area.

Hydrology

5.7.33. There are eight classified surface watercourses within the study area, which together with their WFD classification, are presented in **Table 5-32**.

Table 5-32 - Summary of classified surface watercourses within the study area

Name	Chemical	Ecological
Main Scheme Area, including Charlton Mires Compound		
Unnamed tributary of Kittycarter Burn	Good	Poor
Denwick Burn	Good	Poor
White House Burn	Good	Poor
Shipperton Burn	Good	Good
Charlton Burn	Good	Good
Main Compound		
Unnamed tributary of Thirston Burn	Good	Moderate
Lionheart Enterprise Park Compound		
Willow Burn	Good	Poor
Cawledge Burn	Good	Good

5.7.34. There are no main rivers within the study area.

Unexploded ordnance

Main Scheme Area, including Charlton Mires Site Compound

5.7.35. The PSSR (**Ref 5.7.3**) states that a Pre-Desk Study Assessment (PDSA) prepared by Zetica indicates that there are no readily available records of bombing or other significant military activity within the study area. The PDSA suggests that the completion of further detailed investigation is likely to confirm a low risk of Unexploded Ordnance (UXO).

Lionheart Enterprise Park Compound

The Zetica Unexploded Bomb (UXB) risk map for the area indicates that the Lionheart Enterprise Park Compound lies within a low risk area. Zetica have also completed a PDSA for the Lionheart Enterprise Park Compound and have stated that a detailed desk study, whilst always prudent, is not considered essential in this instance.

Main Compound

5.7.36. A detailed desk study assessment was undertaken for the A1 in Northumberland: Morpeth to Felton scheme (**Ref 5.7.4**). A strategic target was located within the study area; Eshott Airfield (located to the south of the Main Compound). The UXO hazard plan provided within the Zetica report presents the A1 in Northumberland: Morpeth to Felton scheme area as a low risk with respect to UXO, however the redline boundary of the detailed desk study does not extend across the Main Compound. A PDSA prepared specifically for the Main Compound recommends that a detailed desk

study is commissioned to further assess and potentially zone the UXO hazard level of the area. It is understood that there are no below ground excavations proposed within the Main Compound as such it is not recommended that a detailed desk study is commissioned at this stage, however should any significant excavations or below ground works be proposed as the Scheme progresses it is recommended that a detailed desk study be obtained.

Designated sites

5.7.37. NCC have confirmed that there are no Regionally Important Geological and Geomorphological Sites (RIGS) or Local Geological Sites within the study area.

5.7.38. NCC have confirmed that there are no SSSIs within the study area. The nearest SSSI is Longhoughton Quarry (geological site), located approximately 1.4 km to the south-east of the access track off the B1430.

Waste disposal

Main Scheme Area, including Charlton Mires Site Compound

5.7.39. There are no active or historical landfills or waste transfer stations within 250 m of the Main Scheme Area.

Lionheart Enterprise Park Compound

5.7.40. A historical landfill site, East Cawledge, is shown 186 m to the north of the proposed Lionheart Enterprise Park Compound (see **Figure A3: Environmental Constraints Plan** in **Appendix A**). Records show that the historical landfill was first recorded in 1927 and last recorded in 1972, there are no details relating to the waste types deposited.

Main Compound

5.7.41. There are no active or historical landfills within 250 m of the Main Compound.

Potential sources of contamination

5.7.42. Based on a review of publicly available desk based information and the PSSR, the following potential sources of contamination within the study area have been identified:

- Made ground associated within construction of the existing carriageway;
- Made ground or fill material associated with historical small quarries and ponds;
- Fuel storage tanks within farmsteads located within the study area;
- Historical tramway crossing the Lionheart Enterprise Park Compound;
- Storage of agricultural chemicals within farmsteads located within the study area;
- Agricultural run-off (nitrates, ammonium, organics, sediments);
- WWII airfield adjacent to the Main Compound; and
- Run-off and potential fuel / oil spillages from vehicles using the existing carriageway.

Potential contaminant pathways

5.7.43. Potential contaminant pathways include:

Human Health

- Direct contact, soil ingestion and inhalation; and
- Migration and accumulation of ground gas and or vapours in excavations and inhalation / asphyxiation by site preparation, earthworks, construction and maintenance workers.

Controlled Waters

- Infiltration of rainwater and leaching of contamination to shallow perched water and or groundwater;
- Surface run-off of contaminants and sediments into surface water bodies (rivers, drains and ponds);
- Migration from groundwater into surface water bodies; and
- Lateral and vertical leaching of contaminants into underlying Secondary A Aquifer.

POTENTIAL IMPACTS

5.7.44. Without mitigation measures in place, potential impacts of the Scheme on soils and geology are presented below:

Construction

- Loss of agricultural soil;
- Excavation of peat;
- Deterioration of soil quality via compaction and sealing;
- Impact to human health (construction workers and neighbours) caused by exposure to potentially contaminated ground;
- Impact to human health associated with potential ground instability;
- Impacts to human health associated with UXO; and
- Impact to shallow soils and controlled waters from the release of physical and chemical contaminants.

Operation

- Impact to shallow soils and controlled waters because of surface run-off from general operation of the carriageway;
- Impact to shallow soils and controlled waters because of fuel / oil leaks from vehicles using the carriageway (general operation);
- Impact to shallow soils and controlled waters from a considerable release of physical and chemical contaminants because of an isolated incident such as an accident (e.g. fuel, oils, fire water, release of a potentially contaminative vehicle load);
- Impacts to human health caused by exposure to potential contamination exposed within landscaped areas of the Scheme (e.g. grass verges); and
- Impacts to human health (maintenance workers) caused by exposure to potential contamination within areas requiring groundworks during operation such as service trenches.

Accommodation bridge options

5.7.45. The construction of the proposed bridge at either Broxfield or Heckley Fence would result in the permanent loss of agricultural land beneath the footprint of the embankment and temporary loss of agricultural land within the Scheme Footprint during construction.

5.7.46. Although the bridge specification would be the same for each of the two options, the footprint of the earth embankments and span of the bridges are likely to differ. At this time, the extent of the difference is unknown.

5.7.47. Based on the existing baseline data available the geology and soils setting of each of the two options is very similar and can be summarised as follows:

- Both are located within an agricultural setting, including existing farm tracks;
- Shallow ground conditions are anticipated to comprise limited made ground associated with the existing farm tracks and potentially related to construction of the existing carriageway and topsoil in existing agricultural and vegetated areas.
- Superficial deposits are shown to comprise glacial till and the underlying bedrock is shown to comprise the Tyne Limestone Formation and Alston Formation (undifferentiated) beneath the Heckley Fence option and the Alston Formation beneath the Broxfield option.
- The Heckley Fence option is located just to the north of a Coal Authority Coal Mining Reporting Area and the Broxfield option is located within a Coal Authority Coal Mining Reporting Area. Neither of the two options are located within a Development High Risk Area.

DESIGN, MITIGATION AND ENHANCEMENT MEASURES

5.7.48. The likely mitigation measures to be applied to the Scheme to avoid, prevent or reduce significant effects to soils and geology related environmental receptors, during both the construction and operational phases are outlined separately below.

Construction

- An ALC survey will be completed to inform the EIA and assess the requirement for mitigation measures to be put in place during construction.
- Consultation with Mineral Planning Authorities to assess the requirement for mineral safeguarding measures during construction.
- Implementation of a CEMP to mitigate risks associated with the construction phase. To include measures to:
  - Mitigate impacts to soil quality;
  - Mitigate physical and chemical surface water contamination;
  - Limit chemical spillages; and
  - Provide guidance of suitable health and safety practices.
- Earthworks to be completed in accordance with a Contaminated Land: Applications in Real Environments (CL:AIRE) compliant Materials Management Plan (MMP) to ensure that re-used material do not present a risk to human health or the environment.
- Construction works to be completed in accordance with relevant guidance and best practice documents to limit environmental impact during construction. Key guidance documents include Defra's Good Practice Guide for Handling Soils and The Construction Code of Practice for the Sustainable Use of Soils on Construction Sites.
- Further assessment with respect to UXO and utilisation of best practice, if required, for the avoidance of UXO hazards.
- Ensuring construction workers wear appropriate Personal Protective Equipment (PPE) and use monitoring equipment where appropriate. The preparation of Risk Assessments and Method Statements (RAMS) to ensure the appropriate use of PPE such as Respiratory Protective Equipment (RPE) where required.
- The incorporation of a temporary drainage strategy during the construction phase to limit the uncontrolled run-off of chemical and physical contaminants, further details relating to the temporary and permanent drainage strategy are provided in **Section 5.6 - Road Drainage and The Water Environment** of this PEIR.

- The preparation of a RAMS to ensure mitigation measures such as temporary shoring is incorporated should there be a risk of loose or unstable ground.

Operation

- Pollution control measures such as detention basins and filter drains are to be incorporated within the Scheme drainage design.
- The completion of earthworks in accordance with a MMP to mitigate potential impacts to human health and controlled waters.
- Ongoing maintenance plan to ensure the Scheme drainage system is meeting its operational requirements.

LIKELY SIGNIFICANT EFFECTS

5.7.49. The comparison of preliminary likely significant effects between the two bridge options are set out in **Table 5-33** below, based upon currently available information and professional judgement. Following implementation of appropriate mitigation measures, no significant geology and soils effects are anticipated during construction and operation of the Scheme. However, these effects could change as the EIA progresses. Mitigation measures are outlined in the above section.

Table 5-33 - Preliminary Likely Significant Effects of the two accommodation bridge options

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
Agricultural soils	Construction	Temporary loss of agricultural soil as the footprint of the construction area would extend beyond that of the operational area.	Not anticipated	Not anticipated
Agricultural soils	Operation	Permanent loss of agricultural soil beneath footprint of embankment	Not anticipated, given small footprint of embankment and presence of existing access track	Not anticipated, given small footprint of embankment and presence of existing access track

5.7.50. It is anticipated that permanent mitigation and environmental enhancement measures are to be incorporated into the design of the Scheme and temporary mitigation measures would be implemented during the construction phase.

5.7.51. As such residual effects are not considered to be significant, subject to the findings of the Ground Investigation, ALC survey and consultation with NCC.

5.7.52. Further assessment of the implications the Scheme has on human health, in addition to those associated with land quality, is provided in **Section 5.8 Population and Human Health**. Further

assessment in relation to water quality is provided in **Section 5.6 Road Drainage and The Water Environment**.

5.7.53. A summary of the preliminary likely significant effects of the Scheme is presented in **Table 5-34**.

Table 5-34 - Summary of Preliminary Likely Significant Effects – soils and geology

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Agricultural Soil and Peat	Construction	Temporary and permanent loss of agricultural land, soil and peat because of land take.	Soil management operations, where appropriate, to be in accordance with Defra's Good Practice Guide for Handling Soils and the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites. Soil Management Plan to be implemented.	Not anticipated
	Construction	Temporary and permanent reduction in soil quality due to compaction and sealing by construction plant and workers.		
	Operation	Permanent loss of agricultural land, soil and peat due to permanent land take.	Extent of permanent land take will be dependent on the final Scheme design.	At this stage it is not anticipated that there would be a significant effect based on the likely extent of permanent land take. The likely significant effect would be reassessed within the ES on completion of the ALC survey and further refinement of the Scheme.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Mineral Resources - river sand, gravels, glacial sand and gravels, peat and coal	Construction	Temporary and permanent sterilisation of mineral resources due to Scheme and compound placement and construction.	Consultation with Mineral Planning Authority of local / regional council, works undertaken in accordance with BGS Mineral safeguarding in England: good practice advice.	Not anticipated
	Operation	Temporary or permanent sterilisation of mineral resources.		Not anticipated
Human Health (construction workers, maintenance workers, surrounding occupants)	Construction	Adverse health related impacts to human receptors (e.g. construction workers and third parties) caused by exposure to contaminated ground, ground gases and buried UXO.	Works to be undertaken in accordance with a CEMP. Appropriate health and safety procedures and remedial measures to be in place.	Not anticipated
	Construction	Adverse health related impacts to humans associated with ground instability (e.g. shallow mine working collapses or failure of the sides of any granular excavations during construction resulting in collapse).	Coal mining risks assessment to be undertaken to assess risks and set out suitable mitigation measures (e.g. capping shafts, and grouting voids), if required. Temporary shoring associated with loose or unstable ground.	Not anticipated
	Operation	Adverse heath related impacts to humans caused by exposure to contamination on any grass verges (e.g. inhalation of asbestos contaminated dust) or during any future groundworks required for maintenance or future construction works.	A capping layer to be placed over any soft landscaped areas if contamination is identified in any made ground deposits. A record to be kept of any potential contamination sources identified during construction and all future groundworks to be completed in accordance with appropriate	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
			RAMS to include the requirement for suitable PPE.	
Controlled water bodies (surface water courses, Secondary A Aquifers)	Construction	Temporary adverse impacts to controlled waters from the release of physical and chemical contaminants resulting in reduced water quality and loss of aquatic organisms.	Works to be undertaken in accordance with measures set out within a CEMP. Temporary drainage strategy which would include pollution control measures.	Not anticipated.
	Operation	Permanent adverse impacts to controlled water from the release of spillages (e.g. fuel, oil) from vehicles and surface water run-off from general operation, and potential significant release of physical / chemical contaminants because of an accident, resulting in a deterioration of water quality and potential loss of aquatic organisms.	Pollution control measures incorporated within the Scheme drainage system, as part of the design. Refer to **Section 5.6 Road Drainage and The Water Environment** of this PEIR for further detail.	Not anticipated.

FURTHER WORK FOR THE EIA

5.7.54. A **Detailed Level** of assessment of potential impacts on soils and geology during the construction and operation phases of the Scheme will be undertaken in accordance with the methodology set out in DMRB Volume 11, Section 3 Part 11 Soils and Geology, DMRB Volume 11, Section 3 Part 6 Land Use (agricultural land only) and DMRB Volume 11, Section 2 Part 5 HA 205/08 Assessment and Management of Environmental Effects (**Ref 5.7.8**). In addition to the assessment detailed in the Scoping Report (**Volume 2, Appendix A, Chapter 12 – Geology and Soils**), and in response to the Scoping Opinion (refer to **Volume 2, Appendix B, Section 4.7**), the following will be carried out for the EIA:

- Completion of an ALC survey;
- Review information of the agricultural quality of land;
- Further detailed review of historical mapping and Environment Agency data to refine the assessment of potential constraints associated with land contamination;
- Review ground investigation factual report (issued in January 2019) to confirm attribute importance and facilitate assessment of potential contaminant linkages;
- Review of Development High Risk Area information and identification of any impacts associated with historic mine workings.
- Assessment of the potential presence of coal tar bearing waste which could be generated from the demolition of the existing carriageway.
- Review of ground investigation data to provide assessment of the suitability for the re-use of materials arising during construction.
- Consultation with Mineral Planning Authority to understand any potential constraints associated with potential sterilisation of mineral resources in the Scheme Footprint;
- List and assess potential impacts;
- Assess the sensitivity of the attributes; and
- List and assess the likely significance of the effects.

5.7.55. Contaminated land issues will be assessed in accordance with Model Procedures for the Management of Contaminated Land (CLR11) (**Ref 5.7.9**). The document advocates the use of a Conceptual Site Model (CSM) to establish the links between a potentially hazardous source and a sensitive receptor via an exposure pathway. The concept behind this approach is that, without each of the three fundamental elements (source, pathway and receptor), there can be no risk from contamination. Thus, the mere presence of a contamination hazard does not necessarily imply the existence of associated risks. The following elements of the Scheme are relevant to the assessment of effects of soils and geology:

- Land Take – As part of the construction phase of the Scheme, areas of existing land use (e.g. agricultural) to be converted to highway. As part of the construction phase, there would also be temporary areas of land take, for use as construction compounds;
- Earthworks – As part of the construction and preparation phase of the Scheme, there would be elements of soil excavation and ground preparation;
- Land Uses – Highway and areas of soft landscaping (i.e. embankments) where contaminated soils may be present at / or near the surface; and
- Construction of foundations (e.g. piling for bridge crossings) and below ground utility structure – Creation of enclosed soaves and placing below ground structures / services (e.g. box culverts) into the ground.

5.8 POPULATION AND HEALTH

INTRODUCTION

5.8.1. This section considers the implications of the Scheme on population and human health during construction and operation and details any potentially significant effects. This Section considers the Main Scheme Area, the Main Compound, the Lionheart Enterprise Park Compound and the Charlton Mires Site Compound which is located within the Main Scheme Area.

5.8.2. In line with current guidance from Highways England on implementing the requirements of 2011/92/EU, as amended by 2014/52/EA (EU Directive) (**Ref 5.8.1**), the following topics are considered relevant to this assessment:

Population

- Physical Assets and Land Use;
- Community Amenity and Severance;
- Walkers, Cyclists and Horse Riders (WCHs) – previously known as Non-Motorised Users (NMUs); and
- Economy and Employment.

Human Health

- Air Quality;
- Noise and Vibration;
- Road Drainage and the Water Environment; and
- Vehicle Travellers.

5.8.3. This Section has been structured according to these topics and considers the potential for significant effects during construction and operation of the Scheme.

5.8.4. Consultation with the PRoW Officer at NCC has been undertaken to confirm the methodology for assessment of PRoW during construction and operation of the Scheme.

EXISTING BASELINE KNOWLEDGE

Main Scheme Area

Population

5.8.5. The Scheme is located in Northumberland, with the route falling within three ward boundaries: Lesbury; Alnwick; and Longhoughton. According to 2011 Census data (**Ref 5.8.2**), the resident population of each ward is broadly similar; with Longhoughton having the lowest resident population (4,424), and Lesbury having the highest population (5,069) of the three wards.

5.8.6. The population density within Alnwick (31.0 per/hectare) is considerably higher than that of Longhoughton and Lesbury (0.2 persons/hectare and 0.6 persons/hectare respectively). This reflects the considerable level of residential development within Alnwick ward compared with the surrounding localities. The population density within Northumberland (0.6 persons/hectare) is notably lower than both the North East and England averages (3.0 persons/hectare and 4.1 persons/hectare respectively), emphasising the rural nature of the county. Inward and outward migration to Northumberland is relatively stable.

Age breakdown

5.8.7. The population aged 15 years and under in Northumberland (17.1%) is broadly consistent with the England average (18.9%). However, there is a slightly higher proportion of adults over the age of 65 in Northumberland (20.2%) compared with England (16.3%). The 2011 Census data (**Ref 5.8.2**) indicates that Northumberland has a slightly older demographic and is therefore likely to have a greater prevalence of health issues and associated demand for services, compared to the national average.

Life Expectancy

5.8.8. Data from Public Health England (PHE) (**Ref 5.8.3**) identifies that there is a gap in life expectancy of 9.4 years for males and 6.2 years for females between the most and least deprived areas within Northumberland, indicating a moderate level of health inequity within the county.

Indices of Multiple Deprivation

5.8.9. The English Indices of Multiple Deprivation 2015 (IMD) (**Ref 5.8.4**) comprise seven different 'domains' which relate to income, employment, education, health, skills and training, barriers to housing, and services to create an overall deprivation score. Deprivation is ranked from 1 to 326, on the basis of the 326 local authority areas in England

5.8.10. The IMD indicates that NCC was ranked 145 out of 326 local authorities in England (**Table 5-35**) and as such, was in the 50% of the most deprived areas.

Table 5-35 - Northumberland Local Authority ranking compared to the most and least deprived Local Authorities

IMD Indicator	Most deprived Local Authority ranking	NCC	Least deprived Local Authority ranking
Deprivation	1	145	326

5.8.11. There are 197 Lower Super Output Areas (LSOAs) in Northumberland, where 101 are within the 50% most deprived areas, 14 of which are within the 10% most deprived areas. Health

5.8.12. The PHE Health Profiles for each local authority compare the indicators for a number of health statistics with the national average (**Ref 5.8.3**). Relevant health indicators for Northumberland are presented in **Table 5-36** and **Table 5-37** below.

Table 5-36 - Indicators of population health for Northumberland compared with England

Indicator	Indicator Value	Period	Northumberland	England
Obese children (aged 10-11)	%	2016/17	21.1	20.0
Excess weight in adults	%	2016/17	63.8	61.3

Indicator	Indicator Value	Period	Northumberland	England
Life expectancy at birth – males	Years	2014-16	79.2	79.5
Life expectancy at birth – females	Years	2014-16	82.6	83.1
Under 75 mortality: all causes	Per 100,000 of population aged under 75	2014-16	340.5	333.8
Under 75 mortality: cardiovascular	Per 100,000 of population aged under 75	2014-16	72.7	73.5
Under 75 mortality: cancer	Per 100,000 of population aged under 75	2014-16	139.1	136.8
Suicide rate	Per 100,000 population aged 10 and over	2014-16	11.0	9.9

5.8.13. Rates of child obesity in children aged 10-11 years old and excess weight in adults for Northumberland are both slightly higher than the national average. Life expectancy at birth for both males and females is slightly lower than the national average. Mortality rates in Northumberland for those under 75 from cardiovascular diseases is lower than the national average, however mortality rates for those under 75 from cancer is higher than the national average. The suicide rate in Northumberland is also slightly higher than the national average. The PHE health profile for Northumberland therefore indicates that the health of the Northumberland population is slightly worse than the national average.

