A10 Initial Environmental Assessment

Initial Environmental Assessment

Cambridgeshire and Peterborough Combined Authority

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Contents

Tables

Appendices

1 Introduction

1.1 Purpose of the report

The A10 Dualling Scheme (hereafter called the Proposed Scheme) is looking at improving the A10 between Milton and Ely, north of Cambridge. The Proposed Scheme includes options for both dualling sections of the existing A10 and providing offline bypass routes to redirect traffic away for settlements along the corridor. Based on the options being considered it is likely that the Proposed Scheme would create significant effects on the environment and therefore may require a statutory Environmental Impact Assessment (EIA). Further details about the consenting regime can be found in section 1.3.

This is a high-level Environmental Assessment Report that has been prepared as part of a suite of documents to support a Strategic Outline Business Case (SOBC) for the Proposed Scheme. The aim of the report is to identify matters that would affect the business case including:-

- Key constraints on viable options;
- Adverse environmental effects which could occur from different options;
- The beneficial environmental outcomes that could be achieved by the identified options;
- Environmental risks; and
- Likely mitigation associated with the proposed options.

The reporting of likely significant effects per option is to help guide the selection of a preferred option and inform on the scope of future environmental assessments and surveys. The report includes the topics covered within the Design Manual for Roads and Bridges (DMRB) guidance and is guided by the standardised structure of report required PCF Stage 1 of Highways England report with the additions of a comparative review of the options and exclusion of the potential impacts section. Additional topics set out in the EIA Directive have been omitted at this stage but will be incorporated into the next stage of assessment.

1.2 Overview of the A10

The A10 corridor between Cambridge and Ely is a primary route in the Greater Cambridgeshire area, used by local traffic, agricultural vehicles and long-distance traffic including freight. The single carriageway road forms part of the direct route between London (via the M11 and A14), Cambridge and King's Lynn, with the road providing onward connections to the Strategic Road Network (A47 and A17) and primary routes (A142, A1122 and A148) within Cambridgeshire and Norfolk. Locally it provides connectivity to communities such as Milton, Landbeach, Waterbeach, Stretham and Little Thetford, as well as centres of employment such as the Cambridge Science Park and Cambridge Research Park. It also provides access to locally important east-west routes such as the A1123 between Fordham, Haddenham and St. Ives.

Secondary B-roads (B1049 and B1050) provide additional north-south links and an alternative to the busy A10. The A10 does not have any designated cycle infrastructure. It has only one hourly bus service from Cambridge Bus Station to Littleport between 9am and 7pm. In addition, there are three early morning services; five morning services; one midday service and a one way evening service.

The Cambridge to Ely railway line runs parallel to the A10. The line is used by a mix of passenger and freight services. Passenger trains operate from London King's Cross and Liverpool Street to Ely and King's Lynn, and Stansted Airport to Norwich, Peterborough and Birmingham New Street. Major rail capacity constraints exist at Ely, where its complex junction of five routes, multiple level crossings and aged infrastructure limit the potential for additional train paths.

The Cambridge to Ely A10 study corridor runs through a largely flat landscape dominated by arable farmland, including the flood zone adjacent to the Great River Ouse. A number of residential development sites have been identified along the study corridor including the redevelopment of a disused armed forces base referred to as Waterbeach Barracks which has been eared marked for residential development in the South Cambridgeshire Local Plan 2018. A planning application for 6,500 new homes, 5 new schools, public facilities such as a health care centre, library and leisure centre and 34 ha of recreational space was approved by the Local Planning Authority in 2019. The planning permission also include the planting of 17,000 new trees and improvements to existing terrestrial and aquatic habitats.

1.3 Legislative Framework

1.3.1 Consenting regime

The Proposed Scheme would include improvements in part outside of the existing highways corridor and so would not fall within permitted powers. Therefore, consent to build, operate and maintain the Proposed Scheme would progress under the Town and Country Planning Act 1990.

The Proposed Scheme has the potential to fall under the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 and dependant on the option selected would meet the project description under either;

- Schedule 1, 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.' – Options A, B, D and E

- Schedule 2, 10f, infrastructure projects, construction of roads – Options C, F and G

The selection criteria in Schedule 3 will be used to screen the Proposed Scheme and identified the potential for significant effects. As a preferred option has yet to be selected it cannot be confirmed if a statutory EIA would be required or not.

1.3.2 National Policy

The revised National Planning Policy Framework (NPPF) (2019) sets out the Government's planning policies and how these should be applied. The need to ensure sustainable development is at the heart of the NPPF. This means balancing the need for economic growth with social and environmental requirements. It sets out a presumption in favour of sustainable requirements.

Relevant sections and paragraphs of the NPPF are detailed within each topic chapter of this report.

1.3.3 Local Policy

The scheme is located within the administrative boundaries of the following local planning authorities (LPA): East Cambridgeshire District Council (East Cambs) and South Cambridgeshire District Council (South Cambs). In 2016 both East and South Cambs became 2 of 8 founding partners to create the Cambridgeshire and Peterborough Combined Authority. Table 1.1 details the local planning policy documents relevant to the Proposed Scheme. East Cambs is in the process of reviewing its local plan, which will replace the policies set out in current documents.

Table 1.1 Local planning policy documents relevant to the Proposed Scheme

Council	Planning policy document
Cambridgeshire and Peterborough Combined Authority	• Cambridgeshire & Peterborough Minerals and Waste Local Development Framework (2011) • Local Transport Plan (2019)
East Cambridgeshire District Council	• Second Review of Local Plan (2020) • Local Plan (2015) • Policies Map 2015
South Cambridgeshire District Council	• Local Plan (2018) • Adopted Polices Map (2018)

2 The Project

2.1 Need for the project

Section 1.5 of the Strategic Outline Business Case (Document reference: BESP0020-JAC-GEN-XX-RP-TR-0001), sets out the current and future land use and transport-related problems, issues and opportunities identified along the A10 corridor and the surrounding communities. To prevent duplication the information has been briefly summarised below.

The need for intervention and development of the highway infrastructure within the existing A10 corridor is due to;

- Pressures in housing affordability and increases in housing demand which although is being supplied is not keeping pace with the rate of demand;
- Current infrastructure (including the road network) does not reflect or support economic growth within Cambridge and existing infrastructure is restricting the development of allocated residential and employment sites;
- Constraints to future growth and productivity in the region due to lack of evolution of local infrastructure;
- Lack of sustainable and active travel options are contributing to rising carbon emissions and create a blocker to regional strategies and actions plans around climate change; and
- The current A10 and associated infrastructure was not built for modern day traffic capacity and congestion is leading to slower and unreliable journey times, health and safety issues, community severance and environmental impacts.

2.2 Project objectives

The following scheme objectives have been identified for development as part of the Strategic Case and will be refined as the scheme progresses;

- Housing - Provide infrastructure needed to realise sustainable housing opportunities associated with existing Local Plans and provide the opportunity to unlock thousands of new homes between Cambridge and Ely as part of the CPCA's emerging non-statutory spatial plan by 2050;
- Productivity - Increase productivity of the nationally important CPCA economy (including science, technology, agriculture) through improved connectivity to labour, suppliers and markets;
- Environment - As part of a wider package for the Corridor contribute to the achievement of CCC's Draft Net Zero Cambridgeshire by 2050 policy objective. Enhance biodiversity in line with the CPCA's emerging 'doubling nature' policy aims by 2050 (100% increase in land managed for nature in km2);
- Quality of life - Improve the quality of life for residents in local communities by reducing the community severance and environmental impacts of traffic on the built environment;

- Sustainable and active travel - Encourage sustainable travel by improving the comfort, reliability, capacity and / or speed of alternative transport services (including rail, CAM, buses, walking, cycling and horse riding) along the A10 corridor; and
- Network performance - Reduce the risk of collisions along the A10 and on parallel 'B' / unclassified roads in local communities relative to 2018 levels and reduce congestion and improving journey time reliability along the A10, sustaining these benefits for the long-term.

2.3 Project Location

A 1km study area which encompasses the footprints of all options and the existing A10 has been used as the basis of this description of the project location. This is also shown on the figures in Appendix B.

The Proposed Scheme is predominately located within the Fens National Character Area (NCA) with approximately 9 km of the existing A10 corridor located within the Bedfordshire and Cambridgeshire Claylands NCA. The existing A10 corridor and surrounding environment is characterised by the outer fringes of the cities of Cambridge and Ely, a series of semi-rural settlements, the existing highway and railway infrastructure towards the east with predominantly open pastoral farmland to beyond and to the west and lowland floodplain meadows adjoining the River Great Ouse.

Notable land uses include: industrial areas / business parks; residential properties; farm land; green open spaces; leisure / activity spaces; water features; and cultural heritage sites. The Cambridge Research Park and Amey Waste Management Park are prominent features to the north of Landbeach, bounding the western side of the existing A10. There are two scheduled monuments on the eastern side of the existing A10 at Denny Abbey and Chittering. There are a number of Noise Important Areas (NIAs) located along the existing A10 where residential properties are exposed to elevated road noise. There are no Air Quality Management Areas (AQMAs) located within 1km of either the existing A10 or the proposed options. The southern extent of the study area (with the exception of Milton) falls within the Cambridge Greenbelt. Beyond the 1km study area, notable potential receptors include the cities of Cambridge and Ely, and designated environmental sites including Ouse Washes Special Protection Areas (SPA), Wicken Fen and Cam Washes (both Sites of Special Scientific Interest and the first of which is also a Ramsar site).

The topography of the study area can be described as low-lying flat plains that are dissected by drain ditches, dykes and rivers with metres Above Ordnance Datum ranging from 0m up to approximately 26m.

2.4 Project description

Seven options have been selected and assessed within the Strategic Outline Business Case for development into a preferred option. These 7 options consist of a series of online and offline (bypasses) elements with junction improvements either incorporated into the option or in the case of Option G are considered as the sole element. Drawings of each of the options can be found in Appendix A. A description of theses options is as follows;

- Option A (19.4 km in length) – Full length dualling of the existing A10 with three bypass elements at Landbeach, Stretham (to the west) and Little Thetford to divert from existing pinch points.
- Option B (19.4 km in length) – Full length dualling of the existing A10 with three bypass elements at Landbeach, Stretham (to the east) and Little Thetford to divert from existing pinch points.
- Option C (6.2 km in length) – Dualling of the southern section of the existing A10 with a bypass section to the Cambridge Research Park. Junction improvements to be incorporated into the option.
- Option D (18.7 km in length) – Full offline dualling option starting to the east of Milton and running east of the existing A10 before reconnecting at the A142 Witchford Road Roundabout.
- Option E (20 km in length) – Maximum dualling of the existing A10 from the Milton Interchange to the A142 Witchford Road Roundabout within two bypass elements at Stretham and Little Thetford.

- Option F (6.7 km in length) - Dualling of the southern section of the existing A10 to the Cambridge Research Park. Junction improvements to be incorporated into the option.
- Option G (area in m^2 against each option)– Slip road improvements at the Milton Interchange, Junction improvements only to the following junctions: Butt Lane (8036.8 m^2), Denny End Road (10901.6 m^2), Cambridge Research Park (10968.6 m^2), Waste Treatment Site (9206.86 m^2), A1123 Stretham Roundabout (12746.5 m^2), A142 Angel Drov (13486.7 m^2) and A142 Witchford Road (7714 m^2).

2.5 Environmental Assessment

This is a high-level Environmental Assessment Report that has been prepared as part of a suite of documents to support a Strategic Outline Business Case (SOBC). The aim of the report is to identify matters that would affect the business case including:-

- Key constraints on viable options;
- Adverse environmental effects which could occur from different options;
- The beneficial environmental outcomes that could be achieved by the identified options;
- Environmental risks; and
- Likely mitigation (primary, secondary or tertiary) associated with the proposed options.

The reporting of likely significant effects per option is to help guide the selection of a preferred option and inform on the scope of future environmental assessments and surveys. The report includes the topics covered within the Design Manual for Roads and Bridges (DMRB) guidance and is guided by the standardised structure of a report required PCF Stage 1 of Highways England report with additional headings relating to a comparative assessment of the proposed options and the omission of the potential impacts heading. Additional topics set out in the EIA Directive have been omitted at this stage but will be incorporated into the next stage of assessment.

The report uses the terminology of 'likely significant effects' in accordance with relevant EIA Regulations[1] However, the Proposed Scheme is at the very earliest stage of development and the assessment of effects has been based on professional judgement informed by high level design on likely routes and the width of any road improvements. The assessment is not an EIA and for example, there is no vertical profile, no construction information. The conclusions made regarding likely effects is therefore, high level and subject to change if the Proposed Scheme progresses into future design stages and further information becomes available (including for example on site surveys).

For options C, F and G a project commitment has been made to undertake further assessment of the junction at Little Thetford however, at this stage of the project this did not form part of the environmental assessment that has been completed.

For the options which include sections of on-line dualling it has been assumed that an 18m dualling could take place on either side of the existing carriageway. There is therefore an assumed loss where features are located are within this 18m buffer e.g. adjacent to the existing carriageway as the potential for avoidance is unknown at this stage. During later stages of the project a decision would be taken on which side of the existing carriageway would be widened. It is also possible that during the subsequent stages of the project the land take (on the side proposed to be widened) could be increased beyond 18m for example, to include a designated cycleway.

[1] Which set of EIA Regulations apply to the Proposed Scheme may be determined by the consenting regime that is followed. At this stage it is likely that the relevant regulations will be the Town and Country Planning (Environmental Impact Assessment) Regulations 2017.

For the options which include sections of off-line dualling it has been assumed that the new road would be 27m wide. It is also possible that during the subsequent stages of the project the land take could be increased beyond 27m for example, to include a designated cycleway.

At this stage of the project it is not certain how inclusion of a cycleway would affect the width of different options and so to provide a like for like comparison the assessment has focused on the extent of the main road widening: 18m for on-line dualling and 27m for off-line dualling.

A precautionary approach has been adopted relating the biodiversity and earth heritage value of features, as well as the identification of potential pathways of impacts (e.g. associated with air quality, water quality, water environment, noise) and the magnitude of impacts.

The consideration of mitigation has used the following terminology (based on the IEMA Institute of Environmental Management and Assessment categories set out in Environmental Impact Assessment Guide to Shaping Quality Development (2015)):

- 'Embedded mitigation' (primary) – these are the measures that would be inherent within the design of the Proposed Scheme and taken into account by the assessment in each topic. An example of this could be where an option alignment by-pass sensitive environmental receptors;
- 'Additional mitigation' (secondary) – these are the mitigation measures proposed following the identification of adverse environmental effects during the assessment process in each topic chapter and consequently included into the Proposed Scheme. An example of this could be the proposal for noise barriers in response to the noise assessment. These would generally be identified during the environmental assessment of the preferred option at a subsequent stage of the project; and
- 'Construction management' (tertiary) – these are the construction management measures such as pollution prevention or dust suppression. It would be expected that these would be set out in the Construction Environment Management Plan at a subsequent stage of the project.

3 Environmental Assessment Summary

The environmental assessment summary sets out a high-level assessment for each EIA topic considered relevant to the Proposed Scheme, these assessments have been undertaken in accordance with the methodologies detailed within the assessment methodology section for each chapter. This section is supported by the Environmental Constraints Plan contained in Appendix 1.

3.1 Air Quality

This Section reports a comparative assessment of how the seven alternative route options may vary in their effect on air quality, their strengths and weaknesses and a conclusion on which option is preferred. The assessment has focused on the number of properties and / or sensitive ecological sites in close proximity to the different routes which have the potential to be adversely affected by permanent increases in traffic flows and therefore, increased road traffic emissions. Analysis has also been undertaken to provide a high-level understanding of the relative impact of each route option on traffic flows along the A10. This chapter is supported by Figures 5 to 5.16.

3.1.1 Legislative and policy framework

The following legislation and national and local policy apply;

- European Union (EU) Framework Directives 96/62/EC and 2008/50/EC on ambient air quality and cleaner air for Europe – legislate for the assessment of air quality in member states, as well as set Limit Values for relevant pollutants;

- Air Quality Standards Regulations 2010 (SI 1001) – transpose the EU directives described above into UK law;

- The Air Quality (England) Regulations 2000 (SI 928) and The Air Quality (England) Amendment Regulations 2002 (SI 3043) –legislate UK Air Quality Objectives (AQOs) for a variety of pollutants including oxides of nitrogen (NO_X), nitrogen dioxide (NO_2), and particulate matter less than 10 µm and 2.5 µm in diameter (PM_{10} and $PM_{2.5}$, respectively). AQOs are established for both the protection of human health and the protection of vegetation and ecosystems;

- Part IV of the Environment Act 1995 – sets out the Local Air Quality Management (LAQM) process, whereby local authorities are required to undertake periodic reviews of air quality in their areas and assess present and likely future air quality against AQOs. Where AQOs are likely to be exceeded, the local authority must designate an Air Quality Management Area (AQMA) and produce an Air Quality Action Plan (AQAP) to improve air quality;

- National Planning Policy Framework – States that "Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas… Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan".

- National Policy Statement for National Networks (NN NPS) – provides guidance and imposes requirements on matters such as good scheme design, as well as the treatment of environmental impacts. Sitting alongside the NN NPS is the investment programme for the road – the Road Investment Strategy (RIS). These, together with the business plans prepared by the relevant delivery bodies, provide detailed articulation of the Government's funding strategy for the road network and investment priorities over forthcoming periods.

- Local Planning Policy -

    - South Cambridgeshire District Councils (SCDC) Local Plan (2018) – Policy SC/12: Air Quality states … "Where development proposals would … have an unacceptable impact on air quality standards they will be refused" and "Development will not be permitted where it would adversely affect air quality in an Air Quality Management Area (AQMA)";

    - East Cambridgeshire District Council (ECDC) Local Plan (2015) – Policy ENV 9: Pollution states "Proposals will be refused where, individually or cumulatively, there are unacceptable impacts arising from the development on … air quality".

- Air Quality Action Plan for the Cambridgeshire Growth Areas (2009) – details the air quality issues within Huntingdonshire and SCDC and sets out solutions and priority areas for air quality.

3.1.2 Assessment Methodology, assumptions and limitations

A high-level, qualitative air quality screening assessment has been undertaken with reference to Design Manual for Roads and Bridges (DMRB) LA 105 Air Quality guidance (Highways England, 2019). Baseline air quality conditions have been established and sensitive receptors with the potential to be affected by each of the Proposed Scheme options identified in an attempt to assess and compare the potential impacts of each option on air quality.

Sensitive receptors have been identified within 200m of the alignment of the A10 in the existing scenario and for each option, between the Milton Interchange near Cambridge and the A142 Witchford Road Roundabout near Ely. This approach has been taken, in the absence of detailed traffic data (as described in the limitations section), to provide a comparison of the potential relative change in exposure to air pollution in the vicinity of the A10 between the proposed options and the existing alignment. The existing alignment is shown in figures 5 and 5.1. The alignments of the proposed options are shown in figures 5.2 to 5.15.