Table 5-37 - Lifestyle indicators for adults in Northumberland compared with England

Indicator	Indicator value	Period	Northumberland	England
Smoking prevalence in adults	%	2017	13.0	14.9
Percentage of physically active adults	%	2016/17	67.2	66.0

Lifestyle

5.8.14. The PHE health profile for Northumberland indicates that the adult population in Northumberland have a healthier lifestyle than the national average, with lower rates of smoking and higher rates of participation in physical activity than the England averages.

Children

5.8.15. The PHE health profile indicates that the proportion of children in low income families in Northumberland is broadly in line with the national average, see **Table 5-38** below. The rate of obesity amongst children in Northumberland is slightly higher than the national average. The General Certificate of Secondary Education (GCSEs) attainment rate in Northumberland is slightly lower than the national average. The PHE health profiles data therefore indicates that the health and level of education of children in Northumberland is slightly poorer than the national average.

Table 5-38 - Indicators of childhood health in Northumberland compared with England

Indicator	Indicator value	Period	Northumberland	England
Children in low income families (under 16s)	%	2015	16.7	16.8
Obese children (aged 10-11)	%	2016/17	21.1	20.0
GCSEs achieved	% (A*-C including Maths and English)	2015/16	55.4	57.8

Collision Risk

5.8.16. The PHE health profile indicates that there is a somewhat higher rate of fatalities or serious injuries on roads than the national average, see **Table 5-39**, suggesting that roads in Northumberland are likely to be more dangerous on average than within England as a whole.

Table 5-39 - Indicator of collision risk in Northumberland compared with England

Indicator	Indicator value	Period	Northumberland	England
Killed and seriously injured on roads	Per 100,000 of population	2014-16	52.5	39.7

Economy and Employment

5.8.17. Data from the Office for National Statistics (ONS) (**Ref 5.8.5**) shows that in 2011 for Northumberland 67.9% of working age residents (16 to 64 year olds) were economically active; a marginally lower proportion of the population than the England average of 69.9%. At ward level, economic activity rates in Alnwick (70.0%) and Longhoughton (71.5%) are marginally higher than those within Lesbury (67.5%). All wards have a very similar economic activity rates compared to the Northumberland

average. Although employment by industry type varies by ward, the main employment sectors in the Main Scheme Area are:

- Human health and social work activities;
- Public administration and defence, compulsory social security; and
- Wholesale and retail trade; repair of motor vehicles and motor cycles

Community Amenity and Severance

5.8.18. Community receptors within 1 km of the Scheme are outlined in **Table 5-40**. Most of the community receptors are located within Alnwick. One school located in Ellingham lies slightly beyond 1 km from the Scheme boundary, however has been included due to the sensitivity of the receptor. There are no other community receptors included within the assessment within Ellingham, due to their distance from the Main Scheme Area. It is noted that the distances provided below in the table are approximate and subject to potentially change as the design of the Scheme develops.

Table 5-40 - Community facilities proximate to the Scheme

Type of facility	Name	Approximate distance from the Scheme
Education	Ellingham C of E Primary School	2.2 km
	The Duchess's Community High School (and adjacent playing fields)	500 m
Primary Healthcare	Genix Healthcare NHS Dentist	150 m
Sports and Recreation	Alnwick Rugby Football Club	800 m
	Willowburn Leisure Centre	600 m
	St James Park	800 m
	Alnwick Cricket Club	800 m
Places of Worship and Burial Grounds	Alnwick Cemetery	700 m

Physical Assets and Land Use

Residential Properties

5.8.19. There are a number of residential properties located within the Scheme Footprint. These are listed in **Table 5-41** below.

Table 5-41 - Residential properties located within the Scheme Footprint

Name of property(ies)	Approximate Location
West Linkhall	Immediately adjacent to the west of the A1 and accessed via a loop road off the A1

Name of property(ies)	Approximate Location
Loaning Head, Broom House, Heckley House	Approximately 400 m west of the A1 situated to the north of Denwick Junction and can also be accessed via the B6341 which runs parallel to the A1 to the west
Goldenmoor	Approximately 250 m east of the A1 situated to the north of Denwick Junction and can also be accessed via the B1340
Charlton Mires (two residential properties, one of which is called East Cottage)	Located immediately adjacent to the east of the A1) which are accessed from the A1
Two unnamed properties	Located to the east of the A1, directly adjacent to Charlton Miles which are also accessed from the B6347
Rock South Farm and Rock Midstead	Approximately 600 m east of the A1 all of which have use of direct access roads and do not rely on access via the A1
West Lodge	Located on the scheme footprint, under 100 m to the east of the A1,
Drythropple	Within the Scheme Footprint, approximately 500 m east of the A1
The Old House	Approximately 250 m from the A1, accessed via B6347
Unnamed residence	Immediately adjacent to the east of B6341 and also immediately adjacent to the west of the A1
Gull Ha	Partly in the scheme footprint, located approximately 800 m to the east of the A1
Heiferlaw Bank	Located on the western edge of the scheme footprint, directly adjacent to the west of the B6341
Heckley Fence	Very close to two borders of the Scheme Footprint approximately 250 m to the west of the A1
Rennington Moor	Located approximately 1 km east of the A1 and within the Scheme Footprint
Broxfield Farm	Situated right on the eastern edge of the scheme footprint, approximately 500 m east of the A1
Moorhouse	On the most eastern section of the scheme footprint, approximately 1.5 km to east of A1

Name of property(ies)	Approximate Location
Unnamed building	Partly on scheme footprint, approximately 300 m east of A1 and to north of Denwick. Accessed via B1340
Unnamed building	Approximately 500 m west of A1 and west of Denwick Burn

5.8.20. There are a number of residential properties situated beyond the Scheme Footprint but within 500 m. These include:

- Patterson Cottage which has direct access off the A1;
- Charlton Hall and East Linkhall (also located approximately 600 m east of the A1) which have use of direct access roads and do not rely on access via the A1;
- Garden Cottage which is located approximately 300 m to the east of the A1;
- Middlemoor Farmhouse which approximately 500 m west of the A1;
- Garden Cottage which is approximately 400 m east of the A1;
- Rock Moor Farm which is located approximately 900 m east of A1;
- Holywell Cottage is located 100 m west of B6341, accessed via single track road which connect another two unnamed residences approximately 200 m further to the west;
- Unnamed building approximately 1 km east of A1 and just north of Moorhouse accessed via B1340
- Silvermoor approximately 1 km east of A1, accessed via B1340 (listed as Silvermoor Equestrian Haylage on google maps);
- Heckley House is approximately 500 m west of the A1 and located very close to scheme footprint, accessed via B6341;
- Heckley High House and several outbuildings located approximately 1.2 km west of the A1, accessed via B6341;
- Unnamed building approximately 900 m east of the A1 and south of Silvermoor, accessed via B1340;
- Loaning Head directly adjacent to west of B6341 and 1 km to west of A1; and
- The Village of Denwick which contains a number of residential properties close to Scheme Footprint and approximately 350 m east of the A1.

Commercial Properties

5.8.21. Only one commercial property relies on direct access from the A1; Patterson's Cottage boarding kennels (formerly Baseys of Alnwick Pet Boarding, Day Care and Grooming) which is situated immediately adjacent to the west of the A1. There are a number of other commercial assets within close proximity of the Scheme Footprint (such as Reading Rooms Cottage, Rock Lodge and Rocking Horse Café & Gallery). However, these assets do not have direct access to/from the A1.

Development Land

5.8.22. There is no land within the Main Scheme Area that has been allocated for development within the Alnwick District Wide Local Plan. Within Northumberland Local Plan Draft Policies Map, an area has been identified as suitable for wind turbine development (Policy REN2) to the west of the existing A1 between approximately West Linkhall and North Charlton.

Recreation and Open Space

5.8.23. Within 1 km of the Scheme there are a wide range of open and recreational spaces that serve both Alnwick and the wider area. These are predominantly located in Alnwick and include sports clubs, schools with significant areas of playing fields and children's play areas. In addition, Alnwick Garden is located approximately 1.2 km to the south-west of Denwick Junction. To the north of Alnwick, to the east and west of the A1, there are small pockets of woodland which can be accessed by some of the PRoW described in **Table 5-42** below.

All Travellers

Motorised Users: Driver Stress

5.8.24. The existing stretch of the A1 between Alnwick and Ellingham experiences slight delays for vehicle travellers under baseline conditions. Delays are more prevalent on the minor roads that adjoin the A1 due to drivers having to wait for a gap in traffic to merge onto the A1 carriageway. During current baseline operation, driver stress along the Scheme route is considered to be 'moderate' or 'high'.

Motorised Users: Views from the road

5.8.25. The gently rolling landscape surrounding the Scheme afford views from the sections of the existing A1 that are not screened by lines of trees, woodland and/or embankments running parallel to the A1.

Walkers, Cyclists and Horse-riders: Journey Length and Amenity

5.8.26. There are no national cycle routes in close proximity to the Scheme.

5.8.27. There are 18 PRoW which lie within 500 m of the Scheme Footprint of the Main Scheme Area, with the majority located to the east of the A1 (**Ref 5.8.6**). These form a coherent network, linked in some places by minor roads, and offer a high level of recreational value for users. PRoW also offer WCHs traffic free routes which create linkages between rural communities. Dependent on their classification, they provide permissible access for pedestrians, cyclists and equestrians.

5.8.28. **Table 5-42** provides a summary of PRoW within 500 m of the Scheme Footprint. Key routes/desire lines have been determined by professional judgement based on the location of the PRoW and following WCH usage surveys which were undertaken in September 2016.

Table 5-42 - Summary of PRoWs within the Alnwick to Ellingham study area

PRoW ref.	PRoW Type	Description
110/004	Footpath	Follows the local road network north of Alnwick northwards to the existing A1, near to Broom House Farm, where it connects to footpath 129/014 on the opposite side of the A1.
129/014	Footpath	Continues the line of 110/004 north through agricultural land, connecting with the wider PRoW network, via byway 129/022.
110/013	Byway	Follows a west/east alignment along the local road network near Heckley House to the A1, where it continues east of the A1 via byway 129/022.

PRoW ref.	PRoW Type	Description
129/022	Byway	Runs from the A1 (where it adjoins 110/013) west along a continuous route to the village of Rennington, connecting with several other footpaths, agricultural tracks and local roads.
129/023	Byway	Travels north from the intersection of 129/022 and 110/011 at Broxfield and splits into 129/005 and 120/023.
110/019	Footpath	Runs from the B6341 near Heiferlaw Tower west of the A1 and continues east on the opposite side of the A1 along 129/009 and connects with a network of PRoW from Rock South Farm.
110/003 / 129/009	Footpath	A single path crossing a parish boundary. Runs from the A1, where it continues the line of 110/019, to Rock South Farm, where it connects with a network of other PRoW and a minor road.
110/010	Footpath	Runs from west to east along a track from the B6341 at Heiferlaw Bank to the A1.
129/005	Footpath	Runs northwards from Rock South Farm parallel to the A1 and connects to 'the Avenue' (129/004) and the local road network to Rock, Rock Midstead and Rock Moor House. Also runs south from Rock South Farm and connects to PRoW 129/023.
129/006	Footpath	Runs north eastwards from Rock South Farm to Rock.
129/024	Footpath	Located on the western side of the A1 and connects the B6341 near Rock Lodge to the A1. Its line is continued eastwards on the opposite side of the A1 by Footpath 129/004.
129/004	Footpath	Continues the line of Footpath 129/024 eastwards from the A1 adjacent to 'the Avenue' past Rock Midstead to Rock Hall and Rock.
112/009	Bridleway	Runs north to south from West Linkhall and connects West Linkhall (west of the A1), with Craggy Wood and South Charlton to the southwest.
112/008	Footpath	Runs west to east and connects West Linkhall (which is west of the A1) with Craggy Wood and the wider PRoW network.
112/037/218/024	Bridleway	Follows a north/south route from a layby on the east side of the A1 opposite North Charlton to connect with a network of minor roads near Tynely and Footpath 112/007.

PRoW ref.	PRoW Type	Description
112/007/218/023	Footpath	Runs parallel to Charlton Burn and runs west to east and links with the wider PRoW network and minor roads in an area of high recreational use. It connects to 112/037 (a bridleway) which continues south parallel to the A1, 218/024 which runs north towards Brownieside, and 218/023 which continues east.
218/004	Footpath	A small portion of this footpath runs parallel to the A1, then follows an east/west alignment connecting to bridleway 218/024.
126/026	Bridleway	This bridleway is located to the east of the Scheme and passes adjacent to the Combs Plantation and Doxford Farm. It connects to PRoW 218/026 to the north.

5.8.29. In addition to the PRoW, there are routes utilised by pedestrians along several sections of the A1.

5.8.30. The WCH surveys carried out between July and September 2017 suggest that the busiest recorded pedestrian movements were observed in the North Charlton east and west areas which are 2 of the 12 locations from Alnwick to Ellingham where the surveys were carried out. The busiest PRoW was bridleway 112/009 at West Linkhall. A summary of WCH counts is provided below in **Table 5-43** below.

Table 5-43 - WCH counts for the survey area

Public Right of Way	Site WCH Totals	Pedestrians	Cyclists	Horse riders
Footpaths 110/004 continuing as 129/014 crossing A1	4	4	0	0
Byway 110/013 continuing as 129/02	3	3	0	0
Footpath 110/019 across A1 as 110/003 and 129/009	2	1	1	0
Footpaths 129/021 and 110/110 and road to Rock South Farm	2	0	2	0
Broxfield *but not crossing A1, only movements to A1 used	89	30*	0	0
Rock South Farm *but not crossing A1, only movements to A1 used	71	25**	0	4
Footpath 129/024 and 129/004	2	0	2	0
B6341, B6347 and A1 Rock Lodge junction	19	7	12	0

Public Right of Way	Site WCH Totals	Pedestrians	Cyclists	Horse riders
A1/B6347 Charlton Mires Junction	20	3	17	0
Bridleway 112/009 at West Linkhall	17	14	3	0
North Charlton West	86	58	28	0
North Charlton East	38	23	15	0
* Only movements to the A1 used and does not include movements crossing the A1 ** Only movements to the A1 used and does not include movements crossing the A1.				

5.8.31. The majority of users were concentrated at four locations:

- Broxfield (but not crossing the A1, only movements to the A1);
- Rock South Farm (but not crossing the A1, only movements to the A1);
- North Charlton West; and
- North Charlton East.

5.8.32. The greatest numbers of cyclists were also recorded in the North Charlton east and west areas. In the area within and adjacent to the Scheme Footprint, equestrian use was observed to be low with only nine equestrian users recorded in the WCH survey at Broxfield Farm and Rock South Farm. Equestrians were noted to be moving away from the A1 and did not cross the A1.

Lionheart Enterprise Park Compound

5.8.33. The baseline findings for the study area surrounding the Lionheart Enterprise Park Compound are the same as those outlined for the above for the Main Scheme Area as they are assessed on a regional basis, aside from those outlined below:

Physical Assets and Land Use

5.8.34. The proposed Lionheart Enterprise Park Compound is located approximately 250 m east of the A1, on the outskirts of the Alnwick Lionheart Enterprise Park. The Compound also comprises of a number of commercial and light industrial premises which fall within the Scheme Footprint.

5.8.35. The closest residential properties are located approximately 400 m to the south-west (Greensfield Moorhouse) and 150 m to the north-east (East Cawledge) of the Lionheart Enterprise Park Compound.

5.8.36. The closest formal recreational spaces to the Lionheart Enterprise Park Compound are the playing fields at The Duchess's Community High School which are located to the west of the Compound, on the opposite side of the A1. Approximately 850 m to the west are the Alnwick Rugby Football Club field and Alnwick Town Football Club Fields. The Willowburn Sport & Leisure Centre is also located approximately 650 m to the west.

Community Amenity and Severance

5.8.37. The Duchess's Community High School is the closest community receptor to the Lionheart Enterprise Park Compound and is located approximately 350 m to the west of the Compound, on the opposite side of the A1.

Walkers, Cyclists and Horse-riders

5.8.38. There are no National Trails or National Cycle Routes within 500 m of the Lionheart Enterprise Park Compound. There are four PRoW within 500 m of the Compound, as set out in **Table 5-44**.

Table 5-44 - PRoW within 500 m of the Lionheart Enterprise Park Compound

PRoW ref.	PRoW Type	Description
104/029	Footpath	Runs along Willowburn Avenue and stops at the roundabout which connects Willowburn Avenue to the A1.
141/022	Footpath	Runs perpendicular to the A1 and starts to the west of the proposed location for the Lionheart Enterprise Park Compound and finishes at the unnamed road which provides access to Redfoot Lea Bed and Breakfast.
141/013	Footpath	Continues on from PRoW 141/022 along the southern most boundary of the Lionheart Enterprise Park Compound towards Nabs Plantation.
141/014	Footpath	Starts from the A1 and runs from west to east along an unnamed road which provides access to the properties to the north of Lionheart Estate, directly to the north of Cawledge Burn.

Main Compound

The baseline findings for the study area surrounding the Main Compound are the same as those outlined above for the Main Scheme Area as they are assessed on a Regional basis, aside from those outlined below:

Physical Assets and Land Use

There are a small number of properties located close to the Main Compound:

- West Moor Houses, two residential properties located approximately 400 m away on the other side of the A1; and
- Thirston New Houses, a grouping of properties located approximately 200 m to the east of the Compound.

5.8.39. Eshott Airfield is located immediately south of the Compound. Approximately 700 m to the west, on the other side of the A1, on the road perpendicular to the A1 is Northumberland Canine Centre. Along this road, within 500 m of the Main Compound, there is one commercial property, which is understood to be a construction yard.

5.8.40. The nearest open and recreational space to the Main Compound is Felton Park, located approximately 800 m to the north, on the northern side of the River Coquet. There are no other open or recreational spaces within or immediately surrounding the Main Compound.

Community Amenity and Severance

5.8.41. There are no community receptors within 1 km of the Main Compound.

Walkers, Cyclists and Horse-riders

5.8.42. There are no National Trails or National Cycle Routes or PRoW within 500 m of the Main Compound.

Sensitive Receptors

5.8.43. The following population and human health receptors have been identified as sensitive:

Population

- Community Amenity and Severance
- Community facilities as follows:
  - Ellingham C of E Primary School;
  - The Duchess's Community High School;
  - Genix Healthcare NHS Dentist;
  - Alnwick Rugby Football Club;
  - Willowburn Leisure Centre;
  - St James Park;
  - Alnwick Cricket Club;
  - Alnwick Cemetery; and
  - Duchess's Community High School.

Physical Assets

5.8.44. There are a number of residential properties located within the Scheme Footprint which include:

- West Linkhall located immediately adjacent to the west of the A1 and accessed via a loop road off the A1;
- Loaning Head, Broom Ho., and Heckley Ho. (located approximately 400 m west of the A1) situated to the north of Denwick Junction and can also be accessed via the B6341 which runs parallel to the A1 to the west;
- Goldenmoor (located approximately 250 m east of the A1) situated to the north of Denwick Junction and can also be accessed via the B1340;
- Charlton Mires (two residential properties (one of which is called East Cottage) located immediately adjacent to the east of the A1) which are accessed from the A1;
- Two unnamed properties (located to the east of the A1, directly adjacent to Charlton Miles) which are also accessed from the B6347;
- Rock South Farm and Rock Midstead, (located approximately 600 m east of the A1) all of which have use of direct access roads and do not rely on access via the A1;
- Greensfield Moorhouse (located approximately 400 m south-west of the Lionheart Enterprise Park Compound);
- East Cawledge (located approximately 150 m to the north-east of the Lionheart Enterprise Park Compound);
- West Moor Houses, (two residential properties located approximately 400 m away on the other side of the A1 from the Main Compound); and

- Thirston New Houses (a grouping of properties located approximately 200 m to the east of the Main Compound).

5.8.45. The following businesses, which are located within the vicinity of the Scheme:

- Patterson's Cottage kennels (formerly Baseys of Alnwick Pet Boarding, Day Care and Grooming) which is situated immediately adjacent to the west of the A1;
- Reading Rooms Cottage (located west if the A1 and accessible via an unnamed road);
- Rock Lodge;
- Rocking Horse Café and Gallery;
- Beal ME and Sons;
- Eshott Airfield;
- Northumberland Canine Centre; and
- The commercial and light industry premises proximate to the Lionheart Enterprise Park Compound.

Local Economy

- Economic receptors (i.e. individuals of working age within the local (Northumberland) or regional area (North East of England); and
- Economic receptors (such as accommodation providers) at a local level (Northumberland) and at a regional level (North East of England).

Agricultural Land

- Best and Most Versatile agricultural land[9]; and
- Farm Holdings within vicinity of the Scheme.

Recreational Activities

- Users of the recreational areas described above in paragraph 5.8.23, and includes users (who are most likely to be residents from the local area).