The limitations of and assumptions made during this assessment are:

- Changes in traffic conditions (e.g. traffic flows, composition and speed) as a result of each Proposed Scheme option have the potential to affect air quality at locations adjacent to the wider road network (i.e. not just adjacent to the A10). Roads adjacent to which perceptible changes in air quality have the potential to occur are typically identified using the traffic change criteria detailed in DMRB LA 105 Air Quality guidance to determine an 'Affected Road Network' (ARN). Detailed traffic data for each of the Proposed Scheme options were not, however, available at the time of the assessment, so it has not been possible to define an ARN for each option at this stage. Instead a simple, high-level comparison of traffic flows during peak periods along the A10 (just north of Waterbeach) has been undertaken in an attempt to understand the relative magnitude of changes in traffic flows along the A10 which may occur as a result of each route option. As such, the scope of this assessment has focussed primarily on an assessment of the alignment of the A10 for each scheme option;

- Furthermore, as detailed traffic data were not available, a quantitative assessment of the impact of each option on air quality was not possible. The assessment approach employed therefore, aims to identify existing human receptors and designated habitats with the potential to be affected by the Proposed Scheme options and to qualitatively assess the risk of significant air quality effects or delayed compliance with the EU Air Quality Directive, based on professional judgement;

- When establishing baseline conditions, the most recent full years' worth of publicly available monitoring data is 2018 and this has therefore been referred to. It is noted, however, that relatively little air quality monitoring is currently undertaken along the A10, or within proximity to the Proposed Scheme options. Additional air quality monitoring may therefore be required going

forwards, in order to more accurately assess baseline air quality conditions in the vicinity of the Proposed Scheme;

- It is assumed that the construction phase air quality impacts associated with each Proposed Scheme option would be likely to be similar and / or can be minimised through the implementation of appropriate mitigation measures. As such, construction phase impacts would be considered unlikely to be significant (following mitigation), nor differentiate between the Proposed Scheme options, and have therefore not been considered within this assessment; and

- The River Great Ouse County Wildlife Site (CWS) is located in close proximity to the existing A10 and all Proposed Scheme options. At this stage, it has not been possible to confirm whether the habitats within this site are sensitive to nitrogen deposition. Therefore, following discussions with the ecology team, this site has been considered "potentially sensitive" to nitrogen deposition for the purposes of this assessment. In reality, this site may not be sensitive to nitrogen or may not contain sensitive habitats in the specific locations which have the potential to be affected by the Proposed Scheme options.

At this stage a qualitative assessment has been undertaken based on the principles outlined within DMRB LA 105 for scoping. This process relies on professional judgement. No Air Quality modelling has been undertaken to inform this assessment. Transport Analysis Guidance (Department for Transport, TAG UNIT A3 Environmental Impact Appraisal, August 2019) was also followed for the qualitative assessment. An Appraisal Summary Table (AST) has been provided for each route option. The associated WebTAG workbooks cannot be completed due to no air quality modelling being undertaken. This has meant that no monetised evaluation can be provided for the options.

3.1.3 Study Area

For the operational phase assessment, in accordance with DMRB LA 105 Air Quality guidance, the following types of sensitive receptors have been identified, where relevant, within 200m of the alignment each Proposed Scheme option:

- Human health receptors – including residential properties, schools, hospitals and care homes; and

- Ecological receptors – including Ramsar sites, Special Protected Areas (SPA), Special Areas of Conservation (SAC), Sites of Special Scientific Interest (SSSI), Local Nature Reserves (LNR), Local Wildlife Sites (LWS), Nature Improvement Areas (NIA), ancient woodland and veteran trees.

3.1.4 Baseline Conditions

Air quality monitoring undertaken by SCDC, ECDC and Cambridge City Council (CCC) indicates that AQOs are likely to be achieved in the vicinity of the Proposed Scheme options. For example, monitoring sites DT-32N (SCDC) and NAS13 (ECDC), see Figure 5.16, are located on the A10 itself and in 2018 measured annual mean NO_2 concentrations of 23.4 and 20.2 $\mu g/m^3$ respectively (i.e. well within the AQO of 40 $\mu g/m^3$). Furthermore, measured concentrations at all monitoring sites across each of these local authorities in 2018 were all below the annual mean NO_2 AQO.

Monitoring of PM_{10} is less common and there are only three monitors for this pollutant in both CCC and SCDC, and none in ECDC. At all of these sites, measured annual mean and daily mean PM_{10} concentrations are well below their respective AQOs (40$\mu g/m^3$ and 50$\mu g/m^3$, not to be exceeded more than 35 times per year, respectively). None of these monitoring sites are, however, located on or near the A10 or the Proposed Scheme options. It is, however, considered very unlikely that AQOs for either PM_{10} or $PM_{2.5}$ are currently exceeded in the vicinity of the A10.

There are no air quality management areas (AQMA) within the immediate vicinity of the Proposed Scheme options, although the A14 Corridor and Cambridge AQMAs, administered by CCC, are located

approximately 1km to the west and 2km to the south of the Proposed Scheme's southern extent (see Figure 5.16).

A number of Pollution Climate Mapping (PCM) links, which are used by Government to assess compliance with air quality Limit Values, are located within Cambridge, approximately 2km to the south of the Proposed Scheme's southern extent (see Figure 5.16). Modelled annual mean roadside NO_2 concentrations for a base year of 2017, indicate that the annual mean NO_2 Limit Value was achieved adjacent to these links.

A large number of properties are located within 200m of each Proposed Scheme option (see Figures 5 to 5.15), which have the potential to be impacted during both the construction and operational phases.

With regards to ecological receptors, the only designated site located within 200m of the Proposed Scheme options is the River Great Ouse CWS, which is considered potentially sensitive to nitrogen. There are no Ancient Woodlands, LNRs, NIAs, Ramsar sites, SACs, SPAs, SSSIs or veteran trees within 200m of any of the alignments.

3.1.5 Likely significant effects

Based on existing air quality monitoring undertaken adjacent to the A10, exceedances of AQOs would be considered unlikely to occur adjacent to the A10 with any of the Proposed Scheme options in place. As a result, significant air quality impacts on human health would be considered unlikely to occur adjacent to the A10. Additional, quantitative assessment will however be required going forwards to confirm this assumption.

All of the Proposed Scheme options have the potential to affect nitrogen deposition with the River Great Ouse CWS, which is potentially sensitive to nitrogen deposition. Additional, quantitative assessment will therefore be required in order to assess the magnitude and potential significance of changes in nitrogen deposition within the CWS as a result of each option, should this site be confirmed as being sensitive to nitrogen.

In order to compare each of the Proposed Scheme options, an indication of the number of properties within 200m of the existing A10 and each route alignment is provided in Table 3.1.1. It should be noted, however, that whilst these receptors have the potential to be affected by the Proposed Scheme options, it does not mean that the resulting impacts at these receptors would be significant.

In order to compare the impact of each of the Proposed Scheme options on traffic flows, an indication of the relative change in traffic flows along the A10 during peak periods for each route alignment is provided in Table 3.1.2.

Furthermore, as indicated previously, in the absence of detailed traffic data, it has not been possible to identify sensitive receptors that may be affected by changes in traffic flows over the wider road network as a result of each Proposed Scheme option. It is likely, however, that additional sensitive human and ecological receptors will be located within 200m of the ARN. Furthermore, each of the Proposed Scheme options would be considered to have the potential to affect traffic flows and therefore air quality within AQMAs to the south of the Proposed Scheme and / or annual mean NO_2 concentrations adjacent to PCM links within Cambridge. Further assessment is therefore likely to be required in future stages, in order to quantify these impacts.

The potential strength and weaknesses associated with each option are summarised in Table 3.1.3, with regard to air quality.

Table 3.1.1 Number of properties within 200m of the existing A10 and each route alignment, between the Milton Interchange near Cambridge and the A142 Witchford Road Roundabout near Ely

Option	Number of properties within 200m
Existing A10	1,322 properties within 200m of the existing A10
Option A	869 properties within 200m of proposed A10 alignment
Option B	867 properties within 200m of proposed A10 alignment
Option C	1,159 properties within 200m of proposed A10 alignment
Option D	358 properties within 200m of proposed A10 alignment (the fewest)
Option E	1,034 properties within 200m of proposed A10 alignment
Option F	1,324 properties within 200m of proposed A10 alignment
Option G	1,323 properties within 200m of proposed junction improvements and existing A10 alignment

Table 3.1.2 Relative Change in Traffic Flows During Peak Periods Along A10 (north of Waterbeach)

Option	Relative Change in Traffic Flows Along A10 (north of Waterbeach)	
	AM Peak	PM Peak
Option A	53%	85%
Option B	51%	85%
Option C	37%	63%
Option D	51%[a]	90%[a]
Option E	50%	76%
Option F	36%	64%
Option G	6%	6%

Option	Relative Change in Traffic Flows Along A10 (north of Waterbeach)	
	AM Peak	PM Peak

[a] Includes flows along both existing A10 and new offline A10 alignment to allow consistent comparison of 'total' change between options.

Table 3.1.3 Strengths and weaknesses for each of the proposed options

Option	Strengths / weakness
Option A	Strengths Has the potential to result in a reduction in the number of affected properties within 200m of the A10 and therefore potentially a reduction in exposure to pollution. Weakness Has the potential to result in a substantial increase in traffic flows during peak periods along the A10. Has the potential to affect nitrogen deposition within a designated ecological site.
Option B	Strengths Has the potential to result in a reduction in the number of affected properties within 200m of the A10 and therefore potentially a reduction in exposure to pollution. Weakness Has the potential to result in a substantial increase in traffic flows during peak periods along the A10. Has the potential to affect nitrogen deposition within a designated ecological site.
Option C	Strengths Has the potential to result in a small reduction in the number of affected properties within 200m of the A10 and therefore potentially a small reduction in exposure to pollution. Weakness Has the potential to result in a substantial increase in traffic flows during peak periods along the A10. Has the potential to affect nitrogen deposition within a designated ecological site.
Option D	Strengths Has the potential to result in a large reduction in the number of affected properties within 200m of the A10 and therefore potentially a large reduction in exposure to pollution. Weakness Has the potential to result in a substantial increase in traffic flows during peak periods along the A10. Has the potential to affect nitrogen deposition within a designated ecological site.
Option E	Strengths Has the potential to result in a small reduction in the number of affected properties within 200m of the A10 and therefore potentially a small reduction in exposure to pollution.