Motorised Users

- Users of the A1 and main routes connecting to the A1 in the vicinity of the Scheme.

Human Health

5.8.46. Vulnerable groups of people who are most likely to experience health inequality, including:

- Children;
- The elderly; and
- Those who are living in areas of social and economic deprivation.

[9]The Agricultural Land Classification systems classifies land into 5 grades according to their composition. The Best and Most Versatile agricultural land is defined is defined as Grades 1,2 and 3a in accordance with Annex 2 of the National Planning Policy Framework 2012 and is land which is most flexible, productive and efficient.

Walking, Cycling and Horse-riders

- Users of the PRoW and non-designated footpaths within the Scheme Footprint and its immediate vicinity, as shown on **Figure A3: Environmental Constraints Plan** in **Appendix A**.

POTENTIAL IMPACTS

Main Scheme Area, including Charlton Mires Compound

Construction

5.8.47. The construction of the Scheme in the Main Scheme Area has the potential to result in the following temporary impacts upon population and human health receptors:

Population

5.8.48. As part of the construction works, two residential properties would be demolished.

5.8.49. During construction, residents within residential properties surrounding the Scheme Footprint (directly adjacent to the A1) are likely to experience periods of disruption to their access to and from properties. In particular: South Rock Farm; Linkhall Cottages; Charlton Mires; and Patterson Cottages have the potential to experience impacts associated with accessibility during construction.

5.8.50. There are a number of residential properties which are not directly adjacent to the A1 but would be proximate to areas where construction works would take place. The following residential properties have the potential to experience impacts associated with accessibility during construction: Loaning Head; Broom Ho.; Goldenmoor; Heckley Ho.; Heckley Fence; and Rock Midstead.

5.8.51. There is the potential for temporary loss of private land with the use of the Charlton Mires construction compound.

5.8.52. During construction businesses such as Patteron's Cottage kennels and Rock Lodge Holiday Lets are likely to experience periods of disruption to access which has the potential to cause a temporary reduction in trade.

5.8.53. There is likely to be both temporary and permanent severance/disruption to farm holdings and effects on the viability of farm businesses.

5.8.54. There is the potential for a change in amenity value in terms of the presence of construction noise, vibration effects, dust and disruption to views from residential properties. In particular, during the construction phase noise effects are anticipated (see **Section 5.2** – **Noise and Vibration** of this PEIR for further detail).

5.8.55. During construction, traffic management and diversions may lead to vehicular traffic being rerouted off the A1 onto local roads. This has the potential to affect residents and their access to community facilities and recreational resources.

5.8.56. There is the potential for a beneficial impact during construction on the local economy as expenditure within the local supply chain is likely to increase during the construction works. Furthermore, construction could generate direct employment opportunities.

5.8.57. There is the potential for WCHs to experience impacts during construction associated with temporary diversions required for both the construction of the Scheme, and the permanent diversion of PRoW as outlined in **Table 2-1** in **Chapter 2**.

5.8.58. The duration and phasing of these closures is currently unknown, however appropriate mitigation for the PRoW identified will be developed and included within the ES.

5.8.59. *Human Health*

5.8.60. During construction there is the potential for the following human health effects to arise:

- Reduced air quality through an increase in construction vehicle emissions and from dust from earthworks and construction activities;
- Increase in noise and vibration levels due to piling, breaking and demolition activities; and
- Due to the risk of physical and mental health issues arising from an increased flood risk and risk of pollution from spillages into local surface and ground water resources.

5.8.61. Driver stress in relation to vehicle users travelling along routes with construction vehicles, roadworks, or diversions has the potential to be 'moderate' or 'high'. This in combination with increased journey times, is likely to result in increased driver stress during the construction phase for vehicle travellers, however this would be temporary in nature.

5.8.62. It is anticipated that views from sections of the A1 which remain open during the construction period would be adversely affected. This would be due to the presence of construction work areas and activities where there are currently none. However, due to the temporary nature of the construction period and phasing of construction works it is not envisaged that there would be significant effects.

Operation

5.8.63. The operation of the Scheme may result in the following impacts upon population and human health receptors:

Population

5.8.64. During operation, vehicular traffic is likely to travel on the most easily accessible route and avoid using local roads in favour of the A1. As such, this would likely relieve any community severance effects experienced along local roads. As such, during operation there are no anticipated adverse effects on residents in relation to community severance, and there may be the potential for beneficial effects in relation to community severance; due to traffic being attracted away from local roads and favouring use of A1.

5.8.65. During operation there would be changes to private means of access provided for properties where existing access to the A1 would be stopped up during construction. These properties are Rock South Farm, Heckley Fence, West Linkhall, Paterson Cottage, East Linkhall and West Lodge. Further details of the amended access are provided in Chapter 2 of this PEIR.

5.8.66. There is the potential for WCHs to experience operational phase impacts associated with PRoW as outlined in **Table 2-1** in **Chapter 2** of this PEIR.

Human Health

5.8.67. During operation there is the potential for the following human health effects to arise:

- Reduced air quality through an increase in emissions of oxides of nitrogen (NO_X) and nitrogen dioxide (NO_2) due to changes in exhaust emissions from road traffic along the A1 and linked roads;
- Increase in noise and vibration due to the relocation of the A1, this would introduce a new source of noise which would affect local sensitive receptors adjacent to the Scheme; and

- Due to a permanent increase in flood risk as a result of increased rates and volumes of surface water runoff from changes to the existing drainage regime.

5.8.68. There is the potential for reduced journey times as the A1 would have additional capacity to carry the strategic, long-distance traffic separately from local traffic. As a result of improved journey times there is the potential for a reduction in driver stress.

5.8.69. It is anticipated that views from the Scheme would be similar to current views from the A1. This is due to the nature of the Scheme which primarily includes online widening to east of the existing A1.

Lionheart Enterprise Park Compound

Construction

Population

5.8.70. Residential properties in proximity to the Lionheart Enterprise Park Compound are likely to experience disruption and a reduction in amenity, due to increased construction traffic and proximity to construction activities generating noise, dust etc. Given that properties do not share access with the Compound however, effects are unlikely to be significant.

5.8.71. There are a number of commercial properties adjacent to the Lionheart Enterprise Park Compound and there is the potential for increased journey times associated for those people accessing Lionheart Enterprise Park due to increased construction traffic However, there are not anticipated to be impacts associated with accessibility and / or land-take to commercial properties on the Lionheart Industrial Estate.

5.8.72. Nearby properties, facilities and routes used by WCHs are likely to experience a reduction in amenity due to an increase in construction traffic coming in and out of Lionheart Enterprise Park Compound.

5.8.73. As no PRoW would be temporarily closed or diverted as a result of the Lionheart Enterprise Park Compound, there are not anticipated to be any direct effects on WCH. However, there is a potential for a loss of amenity value as noted above.

5.8.74. As mentioned above for the Main Scheme Area, during construction there is the potential for significant effects in relation to direct, indirect and induced employment opportunities through expenditure within the local supply chain. This has the potential to result in beneficial impacts associated with the economy and employment.

Human Health

5.8.75. Activities within the Lionheart Enterprise Park Compound are likely to have the following human health impacts:

- Reduced air quality through an increase in construction vehicle emissions, dust from earthworks and construction activities and a loss of amenity along nearby PRoW due to the presence of construction traffic.
- Increased levels of noise and vibration, due to increased construction traffic and close proximity to construction activities; and
- Increased risk of pollution from spillages into local surface and ground water resources.

5.8.76. Vehicle users travelling to and from the Lionheart Enterprise Park Compound may experience increased journey times due to traffic management measures or increased presence of construction vehicles accessing the Compound.

Operation

5.8.77. As the Lionheart Enterprise Park Compound would no longer be required during operation of the Scheme, it is not envisaged that there would be any impacts arising during this phase.

Main Compound

Construction

Population

5.8.78. The residential properties within vicinity of the Main Compound are likely to experience periods of disruption to their access to and from properties, in particular Thirston New House.

5.8.79. Eshott Airfield is located immediately south of the Main Compound. Approximately 700 m to the west, on the other side of the A1, on the road perpendicular to the A1 is Northumberland Canine Centre. As the Compound is utilising a different access to these facilities, there is not anticipated to the any loss of access to these commercial properties. There is likely to be an increase in the amount of traffic due to construction vehicles which is likely to cause temporary disruption, but not to the extent that the commercial viability of the businesses is compromised.

5.8.80. There is the potential for nearby residents, particularly to the west of the Compound, to experience impacts associated with a loss of amenity during construction primarily due to construction traffic coming in and out of the Main Compound.

5.8.81. As mentioned above for the Main Scheme Area, during construction there is the potential for significant effects in relation to direct, indirect and induced employment opportunities as well as through expenditure within the local supply chain. This has the potential to result in beneficial impacts associated with the economy and employment.

Human Health

5.8.82. Activities within the Main Compound are likely to have the following human health impacts:

- Reduced air quality through an increase in construction vehicle emissions, dust from earthworks and construction activities and a loss of amenity due to the presence of construction traffic.
- Increased levels of noise and vibration due to construction activities and vehicles; and
- Due to a permanent increase in flood risk as a result of increased rates and volumes of surface water runoff from changes to the existing drainage regime.

5.8.83. Vehicle users travelling to Morpeth and Felton utilising the A1 may experience increased journey times due to traffic management measures or increased presence of construction vehicles accessing the Main Compound.

Operation

5.8.84. As the Main Compound would no longer be required during operation of the Scheme, it is not envisaged that there would be any impacts arising during this phase.

Accommodation bridge options

Heckley Fence

Construction

Population

5.8.85. The residential properties within vicinity of the Heckley Fence option, in particular the dwelling at Heckley Fence, are likely to experience periods of disruption to their access to and from the property.

5.8.86. There is the potential for nearby residents, particularly to the west of the bridge, to experience impacts associated with a loss of amenity during construction, primarily due to construction activities and construction traffic coming off the A1 or the B6341. Similarly, users of nearby PRoW are likely to experience a change in amenity value in terms of the presence of construction noise, vibration effects, dust and disruption to views.

5.8.87. The construction of Heckley Fence option requires the permanent closure of the full length or sections of six PRoW (PRoW 110/004, Byway 110/013, PRoW 129/014, Byway 129/022, PRoW 129/009 and PRoW 110/003). A number of diversions would also be required including PRoW 110/004, PRoW 110/019 and PRoW 110/010. This is anticipated to have an adverse effect on WCHs as their route to cross the A1 would be longer.

Human Health

5.8.88. Impacts associated with the construction of the Heckley Fence option are likely to have the following human health impacts:

- Reduced air quality through an increase in construction vehicle emissions, dust from earthworks and construction activities and a loss of amenity due to the presence of construction traffic.
- Increased levels of noise and vibration due to construction activities and vehicles; and
- A permanent increase in flood risk as a result of increased rates and volumes of surface water runoff from changes to the existing drainage regime.

Operation

Population

5.8.89. The operation of the Heckley Fence option may result in the following impacts upon population and human health receptors:

- As PRoWs would be permanently closed and diverted as a result of the new bridge there are anticipated to be direct effects on WCHs;
- As the new bridge is providing an additional crossing for WCHs and occasional motorised users it is anticipated that there would be beneficial impacts on accessibility for both motorised and WCHs. The existing accommodation crossing would be maintained via a bridge, which would provide safer access than the existing crossing.

Human Health

5.8.90. There are not predicted to be potential impacts associated with the operation of the Heckley Fence option.

Broxfield

Construction

Population

5.8.91. The residential properties within vicinity of the Broxfield option, in particular Heckley House and other properties to the north and east of the Scheme at this point are likely to experience periods of disruption to their access to and from the property.

5.8.92. There is the potential for nearby residents, particularly to the west of the bridge, to experience impacts associated with a loss of amenity during construction primarily due to construction activities and construction traffic coming off the A1 or the B6341. Similarly, users of nearby PRoW are likely to experience a change in amenity value in terms of the presence of construction noise, vibration effects, dust and disruption to views.

5.8.93. The construction of Broxfield option requires the permanent closure of three PRoW (PRoW 129/014, PRoW 110/003 and PRoW 129/009). A number of PRoW would also be diverted including PRoW 110/004, PRoW 110/019 and PRoW 110/010.

5.8.94. As outlined in paragraph 3.1.16, the current accommodation crossing at Heckley Fence would be closed. Based on current information, it is understood this closure may affect farming operations. Therefore, there is the potential for impacts on farming access and practices during construction which would continue throughout the operation of the Scheme.

Human Health

5.8.95. Impacts associated with the construction of Broxfield option are likely to have the following human health impacts:

- Reduced air quality through an increase in construction vehicle emissions, dust from earthworks and construction activities and a loss of amenity due to the presence of construction traffic.
- Increased levels of noise and vibration due to construction activities and vehicles; and
- A permanent increase in flood risk as a result of increased rates and volumes of surface water runoff from changes to the existing drainage regime.

Operation

Population

5.8.96. The operation of the Heckley Fence bridge may result in the following impacts upon population and human health receptors:

- As PRoW would be permanently closed and diverted as a result of the new bridge there are anticipated to be direct effects on WCHs.
- As the new bridge is providing an additional crossing for WCHs and motorised users it is anticipated that there would be beneficial impacts on accessibility for both motorised and WCHs.
- As permanent closure of the current accommodation crossing at Heckley Fence is required there may be permanent adverse effects on farming operations.

Human Health

5.8.97. There are not predicted to be potential impacts associated with the operation of Broxfield option.

Comparisons between accommodation bridge options

5.8.98. Heckley Fence option is likely to have a comparatively greater impact on WCHs in relation to their use and enjoyment of PRoW within vicinity of both bridges. The construction of the Heckley Fence option requires the closure of more PRoW when compared to the Broxfield option. Instead the diversion to the north would have to be utilised.

5.8.99. Residential properties are closer to the Heckley Fence option, when compared to the Broxfield option, so are likely to be experience comparatively greater construction impacts, although these would be appropriately managed, as far as practicable, through mitigation.

5.8.100. The potential impact on farming access and practices is considered to be comparatively more significant for the Broxfield bridge as this does not maintain the existing accommodation crossing at Heckley Fence. This would impact farming operations.

5.8.101. Potential human health impacts are the same for both options.

DESIGN, MITIGATION AND ENHANCEMENT MEASURES

Population

Community Amenity and Severance

5.8.102. During construction, traffic management systems and diversion routes would be put in place to maintain access to residential and commercial properties, and potentially community facilities and recreational and open spaces. During construction or operation (the timing of this has not yet been confirmed), direct accesses to residential properties would be stopped up and alternative safer access provided as part of the Scheme. Where appropriate, access roads would be constructed / upgraded ahead of works on the main A1.

Physical Assets

5.8.103. Landowners would be compensated for land required either temporarily during construction or permanently for the operation of the Scheme.

5.8.104. Only land required for temporary works would be reinstated to its former use following the completion of construction, in discussion with the relevant landowner.

Local Economy

5.8.105. During construction, measures would be put in place, where possible, to maximise the potential for the workforce and project supply chain, to be sourced locally.

Agricultural Land

5.8.106. Although agricultural land required within the Scheme Footprint would be lost permanently during operation, the following measures would be implemented during construction:

- Wherever possible, land required in addition for construction, for example for the Compounds, would be returned to agricultural use.
- If topsoil is required to be stored, it would be done so in accordance with best practice industry guidelines.
- Severance during construction to be minimised through careful siting of lay down areas, and careful planning of construction activities through consultation with landowners.

- Crop loss can be reduced by giving advanced warning to enable farmers to plan ahead.
- Consideration of field drainage impacts during the design phase.
- Noise and dust to be kept at a minimum and within acceptable working limits, using best practice methods to be outlined in a CEMP as detailed in **Section 5.2** of this PEIR.

Walking, Cycling and Horse-riders

5.8.107. During construction and operation, WCH facilities would be provided as part of the Scheme. Where possible, routes for WCH which provide direct access onto the A1 have been avoided as these are considered to be less safe and more disruptive to traffic than providing alternative access arrangements. As such, these have been avoided wherever possible whilst still maintaining connectivity for all users.

5.8.108. A footway is provided at Charlton Mires Junction linking diverted PRoW 129/004 to the east of the Scheme. The footpath would then extent along the improved B6347(which is located to the west of the Scheme) to Rock Lodge.

5.8.109. At Broxfield there is provision for all types of WCHs which would link byway 129/022 and 110/013. Similarly, at Heckley Fence there is provision for all types of WCHs which would link byway 110/013 to PRoW 129/005 through the diversion of the byway across the bridge.

Human Health

5.8.110. Best practice construction methods should be used to minimise noise and vibration levels, air quality pollution (i.e. dust emissions), and flood and pollution risk to or from the road drainage and the water environment as detailed in **Sections 5.1, 5.2** and **5.6** of this PEIR. Monitoring should be established to ensure acceptable working limits are adhered to, using best practice methods to be outlined in a CEMP as detailed in **Sections 5.1, 5.2** and **5.6** of this PEIR.

5.8.111. During operation, routes for vehicle travellers which provide direct access on to the A1 have been avoided, where possible, as these routes are considered to be less safe and more disruptive to traffic than providing alternative access arrangements. As such, these have been avoided wherever possible whilst still maintaining connectivity for all users.

5.8.112. During operation, impacts would be mitigated as proposed within the air quality, noise and vibration and the road drainage and water environment chapters.

LIKELY SIGNIFICANT EFFECTS

5.8.113. The comparison of preliminary likely significant effects between the two accommodation bridge options are set out in **Table 5-45** below, based upon currently available information and professional judgement. Following implementation of appropriate mitigation measures, significant residual effects on WCHs are anticipated during construction for both options and during operation for the Heckley Fence option. However, these effects could change as the EIA progresses. Mitigation measures are outlined in the above section.

Table 5-45 - Preliminary Likely Significant Effects of the two accommodation bridge options

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
Residential Receptors	Construction	Temporary disruption due to proximity to construction of the new bridges. In particular, Heckley House to the east of the Scheme for the Broxfield option and Heckley Fence properties for the Heckley Fence Option.	Not anticipated if mitigation such as Traffic Management Systems/Plans, including diversion routes, to maintain access are implemented.	Not anticipated if mitigation such as Traffic Management Systems/Plans, including diversion routes, to maintain access are implemented.
Walkers, Cyclists and Horse-riders	Construction	Potential for an adverse change in users' amenity value in terms of noise, dust and disruption to views. Increase in journey length. Permanent severance of some PRoW	Yes	Yes
	Operation	Increase in journey length. Permanent severance of some PRoW	Not anticipated The permanent closure of the PRoW is not considered to be significant as a permanent diversion is provided which is comparatively safer as a bridge would be provided.	Yes Permanent closure of five PRoW and the diversion of four PRoW makes the route to cross the A1 longer for WCHs..
Farm Holdings	Construction	Temporary severance/disruption to farm landholdings and effects on viability of farm businesses.	Yes Based on current information it is understood this option would affect farming operations which has the potential to be significant.	Not anticipated
	Operation	Potentially permanent severance/disruption	Yes	Not anticipated

		to farm landholdings and effects on viability of farm businesses.	Based on current information it is understood this option would affect farming operations which has the potential to be significant	

5.8.114. A summary of the preliminary likely significant effects of the Scheme is presented in **Table 5-46** below, based upon currently available information and professional judgement. However, these effects could change as the EIA progresses.

Table 5-46 - Summary of Preliminary Likely Significant Effects – population and health

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Main Scheme Area				
Population				
Community Amenity and Severance				
Community facilities and recreational resources	Construction	Potential severance due to construction activities. Potential for an adverse change in users' amenity value in terms of noise, dust and disruption to views.	Traffic Management Systems/Plan, including diversion routes, to maintain access.	Yes
	Operation	Potential relief in community severance and improvements in connectivity in the long-term due to a reduction in traffic along local routes.	None required.	Yes, beneficial
Physical Assets				
East Cottage and Charlton Mires Farm	Construction	Loss of private property.	Financial compensation for permanent loss of private property. The owners of these properties have been consulted in the final location of the Charlton Mire Junction.	Yes
Private properties adjacent to the A1 or with direct access to the A1.	Construction	Temporary disruption and changes in amenity due to change in access to the A1.	Traffic management Systems/Plan, including diversion routes, to maintain access.	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		Temporary loss of land for temporary construction compounds and/or diversions.	Landowners would be compensated for land required either temporarily during construction or permanently for the operation of the Scheme. Land required for temporary works would be reinstated to its former use following the completion of construction in discussion with the relevant landowners.	Not anticipated
Commercial Properties				
Businesses located within 500 m of the scheme	Construction	Disruption due to change in access and construction activities and amenity value (noise, vibration, dust etc.).	Traffic Management Systems/Plans, including diversion routes, to maintain access.	Yes, depending upon level of access which can be maintained
	Operation	Potential for disruption or improvement to access.	Liaison with the community to ensure that access is sufficient.	Not anticipated
Economic Receptors				
Individuals of working age within the local (Northumberland) or regional area (North East of England)	Construction	Generation of direct employment opportunities.	Measures, where possible, to maximise the potential for the workforce to be sourced locally.	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Economic receptors (such as food stores or accommodation providers) at a local level (Northumberland) Economic receptors at a regional level (North East of England)	Construction	Potential benefit due to expenditure	Measures, where possible, to maximise the potential for the workforce to be sourced locally.	Not anticipated
Walkers, Cyclists and Horse-riders				
Users of the PRoW within the Scheme Footprint or its immediate vicinity	Construction	Potential for an adverse change in users' amenity value in terms of noise, dust and disruption to views. Potential changes to availability of recreational resources may include disruption to access and facilities due to construction activities/vehicles. Increase in journey length. Permanent severance of some PRoW.	Clear signage to communicate diversions. The public would also be informed about the nature, timing and duration of particular activities by appropriate communication. Careful timing of works and appropriate diversion routes which will be set out within a CEMP. Measures to mitigate the generation of noise and vibration will be set out in a CEMP.	Yes
	Operation	Potential for an adverse change in users' amenity value due to proximity of existing PRoW to Scheme.	Use of best practice design, with regards to the safety of WCHs, such as lighting and landscaping, would	Yes

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		Increase in journey length due to permanent diversions.	improve the amenity of users of footpaths surrounding areas, particularly in those areas where diversions of PRoW are proposed.	
Agricultural Land				
Farm Holdings	Construction	Temporary severance/disruption to farm landholdings and effects on viability of farm businesses.	Reinstatement of land, where possible, to its former use following the completion of construction	Yes
	Operation	Potentially permanent severance disruption to farm landholdings and effects on viability of farm businesses.	Two accommodation bridge options being considered to minimise severance impacts. Compensation to mitigate potential loss of land and business holdings.	Yes
Human Health				
Human Health Receptors	Construction	Physical health risks associated with increased emissions from construction vehicles and fugitive dust from earthworks and other construction activities. Physical and mental health risks due to increased noise levels from piling, breaking and demolition activities. Physical health issues from increased flood risk and pollution to local surface/ground water resources.	Good practice measures to control noise and vibration levels, dust levels (i.e. through a dust management plan) and flood risk and pollution control that should be incorporated into a CEMP and implemented to minimise human health impacts where possible.	Not anticipated
	Operation	Physical health risks associated with increased levels of oxides of oxygen	During operation impacts would be mitigated as proposed within the Air	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		and nitrogen dioxide from an increase in vehicles travelling along the Scheme. The Scheme would introduce a new source of noise to sensitive receptors to the west of the existing A1 which could lead to physical and mental health risks due to increased noise levels. Physical and mental health issues from a permanent increase in flood risk due to increased rates and volumes of surface water due to changes in the drainage regime.	Quality, Noise and vibration and the Road drainage and the Water Environment chapters of the ES. An Equality Impact Assessment (EqIA) will be undertaken to identify opportunities for improvements is recommended.	
Vehicle Travellers	Construction	In combination with increased journey times, there is likely to be an increase in driver stress during the construction phase for vehicle travellers.	Careful timing of works and appropriate diversion routes which will be set out within a CEMP.	Not anticipated
	Operation	Potential decrease in driver stress due decreased journey times and delays.	None required	Yes, beneficial
Lionheart Enterprise Park Compound				
Population				
Community Amenity and Severance				
Community facilities and recreational resources near to	Construction	Potential severance due to construction activities.	Traffic Management Systems/Plan, including diversion routes, to maintain access.	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
the Lionheart Enterprise Estate Compound		Potential for an adverse change in users' amenity value in terms of noise, dust and disruption to views within the community.		
	Operation	Potential relief in community severance and improvements in connectivity in the long-term due to a reduction in traffic along local routes.	None required	Not anticipated
Physical Assets				
Residential Properties	Construction	Temporary disruption and changes in amenity due to proximity to construction compound and increases in construction traffic.	Traffic management Systems/Plan, including diversion routes, to maintain access.	Not anticipated.
Commercial Properties	Construction	Temporary disruption due increased journey times for both patrons and employees due to construction works near to the commercial properties.	Traffic management Systems/Plan, including diversion routes, to maintain access.	Not anticipated.
Walkers, Cyclists and Horse-riders				
Users of the PRoW near to the compound and other routes used by WCHs	Construction	Potential for an adverse change in users' amenity value in terms of noise, dust and disruption to views.	Careful timing of works and the implementation of a CEMP as detailed in **Section 5.1** and **5.2** of this PEIR.	Not anticipated
Human Health				
Human Health Receptors	Construction	Physical health risks associated with increased emissions from construction	Good practice measures to control noise and vibration levels, dust levels	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		vehicles and fugitive dust from earthworks and other construction activities. Reduced amenity along PRoWs due to construction equipment and activities. Physical and mental health risks due to increased noise levels from construction traffic and activities. Physical health issues from increased flood risk and pollution to local surface/ground water resources.	(i.e. through a dust management plan) and flood risk and pollution control that should be incorporated into a CEMP and implemented to minimise human health impacts where possible.	
Vehicle Travellers	Construction	Vehicle users travelling to and from the Lionheart Enterprise Park Compound may experience increased journey times due to traffic management measures or increased presence of construction vehicles accessing the compound.	Careful timing of works and the implementation of a Traffic Management Plan.	Not anticipated
Main Compound				
Population				
Physical Assets				
Residential Properties within the vicinity of the Main Compound	Construction	Residential properties within vicinity of construction Main Compound are likely to experience periods of disruption to their access to and from	Careful timing of works and the implementation of a Traffic Management Plan.	Yes

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		properties, in particular Thirston New Houses.		
Commercial facilities within the vicinity of the Main Compound (such as Eshott Airfield and Northumberland Canine Centre)	Construction	There is likely to be an increase in the amount of traffic due to construction vehicles which is likely to cause temporary disruption, but not to the extent that the commercial viability of the businesses is compromised.	Careful timing of works and the implementation of a Traffic Management Plan.	Not anticipated
Human Health				
Human Health Receptors	Construction	Physical health risks associated with increased emissions from construction vehicles and fugitive dust from earthworks and other construction activities. Reduced amenity along PRoWs due to construction equipment and activities. Physical and mental health risks due to increased noise levels from construction traffic and activities. Physical and mental health issues from a permanent increase in flood risk due to increased rates and volumes of surface water due to changes in the drainage regime. .	Good practice measures to control noise and vibration levels, dust levels (i.e. through a dust management plan) and flood risk and pollution control that should be incorporated into a CEMP and implemented to minimise human health impacts where possible.	Not anticipated

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Vehicle Travellers	Construction	Vehicle users travelling to and from the Main Compound may experience increased journey times due to traffic management measures or increased presence of construction vehicles accessing the Compound.	Careful timing of works and the implementation of a Traffic Management Plan.	Not anticipated.

FURTHER WORK FOR THE EIA

5.8.115. An assessment of potential impacts on population and health during the construction and operational phases of the Scheme will be undertaken in accordance with the methodology set out in DMRB Volume 11 Section 3 Part 6: Land Use (**Ref 13.8.7**), Part 8: Pedestrians, Equestrians, Cyclists and Community Effects (**Ref 13.8.8**), and Part 9: Vehicle Travellers (**Ref 13.8.9**) and associated Interim Advice Notes. DMRB Interim Advice Note 125/15105 (2015) sets out the requirement to combine DMRB Volume 11: Section 3: Parts 6, 8 and 9 into one chapter titled 'People and Communities' (**Ref 13.8.10**) which will also be adhered to, as well as IAN 195/16 'Cycle Traffic and the Strategic Road Network' (**Ref 13.8.11**).

5.8.116. In addition to the assessment detailed in the Scoping Report (**Volume 2, Appendix A, Chapter 13 Population and Health**), and in response to the Scoping Opinion (refer to **Volume 2, Appendix B, Section 4.8**), the following will be carried out for the EIA:

- An ALC Survey will be completed, including farmer interviews, to inform the assessment and to further subdivide agricultural land into distinct grades. This is not surveying which was outlined in the Scoping Report.
- As the overall design of the Scheme progresses, consideration will be given for the potential to include components which would enhance the environment for walkers, cyclists and vulnerable users, and encourage active lifestyles.
- Potential impacts on open / green space or recreational facilities will be considered within the ES.
- Potential impacts on physical assets and land use during operation will be considered within the ES.
- Potential impacts on development land will be considered within the ES.
- Potential impacts from electromagnetic fields, generated from diverting high voltage cables, will be considered within the ES.
- Monitoring to measure the success of any mitigation and enhancement measures will be considered as part of the EIA.

5.9 MATERIAL RESOURCES

INTRODUCTION

5.9.1. This section considers the implications of the Scheme on the consumption of material resources (which includes site arisings that can be diverted from landfill), and the generation, recovery and disposal of waste during construction and operation. Potentially significant adverse effects are noted.

5.9.2. The assessment methodology proposed for use is based on guidance set out in Interim Advice Note (IAN) 153/11 (Highways Agency, 2011) Environmental Assessment of Material Resources (**Ref 5.9.1**) and instruction from Highways England. IAN153/11 sets out the process and information required for the assessment of significant effects from material resources and waste.

5.9.3. Materials resources are defined in IAN 153/11 as:

'the materials and construction products required for the construction, improvement and maintenance of the road network. Materials resources include primary raw materials such as aggregates and minerals, and manufactured construction products. Many material resources will originate off site, purchased as construction products, and some will arise on site such as excavated soils or recycled road planings'.

5.9.4. IAN 153/11 does not include a definition of waste, however the EU Waste Framework Directive (**Ref 5.9.2**) defines it as:

'any substance or object that the holder discards or intends or is required to discard'.

5.9.5. It is important to note that the definition of 'discard' set out in the Waste Framework Directive is different to its dictionary definition: The Directive definition includes any substance or object that is discarded for disposal or that has not been subject to acceptable recovery (including recycling).

5.9.6. The scope of the assessment of Material Resources includes the:

- Consumption of material resources (from primary, recycled or secondary, and renewable sources, and including products offering sustainability benefits) including the generation and use of arisings recovered from Site.
- Production and disposal of waste to landfill.

EXISTING BASELINE KNOWLEDGE

5.9.7. The operation and maintenance of the current A1 Alnwick to Ellingham assets (excluding land within the Scheme Footprint that is not directly related to the scope of work e.g. existing active farmland) currently requires the consumption of small volumes of materials, and generates minor volume of arisings that may need to be disposed of as waste.

5.9.8. The consumption of materials would be required for the construction of the works, and for the infrastructure required for the Main Compound. Although the Lionheart Enterprise Park Compound forms part of an existing development as a salting and gritting depot, additional new infrastructure would be required to expand the Compound site.

5.9.9. Paragraphs **5.9.10** to **5.9.22** describe baseline material consumption and waste disposal for the current assets within the Scheme Footprint, and provide regional/national information and data in the context of which a subsequent environmental impact assessment can be undertaken.

Materials

5.9.10. The operation and maintenance of the existing A1 Alnwick to Ellingham assets require a small number of specialist components (signage and steelwork for replacement barriers, for example) as well as some bulk material (asphalt for minor re-surfacing) for routine works and repairs of the highway and ancillary infrastructure.

5.9.11. The current consumption of construction and other material resources within the Scheme Footprint is, however, deemed negligible.

5.9.12. **Table 5-47** (**Refs 5.9.3, 5.9.4, 5.9.5**) provides a summary of the availability of the main construction materials in North East England and the UK, as required to deliver typical highways schemes.

Table 5-47 - Construction materials availability in the North East of England and the UK

Material type	Availability (2017 unless otherwise stated)	
	NORTH EAST	UK
Sand and gravel +	1.9 Mt	61.7 Mt
Permitted crushed rock *	5.1 Mt	144.5 Mt
Concrete blocks #	2.6 Mt (North)	6.8 Mm2
Primary aggregate *	6.3 Mt (2016)	203 Mt
Recycled and secondary aggregate *	1.3 Mt (2016)	74 Mt
Ready-mix concrete +	0.7 Mm3	25.9 Mm3
Steel +	(no data)	8 Mt (2016)
Asphalt *	0.8 Mt	27.3 Mt
# stocks + production * sales	Mt – Million tones Mm^3 – Million cubic metres Mm^2 – Million square metres	

5.9.13. The availability of construction materials typically required for highways construction schemes in the North East of England and across the UK, indicates that stocks / production / sales remain buoyant. The sensitivity of materials for the Scheme is therefore assessed to be **low**.

5.9.14. The Northumberland Local Plan: Draft Plan for Regulation 18 Consultation (July 2018) identifies over 30 mineral safeguarding areas in the wider area. None of these safeguarded areas are within or immediately adjacent to the primary study area. Furthermore, there are no known major peat resources or active peat extractions within the primary study area. It should be noted, however, that a localised area of peat is present beneath the existing carriageway to the east of South Charlton Bog. Within the ES chapter for materials, a full assessment of the impacts and effects of the Scheme on this peat resource would be made.

Waste

5.9.15. The operation and maintenance of the existing A1 Alnwick to Ellingham assets currently generates small volumes of waste from routine maintenance, in combination with littering, signage replacement, replacement of reflective road studs (cats' eyes), vegetation from verge clearance and

minor barrier refurbishments. The anticipated effects of disposing of this waste are, however, deemed negligible in the context of available regional landfill capacity.

5.9.16. At the end of 2017, landfill sites in the north east of England presented in **Table 5-48** were recorded as having remaining capacity (**Ref 5.9.6**).

Table 5-48 - Landfill sites in the North East of England

Facility name	Former planning sub region	Landfill site type	Remaining capacity end of 2017 (m^3)
Port Clarence landfill Site (Haz)	Stockton on Tees	Hazardous Merchant Landfill	5,030,630
Bishop Middleham Quarry 2	County Durham	Inert Landfill	4,904,806
ICI No 3 Teesport	Redcar and Cleveland	Hazardous Merchant Landfill	2,028,272
Aycliffe Quarry Landfill	Sedgefield	Non Hazardous Landfill with Stable Non-Reactive Hazardous Waste (SNRHW) cell	1,991,141
Crime Rigg Quarry	County Durham	Inert Landfill	1,836,750
Blaydon Quarry Landfill Site	Gateshead	Non Hazardous	1,788,700
Old Quarrington Quarry Landfill	County Durham	Inert Landfill	1,781,206
Joint Stocks Landfill Phase 2	Durham City	Non Hazardous	1,700,000
Cowpen Bewley Landfill	Stockton on Tees	Non Hazardous	1,374,099
Marsden Quarry Landfill	South Tyneside	Inert Landfill	1,103,841
Ellington Road Landfill Site	Wansbeck	Non Hazardous Landfill With SNRHW cell	1,023,357
Seaton Meadows	Hartlepool	Non Hazardous Landfill With SNRHW cell	1,000,000
ICI No 2 Teesport	Redcar and Cleveland	Non Hazardous	818,089
Port Clarence Non-Hazardous Landfill Site	Stockton on Tees	Non Hazardous	632,950
Hollings Hill Quarry Landfill	County Durham	Inert Landfill	592,268

Facility name	Former planning sub region	Landfill site type	Remaining capacity end of 2017 (m^3)
Houghton-Le-Spring Landfill Site	Sunderland	Non Hazardous	341,431
Field House Quarry	Sunderland	Inert Landfill	308,662
Merryshields Quarry	Northumberland	Inert Landfill	209,023
Coatham Stob Quarry (Area 6)	Stockton on Tees	Non Hazardous	164,115
CLE 3/8 Landfill Site	Redcar and Cleveland	Non Hazardous	83,961
Springwell Quarry	Sunderland	Non Hazardous	18,000
Alcan Ash Lagoons 1-4	Wansbeck	Non Hazardous	15,500
Total Capacity			**28,746,801**

5.9.17. Environment Agency data (**Ref 5.9.6**) confirm that at the end of 2017, 22 permitted landfill sites available in the North East were recorded as having 28.7 Mm^3 of remaining capacity. This is split into capacities by waste type in **Table 5-49**. Any change in capacity from 2016 to 2017 is shown.

Table 5-49 - Remaining landfill capacity in North East England

Landfill type	Capacity in 2016 (m^3)	Remaining capacity m^3 (2017)	2016 to 2017 capacity comparison (m^3)
Hazardous (merchant and restricted)	6,985,466	7,058,902	0.7 Mm^3 increase
Inert	10,236,951	10,736,556	0.5 Mm^3 decrease
Non-hazardous (including stable hazardous waste cells)	15,044,553	10,951,343	4.1 Mm^3 decrease
Total	**32,266,970**	**28,746,801**	**3.5 Mm^3 decrease**

5.9.18. Using the most up to date information available, the baseline regional landfill capacity is detailed in **Figure 5-5** below. Simple statistical forecasting (Microsoft Excel forecasting function) has been used to demonstrate long-term void capacity to the year of planned Scheme completion (2023) in the absence of future provision.

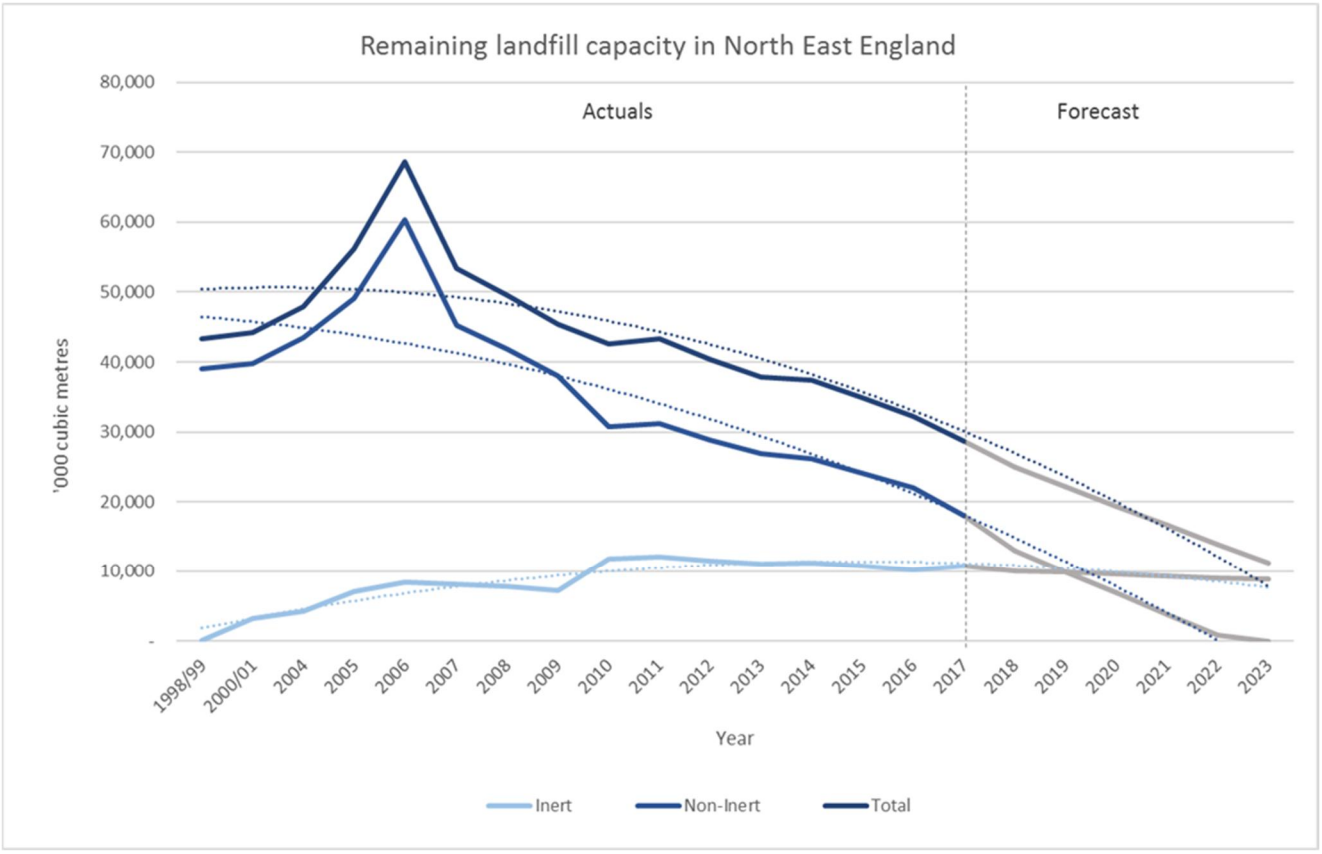

Figure 5-5 - North East England Remaining Landfill Capacity (2000/1-2022/3)

5.9.19. Baseline data indicates that total and non-inert landfill capacity is likely to become an increasingly sensitive receptor over the construction of the Scheme to the first full year of operation (2023). Remaining capacity for non-inert wastes (hazardous and non-hazardous wastes) are forecast to expire in 2023 in the absence of future provision. Simple forecasting indicates that, by comparison with 2017 data and in the absence of future provision, inert capacity is forecast to reduce by as much as 18%, non-inert capacity by 100%, and total capacity by 61%.