Option	Strengths / weakness
	Weakness Has the potential to result in a substantial increase in traffic flows during peak periods along the A10. Has the potential to affect nitrogen deposition within a designated ecological site
Option F	Weakness Has the potential to result in a substantial increase in traffic flows during peak periods along the A10. Has the potential to affect nitrogen deposition within a designated ecological site
Option G	Strengths Is unlikely to result in substantial changes in in traffic flows during peak periods along the A10. Weakness Has the potential to affect nitrogen deposition within a designated ecological site

3.1.6 Required mitigation and enhancement opportunities

Construction effects

During construction there could be emissions from construction activities (such as demolition, earthworks and trackout), as well as plant and machinery for all the options. Mitigation to reduce construction dust impacts and plant emissions will be required for all the Proposed Scheme options, given the proximity to existing sensitive receptors. The scale of mitigation will depend on the outcomes of a construction dust risk assessment, which will be undertaken at a later stage. Tertiary mitigation measures would be expected to be effective for dust and emissions from plant and machinery and would be expected to be included in a Construction Environment Management Plan.

Operational effects

The Proposed Scheme is intended to reduce congestion which can result in beneficial changes in emissions to air quality. It also has the potential to result in increases in traffic flows and subsequently, adverse effects on emissions to air quality. Mitigation for these adverse effects would include measures already included within the wider objectives of the SOBC such as promoting sustainable and active travel. The requirement for further measures would be dependent on the preferred option selected and informed by air quality model at the next stage of the project.

In addition, where on-line dualling is proposed, this should be undertaken on the side of the existing A10 without sensitive receptors in close proximity to the road, where reasonably practicable. This would be to avoid bring traffic (and associated emissions) closer to sensitive receptors.

3.1.7 Topic specific environmental risks

Specific risks relating to air quality would be as follows:

- Each of the Proposed Scheme options have the potential to affect air quality (both positively and negatively) at a number of sensitive human health receptors. The resulting impacts will need to be quantified and assessed going forwards, however, existing monitoring results indicate exceedances of AQOs would be unlikely to occur in the vicinity of the Proposed Scheme.

- All of the Proposed Scheme options have the potential to affect nitrogen deposition within a designated ecological site. Changes in nitrogen deposition within this site will need to be quantified and the potential impact assessed by an ecologist, should this site be confirmed as being sensitive to nitrogen deposition.

- Changes in traffic conditions across the wider road network as a result of each Proposed Scheme option have the potential to result in air quality impacts at sensitive human health and ecological receptors not considered within this assessment, including within AQMAs and adjacent to PCM links (risk for all options). Further assessment will therefore be required to quantify these impacts.

3.1.8 Preferred option

Option D has 358 properties within 200m of the proposed alignment, which is the fewest for any of the options and much fewer than the existing alignment of the A10, which has 1,322. This option therefore has the greatest potential to reduce the exposure of sensitive receptors to air pollution in the vicinity of the A10.

Options A, B, C and E will also potentially affect fewer receptors than the existing alignment of the A10 and therefore could also potentially result in a reduction in exposure to air pollution in the vicinity of the A10.

All of these options, however, have the potential to result in a substantial increase in traffic flows along the A10, which could result in adverse impacts along sections of the A10 which were not realigned away from sensitive receptors and / or as a result of subsequent changes in traffic conditions further afield.

Only Option G would not be expected to have these wider effects but along with Option F would have the highest number of properties within 200m of the proposed alignment.

Therefore, overall Option D would be the preferred option for air quality. Option G may have the potential for avoiding wider effects but Option D would have the potential to have the largest benefit for residential receptors most affected alongside the existing A10.

3.2 Climate

This chapter sets out the requirements for assessing and reporting the effects of climate on highways (climate change resilience and adaptation), and the effect on climate of greenhouse gas from construction, operation and maintenance projects. As stated in the document, "The assessment and reporting shall identify the scale and nature of GHG emissions across the whole project life cycle" and "The assessment should report on construction and operational (maintenance and user) GHG emissions."

3.2.1 Legislative and policy framework

Climate Change Act 2008 (2050 Target Amendment) - The Climate Change Act provides a framework for the UK to reach its long term goal of reducing carbon emissions relative to a 1990 baseline. This was originally set as an 80% reduction in emsiisons by 2050 but this was amended in 2019 so that "the minimum percentage by which the net UK carbon account for the year 2050 must be lower than the 1990 baseline is increased from 80% to 100%." Under this Act the UK government is requried to set legally binding carbon budgets that act as limits to the quantitiy of GHG emissions in fixed periods of 5 years in the UK. The first 5 carbon budgets for caps on GHG emissions have been placed into legislation and currenlty run up to the year 2032. UK carbon budgets are as per Table 3.2.1.

Table 3.2.1 UK carbon budgets[2]

Budget	Carbon Budget Level ($MtCO_2e$)
1st Carbon budget	3,018
2nd Carbon budget	2,782
3rd Carbon budget	2,544
4th Carbon budget	1,950
5th Carbon budget	1,725

Paris Climate Agreement 2016 – This agreement committs to keeping global temperature rise as close to 1.5C as possible.

In addition, both the South Cambridgeshire District Council Zero Carbon Strategy and the East Cambridgeshire District Council Environment Plan both set out the Authorities' vision and apporach to reaching the 2050 Net Zero target.

3.2.1 Assessment Methodology, assumptions and limitations

The Highways England Design Manual for Roads and Bridges: LA 114 Climate provides the basis of the assessment methodology for climate.

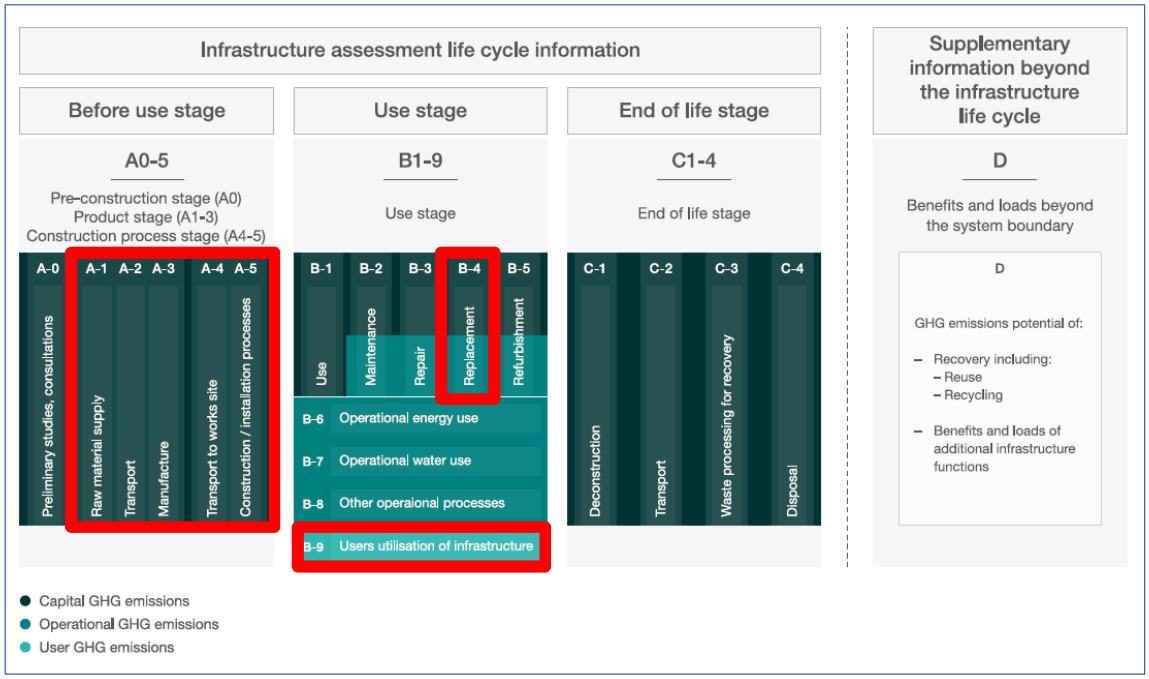
The methodology outlined here is as per LA114 which, mandates that it, "shall be implemented forthwith on all schemes requiring an assessment of climate on the Overseeing Organizations' motorway and all-purpose trunk roads according to the implementation requirements of GG 101."

For the purpose of this report Greenhouse gases (GHG) and Carbon dioxide equivalent (Carbon - CO_2e) have been used throughout and can be considered to be analogous.

A lifecycle assessment approach has been taken in line with PAS 2080 and LA 114 based on the following lifecycle modules, highlighted on the Figure 3.2.1.

[2] https://www.gov.uk/guidance/carbon-budgets

Figure 3.2.1: Life cycle modules taken from BS EN 15978:2011 and adapted for PAS 2080 and infrastructure. Red outline indicates the scope for this study.



Construction

The GHG emissions calculation for the project life cycle was completed using data and assumptions such as emission factors from the Highways England carbon calculator and applying key principles and assumptions (where missing from the HE tool) from PAS 2080: 2016 Carbon Management in Infrastructure and RICS professional standards and guidance, UK Whole life carbon assessment for the built environment (2017).

The construction assessment includes the following life cycle stages (note B4 maintenance is included in operational emissions as it is classed as maintenance):

- Product stage (A1-A3); including raw material supply, transport and manufacture.
- Construction process stage (A4-A5); including transport to/from works site and construction /installation processes.

Some of the key assumptions used were:

- Uniform depths of key materials have been assumed: Asphalt – 350mm, Sub base - aggregate (250mm) and Capping -- aggregate(200mm) and converted to m^2 areas using 18.8m width for on-line sections and 27.1m width for offline. This was then multiplied by the relevant length of each section.
- Standard material densities (from the HE carbon tool) were used to convert volume to tonnage for application of the relevant carbon emission factor.
- A5 construction site emissions were calculated based on capital cost and application of a benchmark of 1400kg CO_2e/£100k of project value (taken from BRE SMARTWaste).

- Transport distances were assumed to be 50km by HGV for all materials in line with RICs assumptions for these material types. It is also assumed that all materials would be brought from off site and there would be no reuse of existing aggregate within the Proposed Scheme. This would a worst case scenario.

- It has been assumed there would be no demolition (removal) of the existing A10 for any option.

Limitations to this assessment were:

- A limited material range has been used for the purpose of the assessment (only 2 key materials of aggregate and asphalt) and no accounting for e.g. noise barriers and other additional elements was undertaken because the information was not available at this stage of the project.

- A standard depth of material has been assumed throughout due to lack of more detailed information, for example sub base has been assumed to be 250mm throughout when this might be adjusted according to ground conditions.

- Junctions were calculated based on the area the junction covered and were assumed to be comprised of the same materials as the road itself.

- Land use change impacts have not been included in the assessment as this data was not judged to be sufficiently accurate, certain or significant to be included. This is in line with the proportionate approach principle in LA 114.

Operational

The operational assessment has been further divided into the following stages:

- Use of the infrastructure by the end-user (road user) – covered by WebTag and TUBA assessments over a 60 year period (B9)
- Operation and maintenance (B4) replacement of assets within the 60 year assessment.

For the operational use by end users, Carbon impacts assessment was carried out in TUBA using the methodology as described in section 4.2 of TAG Unit A3.

In summary, this takes total per year vehicle kilometers s by vehicle type from the traffic flow modelling and calculates the resulting fuel consumption, taking account of fuel efficiency changes as well as changes in the fuel mix over time (for both petrol/diesel cars – untraded and electric vehicles – traded). From this, the resulting CO_2e emissions were calculated and then converted to an equivalent cost using relevant carbon monetary values per tCO_2e emitted. The monetary value is then expressed in 2010 market prices.

Some key assumptions used were:

- Road pavements were assumed to have a 40 year design life with resurfacing works being every 10 years for replacement (B4) emissions

- Do minimum for construction/maintenance embodied emissions was assumed to include only replacement of material as part of the ongoing maintenance or online options. It was assumed that online roads would still be required to be maintained in a do minimum scenario.

Key limitations to this assessment were:

- No emissions were calculated for repair of assets.

- Although the impact of the GHG emissions is not location specific, the impacts could still be judged significant at a global level, despite the clear boundary of the assessment around the scheme corridor in this case.

3.2.2 Study Area

The primary study area is the carriageway and junction footprint of the proposed options, with variance for offline and online options. The study has been principally divided into construction and operational GHG emissions as per LA 114 and it is noted that is important to assess this as early in the design process as possible as this is where the largest carbon emission reductions can be achieved. For operational emissions and as per LA 114, the study area is consistent with the affected road network defined in the project's traffic model.

3.2.3 Baseline Conditions

As the A10 is already an operational road scheme, the baseline conditions are related to current vehicle usage emissions (shown by the 'Do Minimum' outputs from TUBA) and the maintenance activities that would be required in order to continue operation of the current 'online' road based on a 60 year study period. The baseline GHG emissions are consistent with the study area outlined for the project.

3.2.4 Likely significant effects

GHG emissions have been assessed against significance in regard to the relevant UK carbon budget and as per Table 3.18 Project GHG emissions against relevant carbon budgets from LA 114. The significant effects have been divided across the relevant carbon budgets (4th budget 2023-2027 and 5th 2028-2032) and therefore construction emissions have been allocated against the 4th budget and operational (construction/maintenance related and Road user related) have been allocated against the 5th budget.

In order to assess the impact of operational construction/maintenance emissions within the budgeted period, a proportion of these emissions have been allocated to the 5 year budget period. As replacement cycles would be carried out at assumed intervals longer than 5 years, it might be that technically there would be no replacements within this 5 year period and using this method is therefore a conservative assumption. The same process has been undertaken for the end user carbon modelling, which, although it has been done over a 60 year period, only the first 5 years of the scheme (to marry with the 5th Carbon budget) have been included in the significant impacts table below.

It should be noted that these emissions have been reported for completeness and to act as an evidence base for any decision, but LA 114 guidance notes the following on the level of significance:

- National policy states that "It is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets".
- In the context of above, "it is considered unlikely that projects will in isolation represent significant effects on climate."
- However, Carbon budgets are set at the UK level and are therefore large in scale. Hence although any single infrastructure project would be unlikely to materially impact the UK level budget, the receptor for GHGs is in fact global and due to increasing focus on greenhouse gases, the fact that the project is releasing GHGs is important.

Table 3.2.2 Summary of Likely Significant Effects

Option		Summary of likely significant effects		
		Estimated total carbon over carbon budget (tco2e) (Do Something scenario)		Net CO2 project GHG emissions (tco2e) (Do Something - Do minimum)
Carbon Budget		4th	5th	n/a
Option A	Construction (tCo2e)	25,911	N/A	18,217
	Operation (construction related)	N/A	7,694	N/A
	Operation (end user)	N/A	7,974,512	10,285
	Impact on carbon budget (% of total)	0.001%	0.45225%	N/A
Option B	Construction	26,839	N/A	18,847
	Operation (construction related)	N/A	7,992	N/A
	Operation (end user)	N/A	7,977,919	40,484
	Impact on budget (% of total)	0.001%	0.45246%	N/A
Option C	Construction	9,258	N/A	6,574
	Operation (construction related)	N/A	2,684	N/A
	Operation (end user)	N/A	7,995,624	174,793
	Impact on budget (% of total)	0.0005%	0.45316%	N/A
Option D	Construction	29,964	N/A	21,080
	Operation (construction related)	N/A	8,884	N/A
	Operation (end user)	N/A	7,979,345	40,544

Option		Summary of likely significant effects		
		Estimated total carbon over carbon budget (tco2e) (Do Something scenario)		Net CO2 project GHG emissions (tco2e) (Do Something - Do minimum)
	Impact on budget (% of total)	0.002%	0.45259%	N/A
Option E	Construction	24,406	N/A	017,164
	Operation (construction related)	N/A	7,242	N/A
	Operation (end user)	N/A	7,975,774	21,620
	Impact on budget (% of total)	0.001%	0.45230%	N/A
Option F	Construction	7,740	N/A	5,508
	Operation (construction related)	N/A	2,232	N/A
	Operation (end user)	N/A	7,996,369	200,067
	Impact on budget (% of total)	0.0004%	0.45318%	N/A
Option G	Construction	4,250	N/A	2,956
	Operation (construction related)	N/A	1,294	N/A
	Operation (end user)	N/A	7,993,330	59,249
	Impact on budget (% of total)	0.0002%	0.45295%	N/A

In order to best compare the options a whole life carbon (as per the scope above) assessment for the 60-year appraisal period has been carried out below. A summary graph is presented in figure 3.2.2

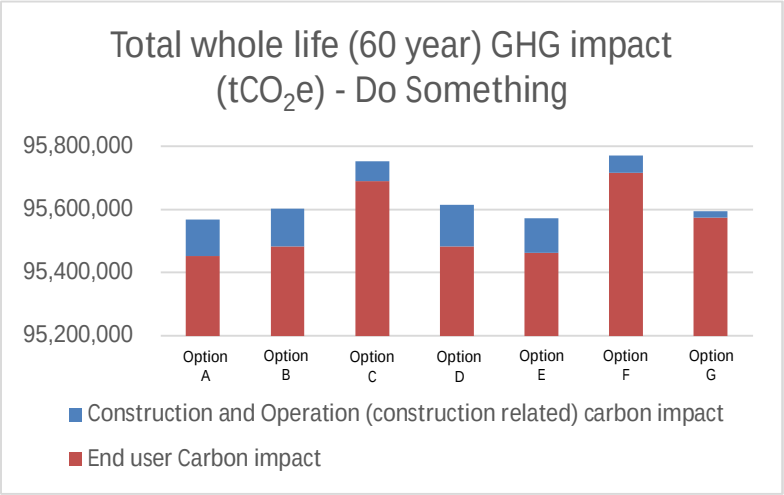


Figure 3.2.2: Total whole life (60 year) GHG impact (tCO2e) - Do Something

Table 3.2.2 Strengths and weaknesses for each of the proposed options

Option	Strengths / weakness
Option A	Strength – Lowest whole life carbon impacts Total: 95,566,278 tCO_2e Rank – 1 for Carbon impact
Option B	Rank – 4 for Carbon impact Total: 95,600,935 tCO_2e
Option C	Weakness – 2nd Highest whole life carbon impact Total: 95,751,887 tCO_2e Rank – 6 for Carbon impact
Option D	Weakness – 3rd Highest whole life carbon impact Total: 95,614,370 tCO_2e Rank – 5 for Carbon impact
Option E	Strength – 2nd Lowest whole life carbon impacts Total: 95,570,837 tCO_2e Rank – 2 for Carbon impact