5.9.20. Individually, the sensitivities of different landfill capacity types over the construction of the Scheme are assessed to be **slight** for inert, **very large** for non-inert and **large** for total. Therefore, based on the size and nature of the Scheme and using professional judgement, the overall sensitivity of landfill capacity on average is assessed to be **large**.

5.9.21. Current routine operation and maintenance works on the Scheme assets generate negligible volumes of site arisings.

National and Regional Perspective: Transfer, Recovery and Recycling

5.9.22. Defra data (**Ref 5.9.7**), as presented in **Table 5-50** shows that within England, the recovery rate for non-hazardous construction and demolition arisings have remained above 90% since 2010. This exceeds the EU target of 70%, which the UK must meet by 2020.

Table 5-50 - Non-hazardous construction and demolition arisings recovery in England

Year	Generation (mt)	Recovery (mt)	Recovery rate (%)
2010	43.9	39.7	90.5%
2011	44.1	39.9	90.6%
2012	45.3	41.3	91.1%
2013	46.3	42.1	91.1%
2014	49.1	44.9	91.4%

5.9.23. No regional data for construction, demolition and excavation production or recovery rates are currently available for the North East of England. Instead, data in **Figure 5-6** has been collated to show that rates of material transfer (non-civic), recovery and metal recycling within the north east of England have risen steadily over the past 17 years. Data provided reflect the recovery of all potential waste types in the region and hence will include, but are not specific to CDE arisings.

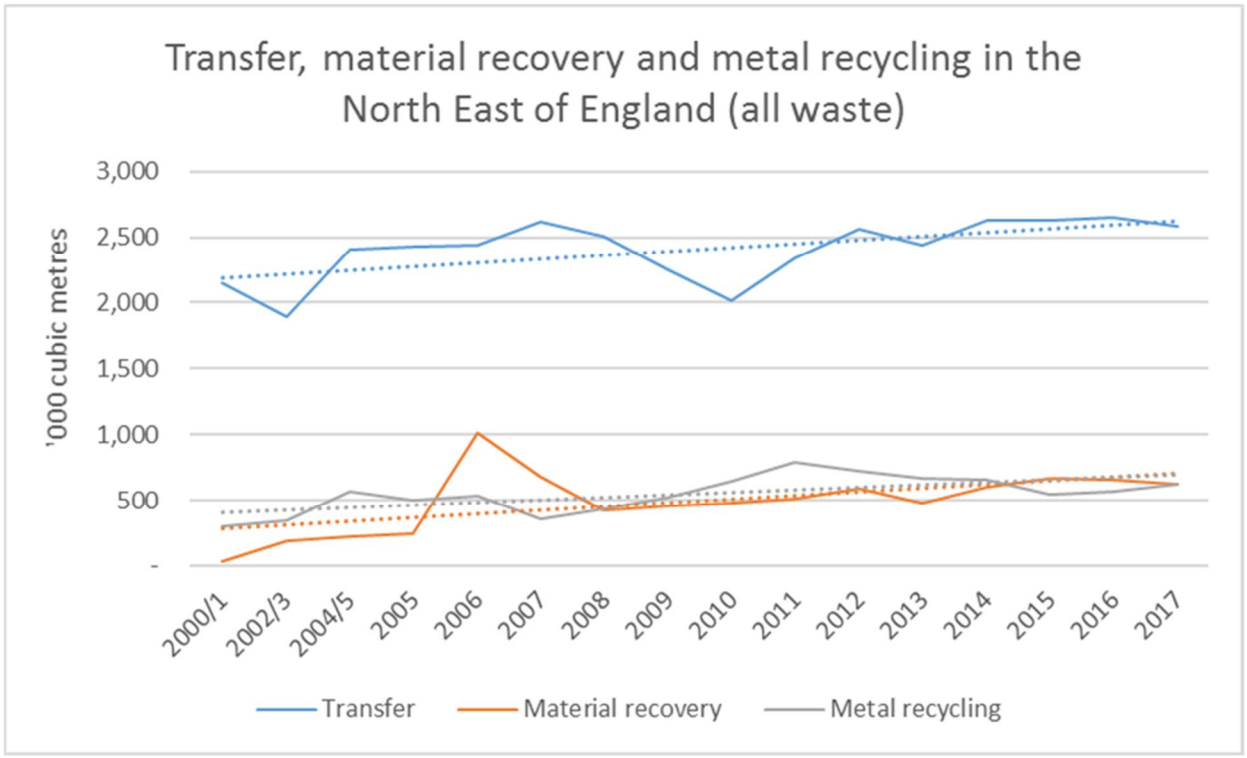

Figure 5-6 - Transfer, material recovery and metal recycling in the North East of England

5.9.24. Available data demonstrate that transfer, recovery and metal recycling shows a general, consistent and upward trend within the North East. Data also show that there is likely to be regional infrastructure and capacity for the transfer and recovery for CDE arisings from the Scheme.

Construction and demolition recovery trends across England demonstrate further capacity in this context.

5.9.25. During demolition, enabling and earthworks, and construction, it is expected that a proportion of any waste generated would be suitable for recovery (processing, reuse or recycling) at a suitably licensed off-site facility. Excavated and other materials that comply with an appropriate waste exemption, or reuse criteria set out in the CL:AIRE Definition of Waste Code of Practice (**Ref 5.9.8**) are expected to be reused on the Scheme.

5.9.26. The availability of materials recovery infrastructure in the North East, and across England, suggests that there is strong potential to divert from landfill site arisings generated by the Scheme. Both the importance (beneficial value) of materials transfer and recovery infrastructure and the potential to maximise the re-use / recycling value of site arisings, are assessed to be beneficial and high.

POTENTIAL IMPACTS

Construction

5.9.27. The Scheme has the potential to generate adverse impacts from material resources during the construction phase as follows:

- During construction of the carriageway and supporting infrastructure, permanent adverse impacts from consuming primary and other materials are expected. These impacts would be the result of consuming resources such as aggregates, concrete, bitumen, steel and timber.
- During construction, permanent impacts from wastes that would be expected to be generated from sources including, but not limited to, excavated arisings that cannot be reused or recycled (particularly during the breaking out of highway surfaces and concrete barriers), surplus cabling and timber formwork.

5.9.28. The associated potential environmental impacts (both direct and indirect) would occur principally during construction, but also (though to a lesser degree) in the first year of operation.

Operation

5.9.29. 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 excavated and other arisings), and produce and discard waste, may be required.

5.9.30. Nevertheless, professional judgement indicates that for this Scheme there are unlikely to be significant effects beyond the first year of operation, therefore this element has been scoped out.

Accommodation bridge options

5.9.31. The construction of the proposed bridge at either Broxfield or Heckley Fence is not considered to differ greatly in respect of material consumption, during both the construction and operational phases. Effects from material consumption would include the depletion of natural resources and local/regional stocks, and degradation of the natural environment.

5.9.32. Both options are anticipated to have a similar impact on waste generation during the construction and operational phases. As the resulting volume of earthworks would differ only slightly for each option, it is expected that the two bridge options would have little difference in terms of overall impact and effect.

5.9.33. Without any specific data at this stage, it is not currently possible to quantifiably compare the two bridge options in terms of materials and waste.

DESIGN, MITIGATION AND ENHANCEMENT MEASURES

5.9.34. Specific measures to avoid and mitigate adverse impacts from materials consumption and the generation and disposal of waste, may include those set out in **Table 5-51**.

Table 5-51 - Potential design, enhancement and mitigation measures

Project activity	Enhancement and mitigation measures	Applicable lifecycle stages	Monitoring
Material resources	Identification and specification of material resources that can be acquired responsibly, in accordance with BES 6001 Responsible Sourcing of Construction Products (**Ref. 5.9.9**).	Design, construction	Incorporate on engineering plans configurations and layouts that show how the most effective use of material resources can be achieved. Maintain records of material resources that were acquired in accordance with BES 6001 Responsible Sourcing of Construction Products.
	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	
Site arisings	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	Incorporate on engineering plans configurations and layouts that show how the most effective use of site arisings can be achieved. Implement a regime of comparing and contrasting data on site arisings in a Design Site Waste Management Plan
	Identify opportunities to minimise the export and import of material resources.	Design, construction	
	Working to a proximity principle, ensuring arisings generated are handled, stored, managed and re-used or recycled as close as possible to the point of origin.	Design, construction	

Project activity	Enhancement and mitigation measures	Applicable lifecycle stages	Monitoring
	Forecast and identify the volume and type of woodland and other vegetative arisings that would be generated, and establish opportunities for high-value re-use and recycling, both on and off-site.	Design, construction	(SWMP) (forecast), with construction data (actuals).
	Identify areas for stockpiling and storing arisings that would minimise quality degradation and leachate, and would minimise damage and loss.	Design, construction	
	Ensure potential arisings and waste are properly characterised before or during design, to maximise the potential for highest value reuse.	Design	
	As part of a CEMP, capture information and data on site arisings recovered and diverted from landfill, by developing a Design Site Waste Management Plan once a preferred option has been selected.	Design	
	As part of a CEMP, implement a Materials Management Plan (MMP) in accordance with the CL:AIRE Definition of Waste: Code of Practice (**Ref 5.9.8**).	Construction	
Waste to landfill	Engage early with contractors to identify possible enhancement and mitigation measures, and to identify opportunities to reduce waste through collaboration and regional synergies.	Design, Procurement	Implement a regime of comparing and contrasting data on waste in a Design SWMP (forecast), with construction data (actuals)
	Capture information and data on waste sent to landfill, by developing a Design SWMP once a preferred option has been selected.	Design	

LIKELY SIGNIFICANT EFFECTS

5.9.35. The comparison of preliminary likely significant effects between the two bridge options are set out in **Table 5-52** below, based upon currently available information and professional judgement. Following implementation of appropriate mitigation measures (**Table 5-46**), no significant residual effects on materials and waste are anticipated during construction and operation of the Scheme. However, these effects could change as the EIA progresses. Mitigation measures are outlined in the above section.

Table 5-52 - Preliminary Likely Significant Effects of the two accommodation bridge options

Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
Construction materials and their availability in North East England and the UK	Construction	Depletion of irreplaceable natural resources (effect) through the consumption of construction materials (impact) such as aggregates, concrete, bitumen, steel and timber. A reduction in adverse effects would be realised where primary material consumption can be reduced, and/or the sustainability performance of materials increased.	Not anticipated	Not anticipated
	Operation	In the first year of operation, minor amendments and changes to the bridge may be required, which could have the potential to consume material resources. However, related effects are anticipated to be negligible.	Not anticipated	Not anticipated
Landfill capacity in North East England	Construction (including site preparation, demolition and excavation)	Reduction in landfill capacity due to the generation and disposal to landfill of inert and non-inert (non-hazardous and hazardous) waste (effect). A reduction in adverse effects would be realised where site arisings can be successfully recovered, diverted from landfill, and re-used or recycled.	Not anticipated	Not anticipated
	Operation	In the first year of operation, minor amendments and changes to the bridge may be required, which could have the potential to produce and discard waste. However, such effects are anticipated to be negligible.	Not anticipated	Not anticipated

5.9.36. A summary of the preliminary likely significant effects of the Scheme is presented in **Table 5-53**. The summary is based upon currently available information in combination with professional judgement. Accordingly, these effects have the potential to change as the EIA progresses.

5.9.37. The way in which materials are sourced and managed, and the proportion of those materials that have properties that can reduce associated impacts (e.g. recycled or secondary content, or other sustainable feature, for example), will strongly influence the potential for significant adverse environmental effects. The percentage of excavated and other arisings that can be reused or recycled on or off-site will also help shape the assessment of materials; data acquired as the design develops will be used to this end.

5.9.38. The way in which wastes from site are treated and managed, and the proportion of wastes that can be recovered and successfully diverted from landfill, will be instrumental in assessing significant adverse environmental effects. Data to confirm the percentage of waste that can be recovered in accordance with legal and best practice criteria for reuse, will be key in this process.

Table 5-53 - Summary of Preliminary Likely Significant Effects – material resources

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Construction materials and their availability in North East England and the UK	Construction	Depletion of irreplaceable natural resources through the consumption of construction materials (impact) such as aggregates, concrete, bitumen, steel and timber. A reduction in adverse effects would be realised where primary material consumption can be reduced and/or the sustainability performance of materials increased.	Incorporate the principles of material resource efficiency into design. Practicably minimise the export and import of materials. Re-use arisings from demolition and excavation in the construction of the new roads and associated infrastructure. Handle, store, manage and re-use or recycle site arisings as close as possible to their point of origin. Develop and implement a CEMP, incorporating a SWMP and MMP to identify, monitor and manage material resources and waste arisings on site.	Not anticipated.
	Operation	In the first year of operation, minor amendments and changes to the Scheme assets may be required, which could have the potential to consume material resources. However, related effects are anticipated to be negligible.	None required.	Not anticipated.
Landfill capacity in North East England	Construction (including site preparation, demolition and excavation)	Reduction in landfill capacity due to the generation and disposal to landfill of inert and non-inert (non-hazardous and hazardous) waste (effect). A reduction in adverse effects would be realised where site arisings can be	Incorporate the principles of designing out waste into the design. Engage early with contractors to identify possible enhancement and mitigation measures, and to identify	Not anticipated.

Receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
		successfully recovered, diverted from landfill, and re-used or recycled.	opportunities to reduce waste through collaboration and regional synergies. Develop and implement a CEMP, incorporating a SWMP and MMP to identify, monitor and manage material resources and waste arisings on site.	
	Operation	In the first year of operation, minor amendments and changes to the Scheme assets may be required, which could have the potential to produce and discard waste. However, such effects are anticipated to be negligible.	None required.	Not anticipated.
*The mitigation measures indicated are preliminary, based upon available information. These are subject to further design and assessment work during the EIA.				

FURTHER WORK FOR THE EIA

5.9.39. In accordance with the methodology set out in IAN 153/11 (**Ref 5.9.1**) and instruction from Highways England, a detailed assessment of the potential impacts on materials resources and waste during the construction phase and the first year of operation of the Scheme would be undertaken. As the EIA process evolves, further work is required to ensure an accurate and robust environmental assessment of the associated impacts and effects.

5.9.40. In addition to the assessment detailed in the Scoping Report (**Volume 2, Appendix A, Chapter 14 Material Resources**), and in response to the Scoping Opinion (**Volume 2, Appendix B, Section 4.9**), the following will be carried out for the EIA:

- Consider the generation of road planings / waste which contains tar during the construction phase.
- Waste generated from the demolition of East Cottage and Charlton Mires Farm will be assessed.
- The impacts and effects on the identified peat resource.
- Ascertain with a greater level of confidence how materials and wastes of different types would be managed on site, in accordance with the Waste Hierarchy and Proximity Principle.
- Calculate and improve the granularity of data concerning the type and volume of materials to be consumed, and waste to be generated, recovered and disposed of by the Scheme.
- Consult with NCC, to determine whether there are recovered materials from treatment / processing facilities, or donor sites (including from the A1 in Northumberland: Morpeth to Felton scheme), that could be used to reduce further adverse impacts and effects on the Scheme.

5.10 CLIMATE

INTRODUCTION

5.10.1. This section considers the implications of the Scheme on climate during construction and operation and details any potentially significant effects. The section considers both:

- **Greenhouse gas (GHG) emissions**: the identification, management and reduction of GHG emissions throughout a scheme lifecycle. Carbon is assessed and reported to identify potential sources of emissions, enable an early and informed understanding of a scheme's impacts, and ensure that the complexity and detail of assessment is proportionate to the size and nature of a scheme.
- **Vulnerability of the project to climate change**: identification of projected changes in climate variables, assessment of the vulnerability of the Scheme to these changes and identification of measures to increase resilience.

5.10.2. The approach and methodology takes direct reference from industry best practice documents, including:

- PAS2080:2016 Carbon Management in Infrastructure (PAS2080) (**Ref 5.10.1**);
- IEMA EIA Guide to Assessing GHG Emissions and Evaluating their Significance (**Ref 5.10.2**); and
- IEMA EIA Guide to Climate Change Resilience and Adaptation (**Ref 5.10.3**).

5.10.3. For the purposes of this section, carbon is taken to be equivalent to the common GHGs, as defined in the Kyoto Protocol (**Ref 5.10.4**). All carbon is expressed in tonnes of carbon dioxide equivalent (tCO_2e). The GHG assessment is not restricted by geographical area but instead includes any increase or decrease in emissions as a result of the Scheme, throughout its design life. This includes:

- **Construction** - for construction carbon the study area principally takes account of emissions associated with Scheme activities and their associated transport; and
- **Operational** - the study area for the traffic element of the operational GHG emissions assessment will be based on the ARN. The study area for operational replacement will take account of resurfacing activities as outlined for construction.

5.10.4. The assessment of vulnerability of the proposed Scheme to the impacts of climate change will be informed by regional scale information on historic and projected change in climate variables. The UK Climate Projections 2009 (UKCP09) provide data on projected change in climate variables for each of the administrative regions of the UK. The proposed Scheme falls within the North-East England region so this boundary will form the study area for the vulnerability assessment.

EXISTING BASELINE KNOWLEDGE

Greenhouse gas emissions

5.10.5. In the baseline scenario, GHG emissions occur constantly and widely due to human and natural activity including energy consumption (fuel and power), industrial processes, land use and land use change. The baseline conditions focus on those emissions sources subject to change between the baseline scenario and the Scheme. Emissions from 2016 within Northumberland and nationally are presented in **Table 5-54** for context (**Ref 5.10.5**). Emissions from road transport (A roads)

contributed 73% of transport emissions in the period, the largest single source of emissions in the data.

5.10.6. The construction of the Scheme, by nature is additional. As such the baseline scenario involves no construction activities. Baseline GHG emissions from traffic flows on the network without the scheme are modelled as part of the air quality assessments (see **Section 5.1 – Air Quality** of this PEIR). Work has started on calculating GHG emissions associated with traffic and full outputs will be available within the ES.

5.10.7. 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. These materials would have embodied emissions associated with them, and the installation of these materials would 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.

Table 5-54 - Greenhouse gas emissions 2016 (Ref 5.10.5)

Source	Northumberland (ktCO2)	National (ktCO2)
A. Industry and Commercial Electricity	250.0	51,531.70
B. Industry and Commercial Gas	192.3	35,973.10
C. Large Industrial Installations	6.1	32,465.90
D. Industrial and Commercial Other Fuels	88.4	17,657.90
E. Agriculture	115.1	5,381.60
Industry and Commercial Total	651.9	143,010.30
F. Domestic Electricity	161.3	31,441.60
G. Domestic Gas	321.9	60,202.50
H. Domestic 'Other Fuels'	106.4	10,788.00
Domestic Total	589.6	102,432.00
I. Road Transport (A roads)	448.8	54,350.70
J. Road Transport (Motorways)	-	28,031.80
K. Road Transport (Minor roads)	134.7	41,483.30
L. Diesel Railways	32.1	2,150.70
M. Transport Other	2.5	2,036.20
Transport Total	618.0	128,052.70
N. LULUCF Net Emissions	-1294.0	-16,025.60

Source	Northumberland (ktCO2)	National (ktCO2)
Grand Total	565.6	357,469.50
Population ('000s, mid-year estimate)	317.4	65,648.10
Per Capita Emissions (t)	1.8	5.4

Vulnerability of the project to climate change

Current climate

5.10.8. The climate in the north-east is temperate with significant rainfall even in the driest month (typically February in Tynemouth).

5.10.9. Information on long-term average observed climate variables over the period 1980 – 2010 is presented in **Figure 5-7** below. This information is taken from the UKCP09 report, The Climate of the United Kingdom and Observed Trends (**Ref 5.10.6**) and Met Office regional climate profile for North East England (**Ref 5.10.7**).

Temperature

5.10.10. **Figure 5-7** shows the long-term average mean monthly temperature for the North East of England region between 1980 and 2010. The mean annual temperature over the region varies from around 8.5 °C to just over 10°C **(Ref 5.10.7).**

5.10.11. January is usually the coldest month in the region. The lowest known temperature recorded in the region was minus 21.1°C on 5 January 1941 at Houghall near Durham. July and August are the warmest months. Extreme maximum temperatures can occur in July or August, but are less common in North East England than areas further south. However, during the heat wave of 3 - 4 August 1990 temperatures of 33°C occurred widely (**Ref 5.10.7**).