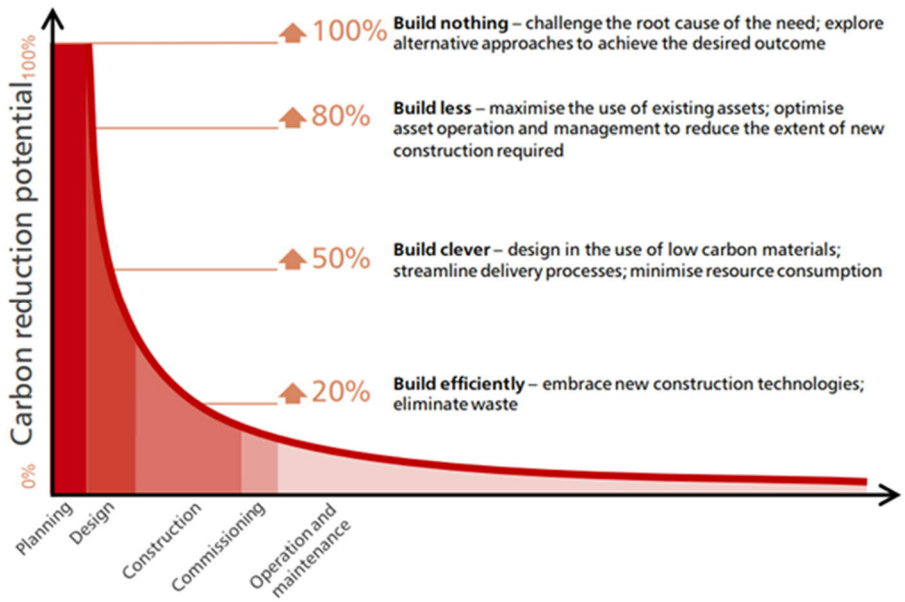
Option	Strengths / weakness
Option F	Weakness – Highest whole life carbon impact Total: 95,770,384 tCO_2e Rank – 7 for Carbon impact
Option G	Strength – 3rd Lowest whole life carbon impacts Total: 95,592,606 tCO_2e Rank – 3 for Carbon impact

It should be noted that although there would be more significant absolute differences between options when assessing whole life carbon for construction and operational (construction related), in relative terms the end user operational carbon impact comprises the majority of the total footprint for each option. The differences between operational (end user) impacts were minor (around 200,000 tCO_2e), especially when compared with UK Carbon Budgets.

3.2.5 Required mitigation and enhancement opportunities

At this stage there are no option specific mitigation measures for GHG emissions but there would be general principles from PAS 2080:2016 that should be considered at an early stage of the design in the next stage of the project. The importance of these is outlined in Figure 3.2.3

Figure 3.2.3 Carbon reduction curve - Infrastructure Carbon Review (2013). Source: Green Construction Board



Construction effects

Some suggested interventions to mitigate construction impacts would be:

- Low carbon plant and use of solar powered construction sites where feasible (Build efficiently).
- Local sourcing of materials to minimise transport distance and reuse of aggregate and site won material on site (Build clever)
- Increase recycled content of Asphalt (Build clever)
- Use existing depots of maintenance vehicles (Build less)
- Review required depth of sub base to optimise where possible and use less material (Build less)
- Maximise use of existing pavement to avoid new build (Build less)

Operational effects

- Look to optimise and extend the design life of key materials to avoid or reduce replacement (Build less)
- Encourage uptake of Ultra Low Emission Vehicles (Electric, Hydrogen) by strategic provision of charge points/filling stations with a suitable capacity and charge speed.
- Incorporate renewable energy technology where feasible, for example to power roadside signs
- Purchase energy efficient roadside signage and lighting (LEDs)
- Encourage model shift to lower carbon methods of transport than private car

3.2.6 Topic specific environmental risks

Specific risks relating to climate would be as follows:

- The GHG impact of the chosen option should be revisited to create a more accurate and complete footprint at the appropriate time, to minimise the impact of assumptions.
- Construction of a new road and reduced travel times could negate some emission savings from more efficient travel (reduced congestion) by making travel by motor vehicle more appealing and hence inducing demand on the network being considered by encouraging trips.
- All the Proposed Schemes have a negative impact on climate by resulting in increased GHG emissions over the 60-year assessment period.
- Changes in related traffic conditions across the wider road network as a result of each Proposed Scheme option have the potential to result in further impacts on GHGs and this is not considered within this assessment. Further assessment will therefore be required to quantify these impacts.

3.2.7 Preferred option

Option A (95,566,278 tCO_2e) would be the preferred option for climate as it would have the lowest overall whole life carbon impacts with approximately a 200,000 tCO_2e saving over 60 years (approx. 3,500 tCO_2e per year) when compared with Option F (95,770,384 tCO_2e), which has the highest whole life carbon impacts.

It is however noted that in the context of this road scheme when compared to the UK overall carbon budget, none of the options presented would be more than a minor impact but any GHG emissions above baseline should be considered an adverse impact on the global climate receptor.

3.3 Biodiversity

This Section reports a comparative assessment of how the seven alternative route options may vary in their effect on biodiversity, their strengths and weaknesses and a conclusion on which option is preferred. This has focused on the designated sites and important habitats in close proximity to the different routes with the potential to be adversely affected as a result of the land take required for the Proposed Scheme, disturbance such as noise and vehicle emissions. This chapter is supported by Figures 4 to 4.56 in Appendix C.

3.3.1 Legislative and policy framework

The following legislation and national and local policies are relevant to this topic:

- Conservation of Habitats and Species Regulations 2017 (as amended) - Usually referred to as the "Habitats Regulations" they implement Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) into national legislation. Articles 12 and 13 of the Habitats Directive contains a range of prohibitions seeking to protect species listed on Annex IV (animal and plant species in need of strict protection). European Protected Species are animals and plants that receive protection under The Conservation of Habitats and Species Regulations 2017.

- Wildlife and Countryside Act (WCA) 1981 (as amended) - Refers to the treatment and management of protected species listed as Schedule 1 (birds), 5 (mammals, reptiles, fish and invertebrates) and 8 (plants) and 8 (non-native invasive species). The most relevant legislation is under Section 9. It is an offence to intentionally kill, injure, or take a scheduled species that is living wild at the time; to possess a scheduled species; to damage, destroy or obstruct access to the place of refuge used by the protected species.

- Natural Environment and Rural Communities (NERC) Act 2006 - Section 41 lists species of principal importance habitats of principal importance. These are the species and habitats found in England which were originally identified under the UK Biodiversity Action Plan (UK BAP) as requiring priority conservation action and they continue to be regarded as conservation priorities under the UK Post-2010 Biodiversity Framework.

- The Hedgerows Regulations 1997 - Affords protection to hedgerows which are deemed important for their ecological and archaeological/historic significance in England and Wales.

- Protection of Badgers Act 1992 - Makes it illegal to wilfully kill, injure, take, cruelly treat, sell, possess or mark a badger. It also makes interference with badger setts illegal, including damaging, destroying or disturbing a sett, intending to do any of these, or being reckless to the consequences of actions which may result in interference.

- National Planning Policy Framework (2019) - This policy sets out the Government's view on how planners should balance nature conservation with development and helps ensure that Government meets its biodiversity commitments regarding the operation of the planning system. There is a presumption against the loss, damage or destruction of irreversible habitats, loss of damage to SSSIs. The NPPF encourages demonstratable net gain to biodiversity.

3.3.2 Assessment Methodology, assumptions and limitations

The following guidance has been used to inform the assessment methodology:

- Department for Transport (2018) TAG: Advice for the Technical Project Manager. Available at: <www.gov.uk/government/publications/webtag-advice-for-the-technical-project-manager-may-2018> [accessed 24th May 2020].

- Department for Transport (2019). Transport Analysis Guidance (TAG). Available at: <www.gov.uk/transport-analysis-guidance-webtag> [accessed 24th May 2020].

- Design Manual for Roads and Bridges (2019) LA 104 Environmental Assessment and Monitoring. Available at https://www.standardsforhighways.co.uk/prod/attachments/78a69059-3177-43dc-94bd-465992cfda82 [accessed 24th May 2020]

- Design Manual for Roads and Bridges (2019) LA 108 Biodiversity Revision 1 Available at: <https://www.standardsforhighways.co.uk/dmrb/search?volume=11&section=3> [accessed 24th May 2020]

- Design Manual for Roads and Bridges (2020). LA 118 Biodiversity Design Available at https://www.standardsforhighways.co.uk/prod/attachments/9317652b-4cb8-4aaf-be57-b96d324c8965 [accessed 24th May 2020]

- The Guidelines for Ecological Impact Assessment (CIEEM, 2018 (updated)).

The Proposed Scheme is at an early stage of route optioneering. There are no detailed designs and the construction methodology is not defined at this stage.

The presence of ecological features has been identified based on a desk top review. This comprised a review of statutory and non-statutory designated site information and notable habitats using the sources outlined below. The presence of habitats of principal importance (HoPI) (as defined by S41 of NERC Act (2006)) is based on Natural England's Priority Habitat Inventory data available from MAGIC and has not been verified. No protected or notable species data (including data on veteran trees), has been obtained to inform this appraisal. The potential presence of protected or notable species has been identified based on identified habitats with cross reference to the Cambridgeshire Biodiversity Action Plan (BAP), as well as review of citation sheets of designated sites and licence application information on MAGIC. The following sources have been used to inform the ecological baseline:

- Cambridgeshire & Peterborough Environmental Records Centre (non-statutory designated site information) (18th May 2020);

- Cambridgeshire and Peterborough Biodiversity Group (2020) Cambridgeshire Local Biodiversity Action Plan (BAP) Species List and Additional Species of Interest List. Available at: <www.cpbiodiversity.org.uk/downloads> [accessed 14th May 2020];

- Multi-Agency Geographic Information for the Countryside (MAGIC) (2020) Available at: www.magic.defra.gov.uk/MagicMap.aspx> [accessed 9th April 2020];

- Joint Nature Conservation Committee (JNCC) Information sheets associated with international and European designated sites www. jncc.gov.uk [accessed 22nd May 2020]; and

- Online aerial photography including Google Maps and Bing Maps.