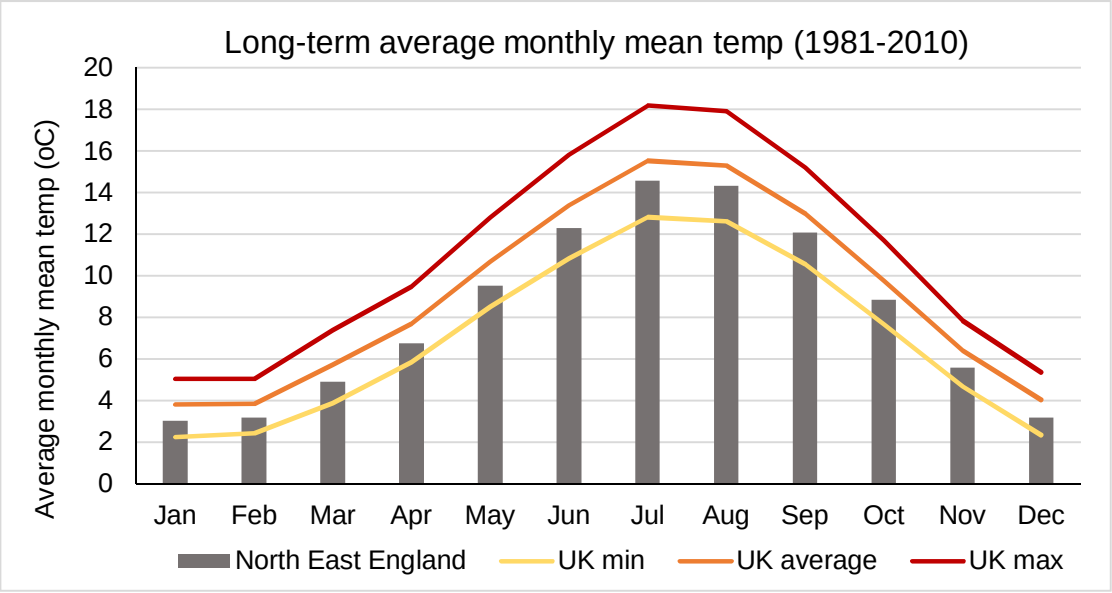

Figure 5-7 - Long-term average mean monthly temperature (Ref 5.10.7)

Precipitation

5.10.12. **Figure 5-8** shows the change in long-term average monthly rainfall for the North East of England region between 1981 and 2010 (compared to a 1961 – 1990 baseline). Over much of the region, the number of rain days (rainfall greater than 1 mm) tends to follow a pattern similar to the monthly rainfall totals. In the lower parts of the region, closer to the coast, there are about 30 rain days in winter and about 25 days in summer **(Ref 5.10.7**).

5.10.13. Periods of prolonged rainfall in the region are often associated with east or north-east winds on the northern flank of depressions passing to the south of the area.

5.10.14. Thunderstorms in the region 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 5 to 8 days with thunder each year. The heaviest falls of rain in the UK are often associated with these summer thunderstorms; examples from the North-East region including a storm on the 28 June 2012 which caused considerable flooding in the Newcastle area (**Ref 5.10.7**).

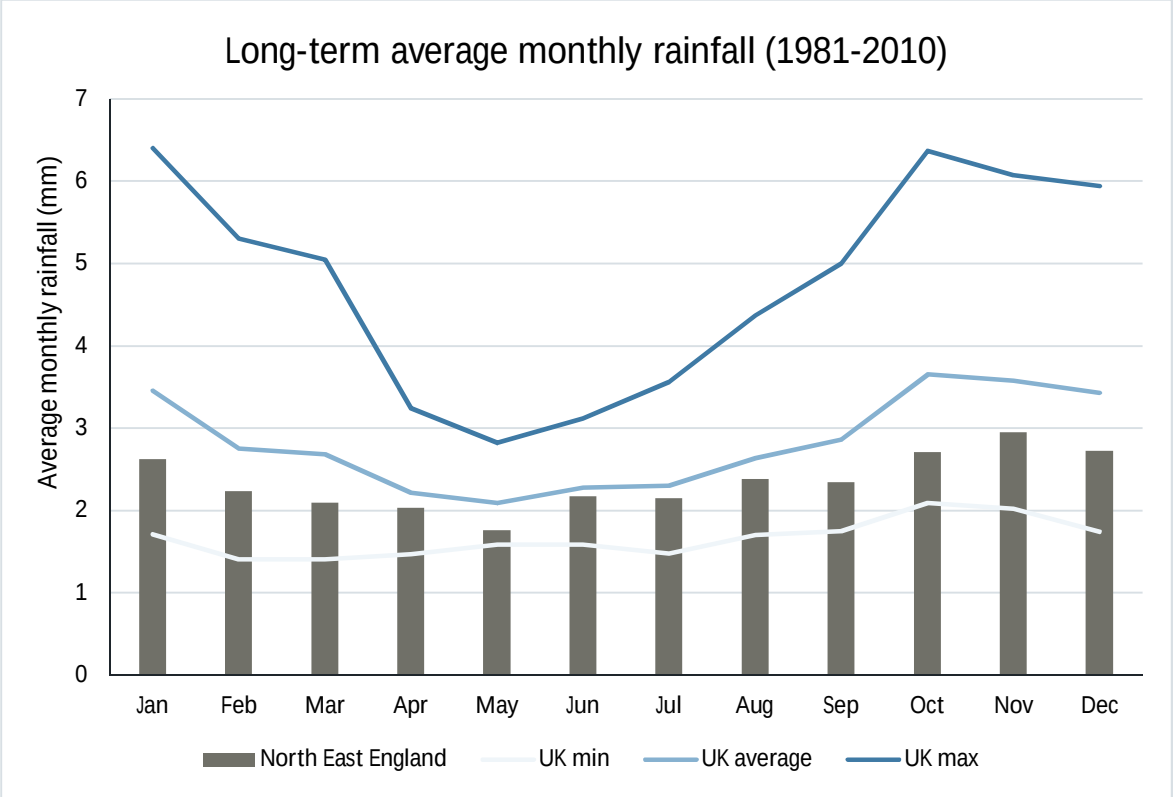

Figure 5-8 - Change in long-term average mean monthly rainfall (Ref 5.10.7)

5.10.15. The occurrence of snow rarely occurs 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. Over most of the area, snowfall is normally confined to the months from November to April, but upland areas may have falls in October and May. Snow rarely lies on low ground outside the period from November to March but over higher ground lying snow can also occur in October and as late as May. The depth of undrifted snow does not often exceed 15 cm at low altitudes but on occasions depths of 30 to 60 cm may occur

over a wide area. When depths exceed 15 cm in association with strong winds, serious drifting may occur, especially in hilly areas, leading to widespread travel disruption.

5.10.16. Notable examples affecting North East England include:

- Heavy snowfalls of 11-13 February 1978 (53 cm at Morpeth on the 13 February);
- 17-18 March 1979; and
- 25 November - 2 December 2010 (**Ref 5.10.7**).

Wind

5.10.17. Figure 5-9 shows the long-term average monthly mean wind speed in the North East of England region between 1981 and 2010.

5.10.18. The strongest winds are associated with the passage of depressions close to or across the UK. The frequency and depth of these areas of low pressure is greatest between December and February, and this is when mean speeds and gusts (short duration peak values) are strongest. Upland areas and coastal areas, particularly those exposed to the north, will experience stronger winds.

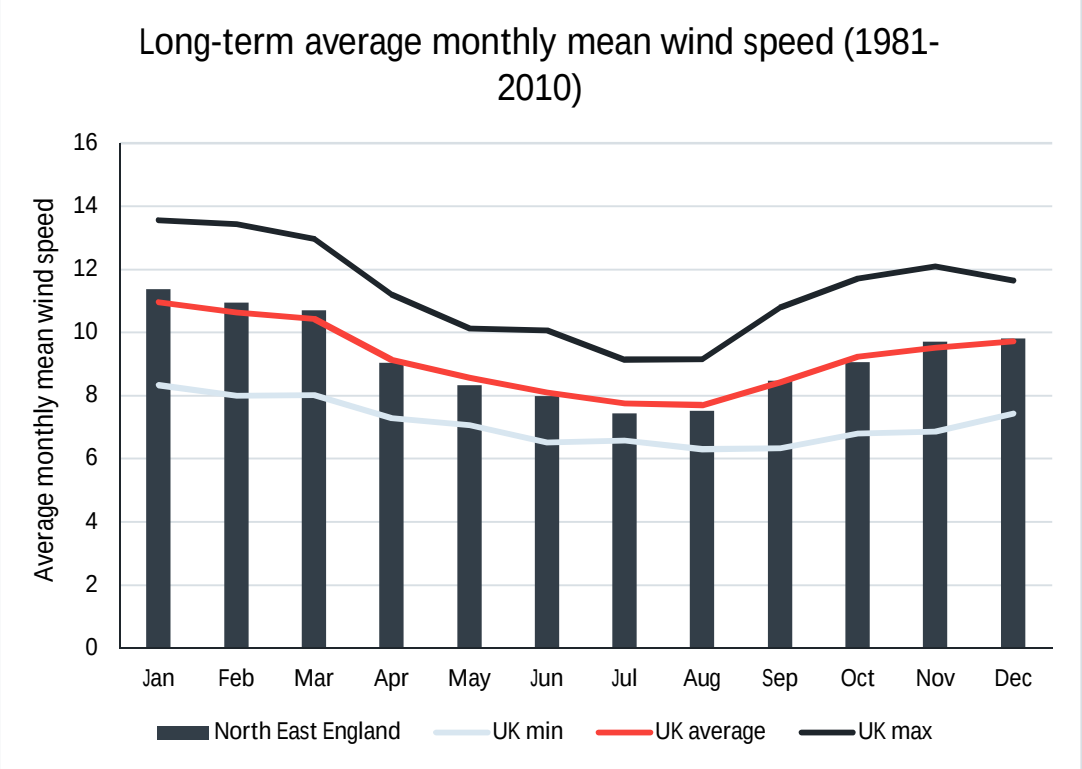

Figure 5-9 - Long-term average monthly mean wind speed (Ref 5.10.6)

Relative humidity

5.10.19. Relative Humidity is the most common measure of humidity. It measures how close the air is to being saturated. Over the period 1961 – 2006, annual average humidity in the North East region has varied between 80 and 83% (**Ref 5.10.6**). **Table 5-55** shows the change in relative humidity (%) from 1961 to 2006 by season for the North East of England (**Ref 5.10.6**).

Table 5-55 - Change in relative humidity (%) from 1961 – 2006 by season

Spring	Summer	Autumn	Winter	Annual
-2.8	-2.8	-2.3	-2.6	-2.7

5.10.20. 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 (**Ref 5.10.6**). There have been several noteworthy gales affecting North East England, accompanied by property damage and disruption to travel and power supplies, including:

- 2 January 1976 - a depression moving eastwards across Scotland to the North Sea brought storm force winds with an hourly mean speed of 70 knots at South Gare (Cleveland).
- 28-29 January 2002 - rail and road transport disruption (with lorries overturning), power cuts (20,000 homes affected in the Tyne valley) and building damage (**Ref 5.10.6**).

Future climate

5.10.21. Information on future climate is taken from the UK Climate Projections 2009 (UKCP09) which is the most up-to-date projections of climate change for the UK currently available. Future climate depends partly on how much carbon dioxide and other greenhouse gases we emit to the atmosphere and UKCP09 provides a range of projections based on different emissions scenarios up to the end of the 21st Century.

Precipitation

5.10.22. Climate change is projected to lead to wetter winters and drier summers, with more extreme rainfall events. UKCP09 suggests that by the 2050s in the North East England region, mean winter precipitation is expected to increase by 12% (50th percentile) and by the 2080s, increase by 19% (50th percentile) under the High emissions scenario. For the summer, by the 2050s, mean summer precipitation is expected to decrease by 15% (50th percentile) and by the 2080s, decrease by 23% (50th percentile), under the High emissions scenario. **Table 5-56** summarises changes in mean winter and summer precipitation in the North East England region for the 2050s and 2080s under the Low, Medium and High emissions scenarios.

5.10.23. In addition to changes in seasonal average precipitation, it is likely that there will be more extreme rainfall events. By the 2050s, projections for the wettest day in winter for the North East England region suggest an increase of up to 20% under the High emissions scenario (central estimate). By the 2080s, projections for the wettest day in winter and summer suggest increase of up to 40% under the High emissions scenario (central estimate).

5.10.24. A combination of higher summer temperatures and reduced summer rainfall could see increases in the risk of drought in the UK. UKCP09 is not suitable for the analysis of low precipitation accumulated over extended time periods (multi-year droughts), however, it does contain some information on changes at the seasonal timescale.

Table 5-56 - Projected change in mean summer and winter precipitation (mm) for the 2050s and 2080s under Low, Medium and High emissions scenario

Period		Emissions scenario								
		Low			Medium			High		
		10th	50th	90th	10th	50th	90th	10th	50th	90th
Summer	2050s	-28	-12	+7	-30	-15	+1	-31	-15	+2
	2080s	-29	-13	+3	-36	-18	+1	-43	-23	0
Winter	2050s	-1	+9	+20	+1	+11	+24	+1	+12	+26
	2080s	+1	+12	+26	+2	+14	+32	+4	+19	+41

5.10.25. Figure 5-10 shows projected changes in winter (left panels) and summer (right panels) precipitation totals expected by 2070-2099 under the UKCP09 High emissions scenario. The upper panels represent changes at the 10% probability (i.e. driest) level of the probabilistic range. The lower panels represent changes at the 90% probability (i.e. wettest) level.

5.10.26. Under the UKCK09 High emissions scenario, the top panel represents changes at the 10% probability (i.e. driest) level of the probabilistic range. The bottom panels represent changes at the 90% probability (i.e. wettest) level.

5.10.27. The overall pattern is a move toward wetter winters and drier summers suggesting that short-term summer droughts may increase in frequency. The range of the projected changes varies considerably across the probability ranges from almost no change through to shifts of greater than 70% of the 30-year average value, therefore there is large uncertainty in the magnitude of change although the direction is agreed (droughts are likely to become more frequent). Other studies, including the recent UK Climate Change Risk Assessment (CCRA) Evidence Report (**Ref 5.10.8**) suggest that the North East region is expected to experience a water surplus, of between >100 to ≤ 1,000 Ml/day by the 2080s under a High emissions scenario. Therefore, risk from drought is likely to be lower than other parts of the country but may still pose a threat, particularly in the summer months.

5.10.28. With regards to future changes in snowfall, rising winter temperatures are likely to reduce the amount of precipitation that falls as snow in winter. 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.

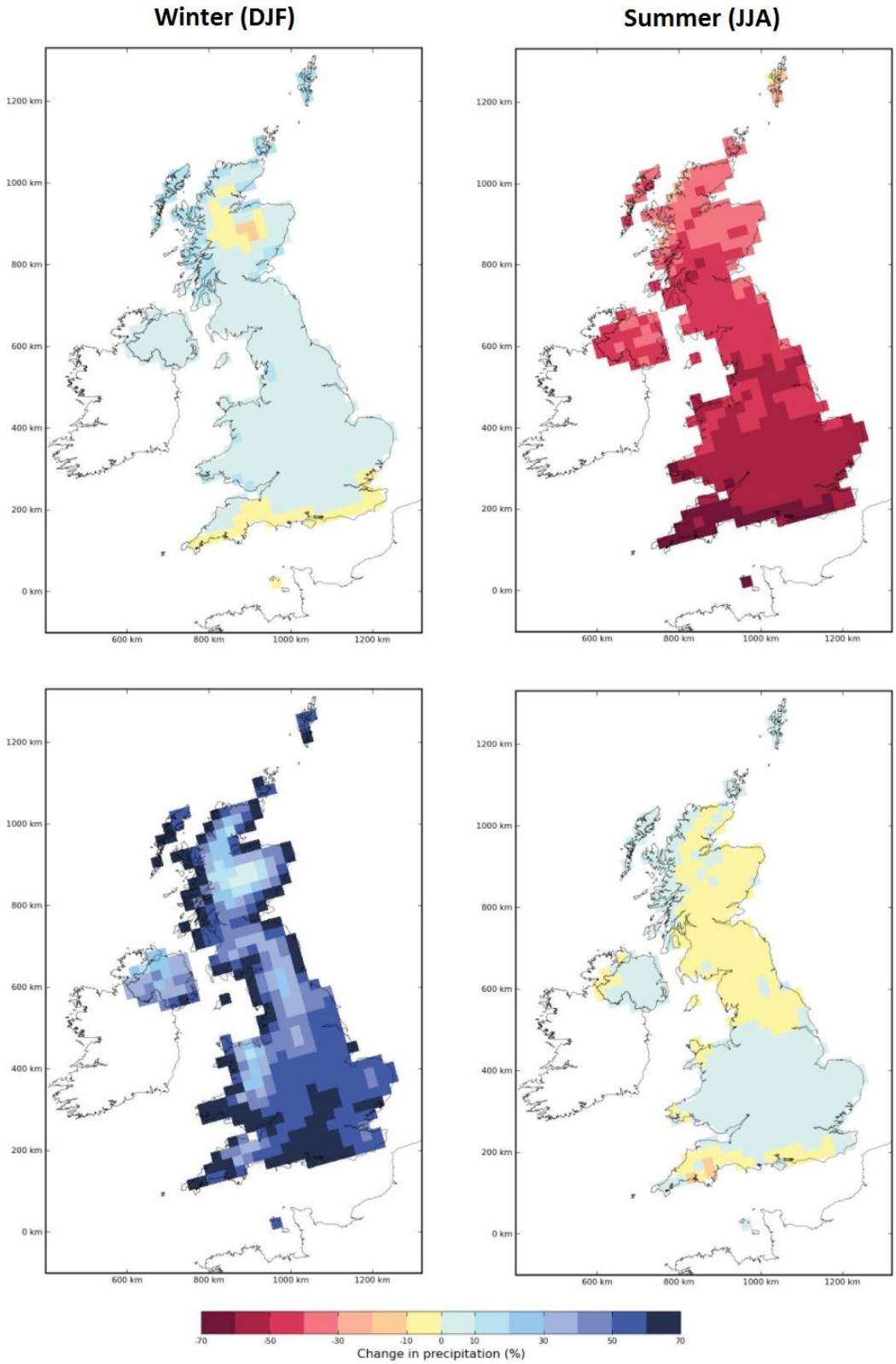

Figure 5-10 - Projected changes in winter December January and February (DJF) (left) and summer June July and August (JJA) (right) total precipitation by 2080s

Temperature

5.10.29. Climate change is projected to lead to hotter summers and warmer winters. UKCP09 suggests that by the 2050s, mean winter temperature in the North East England region is expected to increase by 2.2ºC (50th percentile) and by the 2080s, increase by 3.1ºC (50th percentile), under the High emissions scenario. For the summer, by the 2050s, mean summer temperature is expected to increase by 2.9 ºC (50th percentile) and by the 2080s, increase by 4.7ºC (50th percentile), under the High emissions scenario. **Table 5-46** summarises changes in mean winter and summer precipitation for the 2020s, 2050s and 2080s under the Low, Medium and High emission scenarios.

Table 5-46 - Projected change in mean summer and winter temperature (°C) for the 2050s and 2080s under Low, Medium and High emissions scenario

Period		Emissions scenario								
		Low			Medium			High		
		10th	50th	90th	10th	50th	90th	10th	50th	90th
Summer	2050s	1.1	2.4	3.8	1.2	2.5	4.1	1.4	2.9	4.7
	2080s	1.3	2.8	4.6	2.0	3.7	5.8	2.5	4.7	7.3
Winter	2050s	0.8	1.8	2.9	1.1	2.0	3.1	1.2	2.2	3.4
	2080s	1.3	2.4	3.6	1.4	2.6	4.1	1.9	3.1	4.9

5.10.30. In addition to changes in seasonal average temperatures, it is likely that there will be more extreme temperature events. By the 2050s, projections for the warmest day in summer for North East England region suggest temperature increases of up to 4ºC under the High emissions scenario (central estimate). By the 2080s, projections for the warmest day in summer suggest temperature increases of up to 6ºC under the High emissions scenario (central estimate).

5.10.31. With regard to heat waves, research published by the Met Office Hadley Centre suggests the European summer heat wave in 2003 could become a normal event by the 2040s. By the 2060s, such a summer would be considered cool according to some climate models (**Ref 5.10.13**). It is very likely (confidence level >90%) that human influence has at least doubled the risk of a heatwave exceeding mean summer temperatures experienced in 2003 (**Ref 5.10.6**).

Solar radiation

5.10.32. A recent (regional) study suggests that the North England region (including the UKCP09 North East England administrative region), is likely to see an increase in annual solar radiation by the 2050s of between 3.6 and 3.8 W/m^2, depending on emissions scenario (central estimate). By the 2080s, increases of between 3.9 and 4.6 W/m^2 depending on emissions scenario (central estimate) are projected (**Ref 5.10.14**). 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. **Figure 5-11** shows projected change in solar radiation in the 2050s.

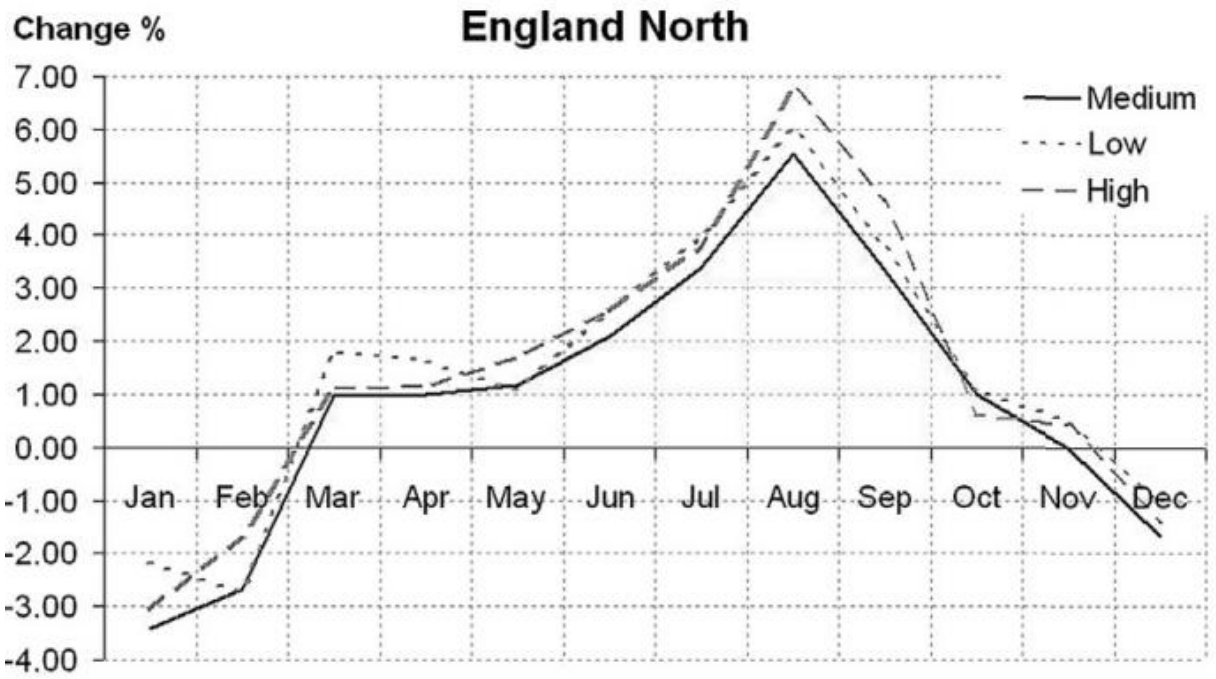

Figure 5-11 Projected regional average change (%) in solar radiation in the 2050s

Wind

5.10.33. The UKCP09 projections depict 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 to much of this uncertainty (**Ref 5.10.12**). It is therefore difficult to represent regional wind extreme winds and gusts within regional climate models (**Ref 5.10.13**).

5.10.34. Central estimates of change in mean wind speed for the 2050s are small in all ensemble runs (<0.2 m/s). A wind speed of 0.2 m/s (~0.4 knots) is small compared with the typical magnitude of summer mean wind speed of about 3.6–5.1 m/s (7–10 knots) over much of England (**Ref 5.10.13**). Seasonal changes at individual locations across the UK lie within the range of –15% to +10%. Results suggest that there could be a future reduction in the summer westerly wind flows over the southern half of the UK. There may be an increase in westerly flows in the north during summer and also an increase in southerly flows over the UK in winter.

Relative humidity

5.10.35. UKCP09 projections indicate that by the 2050s, winter mean relative humidity in North East England may decrease up to 5% under the high emissions scenario (central estimate). By the 2080s, winter mean relative humidity could increase by up to 5% (high emissions scenario, central estimate). The projection for summer mean humidity in the 2050s under the high emissions scenario is a decrease of up to 5% (central estimate). By the 2080s the decrease could be as much as 10% (high emissions scenario, central estimate).

Extreme climate change scenarios

5.10.36. A range of 'extreme' climate change scenarios (produced by Wade et al., 2015) have also been reviewed. Wade et al., (2015) considered a range of climate variables including heatwaves, cold snaps, low and high rainfall, droughts, floods and windstorms (**Ref 5.10.14**). The High ++ scenarios represent the margins or beyond the 10th to 90th percentile range of the 2080s UKCP09 High emissions scenario as presented in the UKCP09 projections and reported here. These scenarios provide a high-impact, low-likelihood event to compare against more likely outcomes.

5.10.37. The H++ scenarios suggest that average summer maximum temperatures will exceed 30°C across most of the UK, with temperatures of the hottest days are also likely to exceed 40°C. The H++ scenarios for heavy daily and sub-daily rainfall suggest that, for the same period, there is a 60% to 80% increase in rainfall for summer or winter events based on a consideration of new high-resolution modelling and physical processes. This is within the UKCP09 distribution range for the 2080s High emissions "wettest day of the winter" variable but higher than uplifts previously considered for summer.

POTENTIAL IMPACTS

Greenhouse gas emissions

Construction

5.10.38. The Scheme has the potential to result in increases in GHG emissions associated with construction activities (such as manufacturing of materials and construction processes). During construction, notable sources of emissions are anticipated to include 'embedded carbon', emissions generated during extraction and manufacturing of construction materials including (but not limited to) asphalt, aggregate, structural and reinforced steel and concrete associated with the pavement and supporting structures. See **Table 5-57** below.

Table 5-57 - Sources of GHG emissions (construction)

Lifecycle stage (as per PAS 2080)	Lifecycle Description (as per PAS 2080)	Potential sources of emissions (not exhaustive)
A1-3[10]	Product stage (manufacture and transport of raw materials to suppliers)	Embodied emissions associated with extraction and manufacturing of the required raw materials.
A4	Transport of materials to site	Emissions from fuel and electricity used in vehicles transporting materials to site
A5	Plant and equipment use during construction	Emissions from fuel and electricity used in plant and equipment on site

[10] PAS2080

Lifecycle stage (as per PAS 2080)	Lifecycle Description (as per PAS 2080)	Potential sources of emissions (not exhaustive)
A5	Transport of waste	Emissions from fuel/energy used in vehicles transporting materials to away from site
A5	Disposal of waste	Emissions from the final disposal of waste materials.
A5	Land use, land use change and forestry	Change in emissions associated with the clearance and disposal of biomass due to the Scheme

Operation

5.10.39. The Scheme may result in changes to end-user traffic emissions throughout its operational life which could increase or decrease depending on the effect on traffic flows and speeds. Any increase in emissions and the corresponding concentrations of GHGs present in the atmosphere will contribute to climate change. There may also be operational effects in terms of emissions for operation and maintenance of the Scheme infrastructure due to materials consumption (e.g. asphalt repairs). See **Table 5-58.**

Table 5-58 - Sources of GHG emissions (operation)

Lifecycle stage (as per PAS 2080[11])	Lifecycle Description (as per PAS 2080[12])	Potential sources of emissions (not exhaustive)
B2-5	Maintenance, repair, replacement, refurbishment	Embodied emissions, and emissions from transport and plant associated with maintenance, repair, replacement, and refurbishment.
B8	Land use, land use change and forestry	Change in emissions associated with the existence of the Scheme hindering or promoting the sequestration of carbo[n] dioxide into biomass.
B9/D	End-user emissions (regional traffic flows) - traffic	Vehicles using highways infrastructure affected by the Scheme

[11] BSI, 2016, PAS 2080, Carbon Management in Infrastructure
[12] BSI, 2016, PAS 2080, Carbon Management in Infrastructure

Vulnerability of the project to climate change

Construction

5.10.40. **Table 5-59** identifies the potential impacts of change in the climate variables on the Scheme during construction.

Table 5-59 - Potential climate change impacts (construction)

Climate variable		Projected change	Potential impacts on the Scheme
Precipitation	Annual average rainfall	Increase in winter rainfall	Flooding of construction works and Compounds Excessive moisture in materials Waterlogging of excavations Increased runoff and silt
		Decrease in summer rainfall	Dry conditions leading to more dust Soil erosion
	Extreme rainfall	Increase in magnitude and frequency of extreme rainfall events	Flooding of construction works and compound Waterlogging of excavations Unsafe working conditions
	Drought	Increased risk of drought	Dry conditions leading to more dust
Temperature	Annual average temperature	Increase in annual and seasonal average temperature	Unsafe working conditions in summer – delays to programme
	Extreme temperature	Increase in magnitude of extreme temperature	Unsafe working conditions – delays to programme or need to change working patterns
	Solar radiation	Increase in solar radiation	Unsafe working conditions
Wind	Gales	Increase in mean wind speed and more frequent gusts	Increase in dust / loss of materials Unsafe working conditions, particularly for working at height
	Storms	Increase in frequency of storms	Unsafe working conditions, particularly for working at height
Humidity	Annual average	Decrease in summer humidity, increase in winter humidity	Improved working conditions in summer Increase in misty conditions in winter may affect operation of plant
Soils	Soil moisture	Decrease in soil moisture in summer	Increase in dust from earthwork / soil erosion Potential beneficial effect on earthworks in summer (but may be offset by increased winter rainfall)
	Soil stability	Decrease in soil stability	Collapse of spoil heaps

Operation

5.10.41. **Table 5-60** identifies the potential impacts of change in the climate variables on the Scheme during operation.

Table 5-60 - Potential climate change impacts (operation)

Climate variable		Projected change	Potential impacts on the Scheme
Precipitation	Annual average rainfall	Increase in winter rainfall	Flooding of associated infrastructure and control equipment Mobilisation of pollutants in soil - damage to materials and health risks H&S risks to users/staff – slips, trips, falls
		Decrease in summer rainfall	Drying out and cracking of soils Dry conditions leading to more dust
	Extreme rainfall	Increase in magnitude and frequency of extreme rainfall events	Surface water flooding Damage to materials Mobilisation of pollutants in soil - damage to materials and health risks H&S risks to users – slips, trips, falls
	Drought	Increased risk of drought	Dry conditions leading to more dust
Temperature	Annual average temperature	Increase in annual and seasonal average temperature	Increased thermal expansion of bridge joints Damage to materials
	Extreme temperature	Increase in magnitude of extreme temperature	Increased thermal expansion of bridge joints Damage to materials Unsafe working conditions for staff Overheating of electronic and control equipment
	Solar radiation	Increase in solar radiation	Faster rate of deterioration of materials e.g. fading, brittleness
Wind	Gales	Increase in mean wind speed and more frequent gusts	Increased wind loading Wind driven rain infiltration into materials causing more rapid deterioration
	Storms	Increase in frequency of storms	Increased risk of lightning strike – affects control equipment
Humidity	Annual average	Decrease in summer humidity, increase in winter humidity	Increased mould growth during winter leading repainting/greater maintenance requirements
Soils	Soil moisture	Decrease in soil moisture in summer	Drying out a cracking of soils leading to damage to foundations and materials
	Soil stability	Decrease in soil stability	Risk of subsidence and damage to foundations

Accommodation bridge options

Greenhouse gases

5.10.42. The construction of the proposed bridge at either Broxfield or Heckley Fence may result in differences in GHG emissions associated with construction due to differences in span and required earthworks between the two options.

5.10.43. Depending on the choice of option, differences in emissions may result from the following sources (PAS2080 references in brackets):

- Product stage (A1-3) - depending on the span for each option, there may be differences in the quantity of materials used and therefore the emissions associated with materials.
- Transport of materials to site (A4) - depending on the span for each option, there may be differences in the quantity of materials used and therefore emissions associated with transport of these materials.
- Plant and equipment use during construction (A5) – depending on the earthworks and construction methods required for each option, there may be differences in emissions associated with plant and equipment use.
- Transport and disposal of waste (A5) – depending on the earthworks required for each option there may be differences in waste arisings and therefore emissions.

5.10.44. At this stage, span lengths and earthwork requirements for each option are not known, therefore no further assessment of the difference in GHG emissions during construction between the options has been undertaken. However, it is assumed that the differences between the two options would not be significant, when taken in the context of the Scheme as a whole.

5.10.45. There are no anticipated differences in GHG emissions during operation associated with the different options.

Vulnerability of the project to climate change

5.10.46. The choice of bridge option would have little effect on vulnerability of the project to climate change during construction or operation. As both options are located within the existing Study Area for the climate vulnerability assessment, they would be exposed to the same future climate (as described in the projected climate section of the baseline). As the specification for both bridge options is the same, there is no anticipated difference in sensitivity of the bridges to climate change. As such, there is no anticipated difference in the potential impacts of climate change between the bridge: potential impacts on both options are described in **Table 5-49.**

DESIGN, MITIGATION AND ENHANCEMENT MEASURES

Greenhouse gas emissions

5.10.47. Measures to mitigate GHG emissions during the construction phase of the Scheme will be set out in a CEMP. The magnitude of GHG emissions associated with the construction phase of the Scheme can be minimised by, amongst others:

- 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.

- Use local waste contractors to reduce distance travelled
- Using more efficient construction plant and delivery vehicles, and/or those powered by electricity from alternative/lower carbon fuels.

5.10.48. 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.
- Operating, maintaining and refurbishing the Scheme using best-practice efficient approaches and equipment.

5.10.49. The mitigation measures outlined above are not expected to result in a carbon neutral Scheme. As such, it is expected that the Scheme would result in an increase in emissions. The magnitude of this increase will be reported in the ES, when more information on the Scheme is available.

Vulnerability of the project to climate change

5.10.50. The resilience of the Scheme during construction (including staff involved in construction) can be improved through the following measures which will be set out in a CEMP as well as working RAMS:

- Ensuring site and Compound drainage infrastructure has sufficient capacity and that silt traps are in use / regularly emptied and maintained.
- Storing chemicals, hazardous materials and plant on high ground or protecting with bunds / flood barriers.
- Using pumps to ensure water levels in excavations do not exceed critical levels.
- Allowing extra time for materials to dry out in the programme of works.
- Reducing the area of impermeable surface e.g. permeable paving.
- Using vegetation to slow down the movement of surface water.
- Dust control measures e.g. water spraying, covering spoil heaps.
- Using rainwater recycling to support other facilities (e.g. washing of machinery etc.).
- Ensuring welfare facilities are available and sufficiently cool. Ensure rest breaks are taken, particularly during the hottest part of the day (generally, 11am – 3pm).
- Provide shade for workers in exposed areas.
- Using PPE to reduce exposure to ultra violet (UV) radiation – light coloured, long sleeved tops, sun cream, hats etc.
- Reviewing wind speed before commencing work at height.
- Ceasing work at height during storms.
- Installing lightening protection for site buildings.
- Using mould inhibiting paint.
- Reducing the size of spoil heaps.

5.10.51. The resilience of the Scheme during operation can be improved through the following measures:

- Ensuring drainage infrastructure is designed with capacity to accommodate projected rainfall levels.
- Regularly clearing and maintenance of drainage infrastructure to prevent blockage.

- Reducing area of impermeable surface e.g. use permeable paving.
- Using a series of detention basins to slow down the movement of surface water.
- Using green infrastructure to bind soil and slow infiltration (e.g. deep-rooted, drought resistant vegetation).
- Consider projected change in soil moisture when specifying foundation depth – potentially need deeper foundations.
- Dust control measures e.g. water spraying of the carriageway during droughts.
- Taking account of projected temperature increases in design of bridge joints.
- Specifying appropriate materials (e.g. asphalt, concrete mix) to take account of higher average temperatures.
- Inspecting bridges and associated infrastructure following periods of extreme temperatures, prolonged sunshine and high winds.
- Taking account of projected wind speed in bridge design.
- Enforcing speed restrictions during high winds.
- Installing lightening protection system on bridges and for associated control equipment and infrastructure.
- Using mould inhibiting paints as part of regular maintenance and updating.
- Using slope stabilisation measures.

LIKELY SIGNIFICANT EFFECTS

5.10.52. The comparison of preliminary likely significant effects between the two accommodation bridge options are set out in **Table 5-61** below, based upon currently available information and professional judgement. Following implementation of appropriate mitigation measures, no significant residual climate effects are anticipated during construction and operation of the Scheme. However, these effects could change as the EIA progresses. Mitigation measures are outlined in the above section.

Table 5-61 - Preliminary Likely Significant Effects of the two accommodation bridge options

Lifecycle stage / Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
Product stage (manufacture and transport of raw materials to suppliers) (A1-3)	Construction	Embodied emissions associated with extraction and manufacturing of the required raw materials contribute to climate change.	Not anticipated	Not anticipated
Transport of materials to site (A4)	Construction	Embodied emissions associated with extraction and manufacturing of the required raw materials contribute to climate change.	Not anticipated	Not anticipated
Plant and equipment	Construction	Emissions from fuel and electricity used in vehicles	Not anticipated	Not anticipated

Lifecycle stage / Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
used during construction (A5)		transporting materials to site contribute to climate change.		
Transport of waste (A5)	Construction	Emissions from fuel/energy used in vehicles transporting materials to and away from site, contributing to climate change.	Not anticipated	Not anticipated
Disposal of waste (A5)	Construction	Emissions from the final disposal of waste materials contribute to climate change.	Not anticipated	Not anticipated
Operation (B1)	Operation	Electricity used for lighting contribute to climate change.	Not anticipated	Not anticipated
Maintenance, repair, replacements, refurbishment (B2-5)	Operation	Embodied emissions, and emissions from transport and plant associated with maintenance, repair, replacement, and refurbishment contribute to climate change.	Not anticipated	Not anticipated
End-user emissions (regional traffic flow) (B9/D)	Operation	Vehicles using highways infrastructure affected by the Scheme contribute to climate change.	Not anticipated	Not anticipated
Construction works and compounds	Construction	Flooding leading to risk of spills, damage and delays. Increased site run-off and silt.	Not anticipated	Not anticipated
Construction works and compounds	Construction	Increased dust	Not anticipated	Not anticipated
Materials	Construction	Excessive moisture and longer drying times	Not anticipated	Not anticipated
Excavations	Construction	Waterlogging	Not anticipated	Not anticipated
Workforce	Construction	Unsafe / uncomfortable working conditions due to high temperatures and UV radiation	Not anticipated	Not anticipated

Lifecycle stage / Receptor	Stage	Potential Impacts and Effects	Likely Significant (Residual) Effects	
			Broxfield (Option 1)	Heckley Fence (Option 2)
Plant	Construction	Increased risk from high winds for use of cranes, delays to programme	Not anticipated	Not anticipated
Carriageway and associated infrastructure	Operation	Flooding leading to damage to materials and/or road closure	Not anticipated	Not anticipated
Carriageway	Operation	Deformation of surface during periods of high temperature	Not anticipated	Not anticipated
Earthworks and embankments	Operation	Drying out and cracking during prolonged hot, dry conditions potentially leading to subsidence and damage to carriageway	Not anticipated	Not anticipated
Bridges	Operation	Increased thermal expansion of joints	Not anticipated	Not anticipated
Structures	Operation	Increased wind loading leading to unsafe conditions and potential closure. Wind-driven moisture infiltration.	Not anticipated	Not anticipated
Electronic equipment e.g. signalling and signage	Operation	Lightning strike leading to loss of power	Not anticipated	Not anticipated

Greenhouse gas emissions

5.10.53. A summary of the preliminary likely significant effects of the Scheme is presented in **Table 5-62** below, based upon currently available information and professional judgement, as such these sources of emissions will be included in the assessment to be presented in the ES. However, these effects could change as the EIA progresses.

Vulnerability of the project to climate change

5.10.54. A summary of the preliminary likely significant effects is presented in **Table 5-62** below, based upon currently available information and professional judgement. However, these effects could change as the EIA progresses.