The limitations of and assumptions made during this assessment were:

- There has been no purchase of species-specific ecological records (e.g. bats, great crested newt) or ecological surveys undertaken to inform this assessment, which is considered appropriate for the purposes of this assessment. For the purpose of this appraisal it is assumed that the information provided by the listed sources is accurate.
- It is recommended the ecological baseline data, in particular the presence of HoPIs and protected species is verified and expanded at the next stage by site survey.
- A degree of land take will be required to the east and west of the Existing A10 and where junction and slip road improvements have been identified.
- Potential impacts associated with changes to air quality and noise have been considered in relation to the sites outlined in the search areas below. Additional sites of ecological interest in the wider area may require consideration for changes to air quality and noise once traffic modelling has been completed.

3.3.3 Study Area

The biodiversity study area for this assessment was based on the likely zone of influence (ZoI) relevant for each ecological feature that has been identified. Professional judgement has been used to define the following proportionate approach to the ZoI:

- International or European Designated sites within a 5km, increased to 10km, 30km and 50km for sites where birds, bats and harbour seals (Phoca vitulina) with hydrological connectivity are listed as reasons for designation respectively);
- Statutory National Designated Sites within the study area including National (Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNRs)) and Regional (Local Nature Reserves (LNRs)) within a 2km study area; extended to 5km where there are clear hydrological connections);
- Non-statutory Local Designated Sites within the study area including County Wildlife Sites (CWS) and City Wildlife Sites (1km study area);
- Habitats of Principal Importance within a 500m study area; and
- Protected and notable species broadly up to 2km with the additional consideration of qualifying species that may be associated with designated sites listed above.

The ZoI has been defined for each of the alternative options in line with the above study areas. The study area has been taken from the footprint of each option as opposed to the existing A10, as such the extent of the ZoI varies for each option. The study areas are illustrated in the Ecological Constraints Plans (Figures 4 to 4.56, Appendix C) which indicate this ZoIs in relation to each option

3.3.4 Baseline Conditions

There are six statutory designated sites of international importance within the defined study areas (combined the ZoI for all options). These comprise: Ouse Washes Special Protection Areas (SPA); Ouse Washes Ramsar, Wicken Fen Ramsar (which is also designated nationally as a SSSI and National Nature Reserve (NNR); Fenland Special Areas of Conservation (SAC); Eversden and Wimpole Woods SAC, and The Wash and North Norfolk Coast SAC.

There are two statutory designated sites of national importance (Sites of Special Scientific Interest (SSSIs)) and two of regional/local importance (Local Nature Reserve (LNR)) within the defined, combined study areas. These comprise: Cam Washes SSSI; Ely Pits and Meadows SSSI; Upware North Pit SSSI; Bramblefields LNR; and Words Meadow LNR.

There are five non-statutory designated sites within 1km of all route options. From south to north of the existing A10 these comprise: Milton Road Hedgerows City Wildlife Site, Cambridge Road Willow Pollards County Wildlife Site (CWS), Landbeach Pits and Willow Wood CWS, Beach Ditch and Engine Drain CWS, Angel Drove Drains County Wildlife Site (CWS) (all located within 1km of the routes A-G). The River Great Ouse CWS is hydrologically linked to Beach Ditch and Engine Drain CWS and is within 1km of options A, B, D and E.

A total of eight mapped habitats of principal importance types from Natural England's Priority Habitat Inventory and/or listed on the local BAP are located within 1km of all route options: broadleaved semi-natural woodland (non-ancient woodland areas), traditional orchards, rivers and streams, ponds, hedgerows, floodplain grazing marsh, lowland fens and semi-improved grassland. Some of these habitats are located within the footprint of all route options (to varying degrees depending on the specific option)

Within the study area, the habitats within semi-natural areas that are not intensively managed (for example the HoPIs listed above) are likely to support protected and notable species (i.e. species of principal importance (as defined by S41 of NERC Act (2006)) or listed on the local BAP) including:

- Mammals such as bats, badger (Meles meles) otter (Lutra lutra), water vole (Arvicola amphibius), hazel dormice (Muscardinus avellanarius), harbour seal, common dolphine (Delphinus delphis) European hedgehog (Erinaceus europaeus), brown hare (Lepus europaeus) and polecat (Mustela putorius);
- Wintering and breeding birds including LBAP species yellowhammer (Emberiza citrinella), stone-curlew (Burhinus oedicnemus) and hawfinch (Coccothraustes coccothraustes);
- Amphibians such as great crested newt (Triturus cristatus) and common toad (Bufo bufo);
- Reptiles such as common lizard (Zootoca vivipara), grass snake (Natrix natrix), slow worn (Anguis fragilis) and adder (Vipera berus);
- Invertebrates including LBAP species tansy beetle (Chrysolina graminis), white letter hairstreak (Satyrium w-album) and Norfolk hawker (Aeshna isosceles);
- Fish such as Atlantic salmon (Salmo salar), brown trout (Salmo trutta) and European eel (Anguilla anguilla), and
- Plants and fungi, including LBAP species fen violet (Viola persicifolia), fen wood-rush (Luzula pallidula) and white helleborine (Cephalanthera damasonium).

The potential presence of these species within the study area has been determined based on the identification of associated habitats and reference to their presence in the wider area based on desk study sources.

3.3.5 Likely significant effects

Based on the information available to inform this appraisal, the following likely effects have been assessed as moderate adverse, before site specific mitigation, and have therefore been considered to be significant.

Table 3.3.1 Summary of likely significant effects

Option	Summary of likely significant effects*
Option A	<u>European Designated Sites</u> Anecdotal evidence suggests that low numbers of harbour seal (a qualifying species of the Wash and North Norfolk Coast SAC) are regular visitors to the River Great Ouse[3]. Major construction work over the River Great Ouse (e.g. through bridge construction or dualling) has the potential to result in underwater noise disturbance, pollution, air quality and loss of prey for harbour seal. These effects could cause disruption to harbour seal's feeding and hunting behaviour and in extreme cases could cause hearing damage/loss. The estimated SAC population of harbour seal ranges from 2,500[4] to 3,850[5]. On the assumption that less than 1% of the population (i.e. 25 – 38 individuals) have the potential to be affected by such construction work the anticipated magnitude of this effect on the qualifying feature

[3] Hows, M (2017) 'The Secretive Seals of Cambridgeshire. Freshwater Feeding and Inland Breeding' in Mammal News: Summer 2017.(www.mammal.org.uk; http://www.hows.org.uk/inter/birds/2017photo/summer2017.pdf) [Accessed 23rd June 2020]
[4] Savage, S (2019) 'Seals in Sussex' in Mammal Week 2019- Seals (20th October 2019) https://www.mammal.org.uk/2019/10/mammal-week-2019-seals/ [Accessed 23rd June 2020]
[5] Joint Nature Conservation Committee (2016) Natura 2000 Standard Data Form Special Areas of Conservation UK0017075 The Wash and North Norfolk Coast (22/12/2015) https://jncc.gov.uk/jncc-assets/SAC-N2K/UK0017075.pdf [Accessed 23rd June 2020]

Option	Summary of likely significant effects*
	of the SAC would be likely to be minor negative, resulting in a potential moderate adverse effect to the SAC. This would need to be fully assessed and documented within an HRA Screening Report at the next stage of the project. <u>County Wildlife Sites</u> There would be the potential for direct habitat loss at Beach Ditch and Engine Drain CWS and River Great Ouse CWS where traversed by or immediately adjacent to Option A online carriageway dualling. There would also be the potential for secondary pollution related impacts arising from changes to water or air quality at these CWS as well as Landbeach Pits and Willow Wood CWS which is hydrologically connected to Beach Ditch and Engine Drain CWS. <u>Habitats of Principle Importance</u> Option A would have the potential for direct loss, fragmentation and/or secondary effects to HoPI lowland fen associated with the River Great Ouse CWS where subject to online carriageway dualling. Increased run-off and pollution during construction and changes to groundwater could also adversely affect the condition of such habitats. This habitat type is irreplaceable. There would be likely to be direct loss, fragmentation and/or secondary effects to HoPI floodplain grazing marsh arising from both online carriageway dualling (at Great River Ouse and immediately south of the Waste Treatment Site), and new offline carriageway (to the west of Denny End Road). Increased run-off and pollution during construction could also adversely affect the condition of such habitats. <u>Protected Species</u> Changes to the water environment would also have the potential to affect existing ponds and the species they support. There would be the potential for significant effects to nesting and wintering birds (e.g. associated with Worts Meadow LNR and floodplain grazing marsh). Species within the immediate local area are likely to be habituated to traffic noise levels due to the existing A10, however, construction noise particularly associated with new offline carriageways in areas of potential ornithological interest have the potential to create most disturbance. Option A would have the potential to sever connectivity of Worts Meadow LNR bird species to the semi-natural habitats including floodplain grazing marsh to the west. Habitats likely to support nesting or wintering birds which may be subject to direct loss, fragmentation or secondary effects (e.g. associated with noise) from Option A include floodplain grazing marsh, hedgerows, farmland. The risk of collision strike for barn owl would also be greatest where new offline routes would be created. There would also be a risk of direct mortality, habitat loss, fragmentation, severance to bats, hazel dormouse, reptiles, terrestrial and aquatic invertebrates. Habitat losses also have the potential to adversely affect notable plants and fungi.