Table 5-62 - Summary of Preliminary Likely Significant Effects - climate

Lifecycle stage / receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
GREENHOUSE GASES				
Product stage (manufacture and transport of raw materials to suppliers) (A1-3)	Construction	Embodied emissions associated with extraction and manufacturing of the required raw materials contribute to climate change.	Minimise quantity of materials required. Maximise use of materials and products with recycled or secondary and low carbon content, from renewable sources, and offering sustainability benefit.	Not anticipated
Transport of materials to site (A4)	Construction	Embodied emissions associated with extraction and manufacturing of the required raw materials contribute to climate change.	Use locally-sourced materials where available and practicable.	Not anticipated
Plant and equipment used during construction (A5)	Construction	Emissions from fuel and electricity used in vehicles transporting materials to site contribute to climate change.	Use more efficient construction plant and delivery vehicles, and/or those powered by electricity from alternative/lower carbon fuels.	Not anticipated
Transport of waste (A5)	Construction	Emissions from fuel/energy used in vehicles transporting materials to and away from site, contributing to climate change.	Minimise amount of waste produced. Use local waste contractors. Use more efficient construction plant and delivery vehicles, and/or those powered by electricity from alternative/lower carbon fuels.	Not anticipated
Disposal of waste (A5)	Construction	Emissions from the final disposal of waste materials contribute to climate change.	Minimise amount of waste produced.	Not anticipated

Lifecycle stage / receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Operation (B1)	Operation	Electricity used for lighting contribute to climate change.	Operating, maintaining and refurbishing the Scheme using best-practice efficient approaches and equipment. Specifying high efficiency mechanical and electrical equipment such as lighting and telecoms.	Not anticipated
Maintenance, repair, replacements, refurbishment (B2-5)	Operation	Embodied emissions, and emissions from transport and plant associated with maintenance, repair, replacement, and refurbishment contribute to climate change.	Designing, specifying and constructing the Scheme with a view to maximising the operational lifespan and minimising the need for maintenance and refurbishment. 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.	Not anticipated
End-user emissions (regional traffic flow) (B9/D)	Operation	Vehicles using highways infrastructure affected by the Scheme contribute to climate change.	N/A	Not anticipated
RESILIENCE				
Construction works and compounds	Construction	Flooding leading to risk of spills, damage and delays. Increased site run-off and silt.	Ensure drainage infrastructure has sufficient capacity. Ensure silt traps are in use and regularly emptied and maintained. Store chemicals, hazardous materials and plant on high ground or protecting with bunds / flood barriers	Not anticipated

Lifecycle stage / receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
			Reduce impermeable area. Temporary use of vegetation to slow down movement of surface water and reduce siltation e.g. passing dewatering effluent over grass. Reduce size of spoil heaps.	
Construction works and compounds	Construction	Increased dust	Dust control measures e.g. water spraying, covering spoil heaps.	Not anticipated
Materials	Construction	Excessive moisture and longer drying times	Allow extra time for materials to dry out.	Not anticipated
Excavations	Construction	Waterlogging	Use pumps to ensure water levels do not exceed critical levels.	Not anticipated
Workforce	Construction	Unsafe / uncomfortable working conditions due to high temperatures and UV radiation	Ensure welfare facilities sufficiently cool. Ensure rest breaks are taken during the hottest part of the day (generally, 11am – 3pm). Provide shade in exposed areas. PPE to reduce exposure to UV radiation – light coloured, long sleeved tops, sun cream, hats etc.	Not anticipated
Plant	Construction	Increased risk from high winds for use of cranes, delays to programme	Review wind speed before commencing work at height. Cease work during storms.	Not anticipated

Lifecycle stage / receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Carriageway and associated infrastructure	Operation	Flooding leading to damage to materials and/or road closure	Ensure drainage infrastructure is designed with capacity to accommodate projected rainfall levels. Regular clearing and maintenance of drainage infrastructure. Reduce area of impermeable surface. Use a series of detention basins to slow flow and infiltration.	Not anticipated
Carriageway	Operation	Deformation of surface during periods of high temperature	Specify appropriate materials (e.g. asphalt, concrete mix). Inspect carriageway following periods of extreme temperatures, prolonged sunshine.	Not anticipated
Earthworks and embankments	Operation	Drying out and cracking during prolonged hot, dry conditions potentially leading to subsidence and damage to carriageway	Use vegetation to bind soil and slow infiltration. Consider projected change in soil moisture when specifying foundation depth. Use slope stabilisation measures. Inspect earthworks following periods of extreme temperatures and low rainfall.	Not anticipated
Bridges	Operation	Increased thermal expansion of joints	Taking account of projected temperature in bridge design. Inspect bridges following periods of extreme temperatures.	Not anticipated

Lifecycle stage / receptor	Stage	Potential Impacts and Effects	Design and Mitigation	Likely Significant (Residual) Effects
Structures	Operation	Increased wind loading leading to unsafe conditions and potential closure. Wind-driven moisture infiltration.	Take account of projected wind speed in design of structures. Use mould inhibiting paints as part of regular maintenance and updating. Inspect structures following periods of high winds.	Not anticipated
Electronic equipment e.g. signalling and signage	Operation	Lightning strike leading to loss of power	Install lightening protection system. Consider provision of alternative power source.	Not anticipated

FURTHER WORK FOR THE EIA

Greenhouse gas emissions

5.10.55. The ES will include an assessment of the likely significant effects of the Scheme on climate (GHG emissions). Calculation of GHG emissions from the sources set out above during the construction and operational phases of the Scheme would be undertaken in accordance with the methodology set out in the Scoping Report (**Volume 2, Appendix A, Chapter 15 Climate**).

5.10.56. Emissions calculations for all sources other than end user emissions (traffic), will be completed using Highways England's carbon tool. Traffic emissions will be quantified in accordance with the DMRB, Volume 11, Section 3, Part 1 Air Quality; HA 207/07. Values will be reported as tonnes of carbon dioxide equivalents (tCO_2e).

5.10.57. In line with the NPSNN, significance of GHG impacts is assessed by comparing estimated GHG emissions arising from the Scheme with the respective UK carbon budgets. There are currently no agreed thresholds for what level of GHG emissions is considered significant in an EIA context. A judgement is however made regarding the potential significance and the need for assessment in line with IEMA guidance (IEMA 2017).

5.10.58. In addition to the assessment detailed above and in the Scoping Report (**Volume 2, Appendix A, Chapter 15 Climate**), and in response to the Scoping Opinion (**Volume 2, Appendix B, Section 4.10**), the following will be carried out:

- The ES will detail how measures to locally source materials would be secured, including reference to relevant legally robust methods.

Vulnerability of the project to climate change

5.10.59. The ES will include an assessment of the vulnerability of the Scheme to climate change. The assessment of the significance of potential risks from climate change during the construction and operational phases of the Scheme would be undertaken in accordance with the methodology set out in the Scoping Report. This method would be in accordance with the IEMA EIA Guide to Climate Change Resilience and Adaptation. Where relevant, the ES will also describe and assess the adaptive capacity which has been incorporated into the design of the Scheme.

6 ASSESSMENT OF CUMULATIVE EFFECTS

6.1 INTRODUCTION

6.1.1. This Chapter considers the cumulative effects of the Scheme during the construction and operation phases. Cumulative effects are effects that result from two or more impacts acting together on a single receptor. This Chapter details the potentially significant effects as a result of "combined effects" and "cumulative effects" as follows:

- **Combined effects**: are defined as cumulative effects from a single scheme on a single receptor (for example, the Scheme may result in noise and visual impacts upon the same receptor).
- **Cumulative effects**: are defined as cumulative effects from different schemes in combination with the Scheme being assessed.

6.1.2. The assessment for cumulative effects is reliant on the technical assessments of the Scheme being well progressed and data relating to other developments within the vicinity being confirmed and as up-to-date as possible. As such, although this Chapter presents the current understanding of likely cumulative effects it is not possible to identify likely significant effects with confidence at this stage.

6.1.3. The Scoping Report (**Volume 2, Appendix A**) provides full details of the methodology for the assessment.

6.2 EXISTING BASELINE KNOWLEDGE

6.2.1. Planning applications will be considered within a study area relevant to each topic, as set out in **Table 4-1** above. The planning applications will be identified as the EIA progresses and will include those submitted to NCC together with Highways England schemes likely to be constructed in the same time as and in proximity to the Scheme.

6.2.2. **Table 6-1** presents proposed applications identified within the Scoping Report that will be considered for cumulative effects of these applications likely to be delivered at the same time and in proximity to the Scheme. This will be reviewed and updated throughout the EIA and, where appropriate, wider study areas will be employed in line with DMRB HA 205/08 to include a wider review of planning applications.

Table 6-1 - Preliminary List of Applications for Consideration of Cumulative Effects

Application Ref	Site Description	Application Description	Decision Issue Date	Approx. Distance from Scheme Footprint
16/02315/FUL	Land South of Charlton Hall, Ellingham, Northumberland	Construction of 15 timber luxury camping cabins	21/10/16	220 m south-east
18/01914/FUL	Land North East of Wandylaw Covered	Change of use of agricultural land to	Not known	800 m west

Application Ref	Site Description	Application Description	Decision Issue Date	Approx. Distance from Scheme Footprint
	Reservoir, Eglingham, Northumberland	mixed use tourism and agricultural land		
16/03075/SCREEN	Brownieside Quarry, Brownieside Chathill, Northumberland, NE67 5HW	Proposed re-opening and extension to quarry	15/09/2016	625 m north-west
18/03233/FUL	Doxford Hall Walled Garden, Doxford, Northumberland	Construction of a new wedding venue comprising of a wedding pavilion, ancillary building for caterers, and 13 no. lodges	Not known	2 km east
18/03208/FUL	Land north of Garden Cottage, Charlton Hall, Ellingham Chathill, Northumberland, NE67 5DZ	Redevelopment of the site of the Walled Garden including visitor shop and facilities, cafe, restaurant and venue space, access road, car parking, vehicle drop off and turning area	Not known	Within and adjacent to the Scheme Footprint (east)

6.2.3. In addition to the planning applications listed in **Table 6-1**, the A1 in Northumberland: Morpeth to Felton scheme will also be considered in the assessment of cumulative effects. The A1 in Northumberland: Morpeth to Felton scheme forms part of Highways England's wider A1 improvement programme. The A1 in Northumberland: Morpeth to Felton scheme is located approximately 12 km south of the Scheme and includes approximately 6.6 km of online widening (i.e. widening along the existing route of the A1) and approximately 6 km of new offline highway. The construction periods for the A1 in Northumberland: Morpeth to Felton scheme and the Scheme would overlap, with the Main Compound being utilised for the Scheme (refer to **Section 2.3** of this PEIR for further information).

6.2.4. The ES for the A1 in Northumberland: Morpeth to Felton will be available for consideration within the cumulative effects assessment of this Scheme EIA. The potential cumulative effects from both the A1 in Northumberland: Morpeth to Felton and the Scheme will be reported within the cumulative effects chapter of the Scheme ES.

SENSITIVE RECEPTORS

6.2.5. The following receptors have been identified as having the potential to be cumulatively affected by the Scheme:

- Local residential dwellings
- Recreational resources;
- PRoW;
- Road users;
- Local businesses;
- Community facilities;
- Cultural heritage assets;
- Ecological Sites adjacent to the ARN; and
- Watercourses, ponds and groundwater.

6.3 POTENTIAL IMPACTS

6.3.1. The EIA will assess the potential impacts based upon results of baseline surveys and data collection, the information available about the key developments identified and the Scheme design.

6.3.2. Based upon the preliminary assessment, the following potential combined effects are anticipated:

- During construction and operation, a number of PRoW, recreational resources, road users, residential receptors and community facilities within the vicinity of the Scheme could experience adverse impacts as a result of increased noise and air quality pollution as well as visual intrusion.
- Local businesses could also experience adverse impacts as a result of increased noise levels and visual intrusion, during both construction and operation.
- Cultural heritage assets could experience changes to the setting of a cultural heritage features through changes in views, light pollution, air pollution and noise levels during construction and operation.
- Ecological Sites adjacent to the ARN could experience an increase in nitrogen deposition and noise levels as a result of increased traffic.
- Watercourses, ponds and groundwater resources, could experience potential accidental pollution / discharge of materials during construction and operation, which would adversely impact water quality and ecological attributes.

6.3.3. Based upon other developments listed in **Table 6-1** above and the preliminary assessment, **Table 6-2** indicated the anticipated potential cumulative effects.

Table 6-2 - Preliminary Assessment of Potential Cumulative Effects

Application	Anticipated Cumulative Effects	Justification and Commentary
16/02315/FUL	No significant cumulative effects predicted.	The Delegated Report for the application (**Ref 6.3.1**) states: 'The nature and scale of the development would not result in any significant or adverse impacts upon the site and wider environment, including the amenity of surrounding residents, whilst any effects can be mitigated by conditions where required'.
18/01914/FUL	No significant cumulative effects predicted.	The Delegated Report for the application (**Ref 6.3.2**) states: 'The application has addressed the main considerations and would accord

Application	Anticipated Cumulative Effects	Justification and Commentary
		with relevant policy. The proposal is therefore recommended for approval'.
16/03075/SCREEN	No significant cumulative effects predicted.	The EIA Screening Opinion for the proposals (**Ref 6.3.3**) states: 'Based on the information provided, the guidance set out in the EIA Regulations 2011 (as amended 2015) and the NPPG [National Planning Policy Guidance] it is considered that the proposed development would not give rise to significant environmental impacts sufficient to require an EIA'.
18/03233/FUL	No significant cumulative effects predicted.	The proposal is located within the ZTV for the Scheme. However, according to the Planning Statement the proposals has 'carefully considered the landscape setting, with the proposed layout designed to maximise the unique and beautiful setting of the Walled Garden, with the wedding pavilion and bridal pavilion located within the confines of this and the lodges on land adjacent … the proposed lodges, wedding pavilion, smaller bridal pavilion and ancillary catering building will adopt a similar appearance to achieve a high standard of design across the whole scheme.' In addition, views of the proposal would be screened by the woodland around Doxford Hall, therefore no significant effects are anticipated.
18/03208/FUL	Cultural Heritage	Potential changes to the setting of cultural heritage features.
	Ecology	Loss of habitat and potential disturbance of protected species during construction.
	Road Drainage and the Water Environment	Risk of polluting Shipperton Burn from the construction and operation of the schemes.
	Air quality	Increased emissions from increased traffic caused by both schemes.
	Noise and Vibration	Increased noise levels at East Linkhall due to increased traffic caused by both schemes.
	Materials	Consumption of raw materials and generation of waste during construction.
	Climate	Increase in greenhouse gas emissions from construction traffic and vehicles once operational.
A1 in Northumberland:	Air quality	Increased emissions from construction traffic traveling to and from the Main Compound and

Application	Anticipated Cumulative Effects	Justification and Commentary
Morpeth to Felton scheme		operational road traffic due to increased demand.
	Noise and Vibration	Increased noise levels from construction traffic traveling to and from the Main Compound and operational road traffic due to increased demand.
	Population and Health	Changes in driver stress, journey times and pleasantness from congestion and temporary diversions during construction. Reduced amenity value for users of PRoW due to increased air pollution i.e. vehicle emissions and dust, noise levels, visual intrusions and PRoW diversions / temporary closures. Beneficial effect to road traveller journey times once operational.
	Materials	Consumption of raw materials and generation of waste during construction.
	Climate	Increase in GHG emissions from construction traffic and vehicles once operational.

6.3.4. The list of applications will be updated and a full assessment of the potential cumulative effects will be undertaken as part of the EIA and reported in the ES.

DESIGN, MITIGATION AND ENHANCEMENT MEASURES

6.3.5. Where significant cumulative effects are identified during the EIA, mitigation will be specified to avoid, reduce or offset such effects.

LIKELY SIGNIFICANT EFFECTS

6.3.6. Based upon the current findings of the preliminary assessments, the following potentially significant combined effects are anticipated:

- A number of PRoW, recreational resources, road users, residential receptors and community facilities within the vicinity of the Scheme could experience adverse impacts as a result of increased noise and air quality pollution as well as visual intrusion, during both construction and operation.
- Local businesses could also experience adverse impacts as a result of increased noise levels and visual intrusion, during both construction and operation.
- Watercourses, ponds and groundwater resources, could experience potential accidental pollution / discharge of materials during construction and operation, which would adversely impact water quality and ecological attributes.

6.3.7. Based upon the preliminary list of other development applications and their potential impacts identified in **Table 6-1** and **Table 6-2**, potential significant cumulative effects from 18/03208/FUL and the Scheme include changes to air quality, greenhouse gas emissions, noise and the setting of

cultural heritage features as well as the potential pollution of Shipperton Burn, use of materials and generation of waste, loss of habitat and disturbance of protected species. Potential significant effects from A1 in Northumberland: Morpeth to Felton scheme and the Scheme include changes to air quality, greenhouse gas emissions and noise as well as use of materials and generation of waste, and disturbance and disruption to road travellers and users of PRoW. However, this is considered indicative at this stage, as the cumulative assessment which will be undertaken for the EIA will be based upon an updated list of developments.

6.4 FURTHER WORK FOR THE EIA

6.4.1. A detailed assessment of the cumulative effects during construction and operation of the Scheme will be reported in the ES. This will follow the guidance contained in DMRB HA 205/08 Volume 11, Section 2, Part 5 'Assessment and Management of Environmental Effects' (**Ref 6.4.4**).

6.4.2. In addition to the methodology stated in the Scoping Report (refer to **Volume 2, Appendix A, Chapter 16**), and in response to the Scoping Opinion (**refer to Volume 2, Appendix B, Section 4.11**), the following will be carried out for the EIA:

- The sensitive receptors considered for the combined cumulative effects assessment will include those that are likely to experience potential residual effects of 'slight' significance or above (i.e. negligible impacts will not be considered in the assessment of combined effects). This will ensure that all possible significant interactions are assessed.

7 SUMMARY

7.1.1. This PEIR informs the public about the EIA process and the likely environmental effects of the Scheme as part of the statutory consultation. This report comes before the EIA and as such is "preliminary" and is based on the most up-to-date information available at the time of writing. This PEIR has been informed by the Scoping Report (**Volume 2**, **Appendix A**) and Scoping Opinion received from the Inspectorate (**Volume 2**, **Appendix B**). Any comments received during the consultation, will be taken into consideration in both the design of the Scheme and the EIA. The assessments carried out for the EIA will be reported within the ES, which will be submitted as part of the DCO application in autumn 2019.

7.1.2. The Scheme does not fall within the criteria listed in "Schedule 1" of the EIA Regulations. However, the Scheme does fall under Schedule 2, Part 10f (construction of roads) of the EIA Regulations. Due to the close proximity and potential direct impacts on 'sites of historical, cultural or archaeological significance' as set out in Regulation 9(1), the Scheme is considered to be 'EIA development' and will require an EIA.

7.1.3. The EIA will be undertaken in line with the following legislation and guidance (see **Chapter 4 – Environmental Assessment Methodology** for more information):

- The EIA Regulations;
- DMRB;
- IANs; and
- Additional best practice guidance.

7.1.4. The NPPF and NPS NN will be considered throughout the development of the Scheme.

7.1.5. **Table 7-1** provides a comparison of preliminary likely residual significant effects between the two accommodation bridge options at Broxfield and Heckley Fence.

Table 7-1 – Preliminary Likely Residual Significant Effects of the two accommodation bridge options

Topic	Stage	Likely Significant (Residual) Effects	
		Broxfield (Option 1)	Heckley Fence (Option 2)
Air Quality	Construction	No likely significant effects are anticipated.	No likely significant effects are anticipated.
	Operation	No likely significant effects are anticipated.	No likely significant effects are anticipated.
Noise and Vibration	Construction	Not likely significant effects anticipated but with increased potential where night-time, evening and weekend works take place	Significant, adverse effect anticipated for Heckley Fence, with increased potential where night-time, evening and weekend works take place.
	Operation	No likely significant effects are anticipated.	No likely significant effects are anticipated.

Topic	Stage	Likely Significant (Residual) Effects	
		Broxfield (Option 1)	Heckley Fence (Option 2)
Landscape and Visual	Construction	Significant, adverse impacts at a local level, but not anticipated for the wider landscape. Significant, adverse impacts on five residential properties, five PRoW and one main road.	Significant, adverse impacts at a local level, but not anticipated for the wider landscape. Significant, adverse impacts on five residential properties, three PRoW and one main road.
	Operation	Significant, adverse impacts at a local level, but not anticipated for the wider landscape. Significant, adverse impacts on one residential properties and three PRoW.	Significant, adverse impacts at a local level, but not anticipated for the wider landscape. Significant, adverse impacts on four residential properties and two PRoW.
Cultural Heritage	Construction	Significant, adverse effect anticipated if below ground archaeology is directly impacted. Significant, adverse effect anticipated for Grade II Listed Building Heckley House (NHLE 1042044	Significant, adverse effect anticipated if below ground archaeology is directly impacted. Significant, adverse effect anticipated for Grade II Listed Building Dovecote to East of Heckley Fence Farmhouse with Attached Wall (NHLE 1371059)
	Operation	Significant, adverse effect anticipated for Grade II Listed Building Heckley House (NHLE 1042044).	Significant, adverse effect anticipated for Grade II Listed Building Dovecote to East of Heckley Fence Farmhouse with Attached Wall (NHLE 1371059)
Biodiversity	Construction	No likely significant effects are anticipated (subject to further survey works).	No likely significant effects are anticipated (subject to further survey works).
	Operation		
Road Drainage and the Water Environment	Construction	No likely significant effects are anticipated.	No likely significant effects are anticipated.
	Operation		
Geology and Soils	Construction	No likely significant effects are anticipated (subject to further investigation, surveys and consultation).	No likely significant effects are anticipated (subject to further investigation, surveys and consultation).
	Operation		

Topic	Stage	Likely Significant (Residual) Effects	
		Broxfield (Option 1)	Heckley Fence (Option 2)
Population and Health	Construction	Significant temporary, adverse effects upon WCHs during the construction of the bridge. Based on current information it is understood this option would affect farming operations which has the potential to be significant	Significant temporary, adverse effects upon WCHs during the construction of the bridge.
	Operation	No likely significant effects are anticipated. Based on current information it is understood this option would affect farming operations which has the potential to be significant	Significant adverse effects on WCHs due to permanent closure of PRoW and PRoW diversions.
Material Resources	Construction	No likely significant effects are anticipated.	No likely significant effects are anticipated.
	Operation		
Climate Change	Construction	No likely significant effects anticipated.	No likely significant effects anticipated.
	Operation		
Cumulative Effects	Construction	Potential for significant adverse combined effects on PRoW users and water resources including Denwick Burn.	Potential for significant adverse combined effects on Heckley Fence, PRoW users and water resources such as the unnamed ditch.
	Operation	No likely significant effects are anticipated.	Potential for significant adverse combined effects on Heckley Fence and PRoW users.

7.1.6. **Table 7-2** summarises the likely residual significant impacts for each of the technical topics for both the construction and operation phases of the Scheme.