Option	Summary of likely significant effects*
Option B	The potential effects from Option B would be as reported for Option A for European Designated Sites, County Wildlife Sites, Habitats of Principal Importance and Protected Species with the following exceptions: <u>County Wildlife Sites</u> There would be an additional risk of secondary effects to Great River Ouse CWS and associated floodplain grazing marsh due to the proximity of the eastern offline section around Stretham to this CWS. <u>Habitats of Principle Importance/ Protected Species</u> There would be likely to be additional habitat loss and fragmentation of habitats of principal importance and habitats used by protected species due the longer offline route.
Option C	<u>Local Nature Reserve</u> The effects to Worts Meadow LNR would be as described for Options A and B. <u>Habitats of Principal Importance</u> South of Cambridge Research Park the effects on HoPI floodplain grazing marsh would be comparable to Options A and B <u>Protected Species</u> South of Cambridge Research Park the potential effects to nesting and wintering birds associated with Worts Meadow LNR and floodplain grazing marsh would be comparable to Options A and B. The habitat loss, fragmentation and severance effects of the offline route would have the potential to adversely affect bats, wintering and breeding birds, great crested newts, reptile and hazel dormouse.
Option D	<u>European Designated Sites</u> As per Options A and B, the construction of a new crossing point over the River Great Ouse would have the potential to adversely affect low numbers of harbour seal, a qualifying species of The Wash and Norfolk Coast SAC. This would need to be fully assessed and documented within an HRA Screening Report at the next stage of the project. <u>Local Nature Reserve</u> Option D would have the potential to result in severance and fragmentation effects on Worts Meadow LNR which is situated between the existing A10 to the east and the new proposed offline carriageway to the west. This would have the potential to affect bird species listed on the Worth Meadow LNR designation and their connectivity to the LNR.

Option	Summary of likely significant effects*
	County Wildlife Site Option D would result in the greatest habitat loss and fragmentation of CWSs. It would require a completely new crossing point over River Great Ouse CWS which may be comparable in terms of footprint of habitat loss compared to Options A and B, but more significant in terms of severance and fragmentation within this CWS. Option D would also result in two crossing points over Beach Ditch and Engine Drain CWS (compared with the one crossing associated with Options A and B). Option D would also sever connectivity of Landbeach Pits and Willow Wood CWS to the surrounding landscape as it would be located between the existing A10 to the east and the new carriageway to the west. The potential for secondary pollution related impacts to the above CWS as well as other rivers and streams would also greatest for Option D (compared with the other options) due to the increase in numbers of crossing points and closer proximity to Landbeach Pits and Willow Wood CWS. This would also result in greatest risk of impacts to notable fish. Habitats of Principal Importance Option D would have the potential to result in the secondary effects to HoPI lowland fen associated with Landbeach Pits Willow Wood CWS due to the close proximity of the new carriageway and the potential for hydrological changes. Increased run-off and pollution during construction and changes to ground water could also adversely affect the condition of such habitats. This habitat type is irreplaceable. Option D would have the potential to result in direct habitat loss and secondary effects HoPI floodplain grazing marsh including areas associated with the River Great Ouse CWS. Secondary hydrological impacts associated with groundwater would have the potential to affect floodplain grazing marsh. Increased run-off and pollution during construction and changes to groundwater could also adversely affect the condition of such habitats. Option D would have the potential to result in significant hedgerow loss and fragmentation of hedgerow and semi-natural broadleaved woodland where remaining habitat would become isolated between the existing carriageway and the new offline route to the west. Protected Species Changes to the water environment described for HoPIs would also have the potential to affect ponds which has the potential to result in adverse effects on aquatic invertebrates and amphibians including great crested newt. Option D would have the potential to result in significant effects to nesting and wintering birds associated with Worts Meadow LNR and floodplain grazing marsh and lowland fen habitats. Species within the immediate local area are likely to be habituated to traffic noise levels due to the existing A10, however, construction noise particularly associated with new offline carriageways in areas of potential ornithological interest would have the potential to create most disturbance. Option D would be likely to sever connectivity of bird species listed in the Worts Meadow LNR to the surrounding landscape, as the LNR would become isolated between the

Option	Summary of likely significant effects*
	existing A10 carriageway to the east, and the new carriageway to the west. Habitats likely to support nesting or wintering birds which may be subject to direct loss, fragmentation or secondary effects (e.g. associated with noise) by Options D include floodplain grazing marsh, lowland fen, hedgerows, farmland. Option D would also result in the greatest severance of hedgerows and therefore fragmentation/habitat loss of farmland bird assemblages. The risk of collision strike for barn owl would also be greatest where new offline routes would be created, most significant for Option D. Option D would have the risk of greatest direct mortality, habitat loss, fragmentation and severance, for protected species including great crested newt, reptiles, bats, hazel dormouse, harbour seal, terrestrial and aquatic invertebrates, otter, water vole, notable fish. Habitat losses also have the potential to adversely affect notable plants and fungi.
Option E	<u>European Designated Sites</u> As per Options A, B and D, major construction over the River Great Ouse for Option E would have the potential to adversely affect low numbers of harbour seal, a qualifying species of The Wash and Norfolk Coast SAC. This will require further consideration through HRA Screening. <u>County Wildlife Sites</u> As per Options A-B there would be the potential for direct habitat loss at Beach Ditch and Engine Drain CWS and River Great Ouse CWS where traversed by or immediately adjacent to the online carriageway dualling for Option E. As per Options A-B, secondary pollution related impacts could arise from changes to water or air quality at these CWS as well as Landbeach Pits and Willow Wood CWS which is hydrologically connected to Beach Ditch and Engine Drain CWS. As per Options A-B there would be potential for direct loss, fragmentation and/or secondary effects to HoPI lowland fen associated with the River Great Ouse CWS as a result of Option E. Increased run-off and pollution during construction could also adversely affect the condition of such habitats. This habitat type is irreplaceable. <u>Habitats of Principal Importance</u> There would be the potential for direct loss, fragmentation and/or secondary effects to HoPI floodplain grazing marsh were associated with River Great Ouse CWS, but this would likely be less than Options A-B which traverse additional areas of this habitat further south. Increased run-off and pollution during construction could also adversely affect the condition of such habitats. <u>Protected Species</u> Loss of mature vegetation associated with the existing carriageway dualling would have the potential to result in the direct mortality and loss of habitat/connectivity for bats, great crested newts, reptiles, hazel dormouse. There would also be the risk of severance and fragmentation on offline sections.

Option	Summary of likely significant effects*
Option F	Protected Species Loss of mature vegetation associated with the existing carriageway dualling would have the potential to result in the direct mortality and loss of habitat/connectivity for bats, great crested newts, reptiles, hazel dormouse
Option G	No significant ecological effects anticipated from Option G.

*At present as the AST guidance has not been updated in line with the DMRB guidance there would be a discrepancy in the level of impact being reported within the environmental assessment compared to the AST workbooks. This is due to a difference in how the value of the receptor is used to determine the magnitude of the impact e.g. In AST guidance (May 2019) Table 12, a site of value of very high for biodiversity and earth heritage with a 'slight adverse' the overall level of effect is considered a minor negative impact, where in Table 3.13 of the for LA 108, a receptor of the same value, with the same level of impact would be considered Moderate or Large. Therefore, although in Table 3.3.2 it has been identified that Options A, B, C, D, E, F would be likely to result in significant effects in EIA terms (without specific mitigation) they should be identified as 'slight adverse' in the AST summary table. However, to address this a professional judgement correction has been made to the AST table so that they are consistent with the assessment in this report.

Table 3.3.2 Strengths and weaknesses for each of the proposed options

Option	Strengths / weakness
Option A	In the absence of specific mitigation, Option A would be likely to result in a number of significant adverse effects. Using a simple GIS calculation 14 potential significant adverse effects have been identified at this stage. These relate to the CWSs (Beach Ditch and Engine Drain CWS, River Great Ouse CWS and Landbeach Pits and Willow Wood CWS), ponds, floodplain grazing marsh, lowland fen. The severance of these habitats, particularly associated with offline sections have the potential to result in significant habitat loss, fragmentation and severance to protected species including bats, hazel dormouse, wintering and breeding birds, reptiles, great crested newts, terrestrial and aquatic invertebrates, and notable plants and fungi. Options A and B have a similar assessment of likely adverse effects, however in comparison Option A would be likely to result in less direct habitat loss, fragmentation due to shorter offline section, as well as lower risk of secondary effects to Great River Ouse CWS and associated floodplain grazing marsh.
Option B	As per Option A, in the absence of specific mitigation, Option B is likely to result in similar levels of adverse biodiversity effects. Using a simple GIS calculation 14 potential significant adverse effects have been identified at this stage. Whilst Options A and B have scored a similar assessment score, Option B carries an additional higher risk of secondary effects to Great River Ouse CWS and associated floodplain grazing marsh due to the proximity of the eastern offline section around Stretham roundabout to this CWS.

Option	Strengths / weakness
Option C	In the absence of specific mitigation, Option C is likely to result in a number of significant adverse effects. Using a simple GIS calculation six potential significant adverse effects have been identified at this stage. These include floodplain grazing marsh, bats, wintering and breeding birds, great crested newts, reptile and hazel dormouse. Option C would be likely to result in fewer adverse ecological effects compared with Options A, B, D and E due to avoidance of impacts relating to Beach Ditch and Engine Drain CWS, River Great Ouse CWS and Landbeach Pits and Willow Wood CWS, floodplain and grazing marsh and lowland fen.
Option D	In the absence of specific mitigation, Option D is likely to result in a number of significant adverse effects. Using a simple GIS calculation twenty potential significant adverse effects have been identified at this stage. These include the Wash and North Norfolk Coast SAC, Worts Meadow LNR, CWSs (Beach Ditch and Engine Drain CWS (two crossings), River Great Ouse CWS and Landbeach Pits and Willow Wood CWS), hedgerows, floodplain grazing marsh, lowland fen, , wintering and breeding birds, great crested newt, bats, hazel dormouse, reptiles, harbour seal, terrestrial and aquatic invertebrates, otter, water vole, notable fish, notable plants and fungi. Option D would be likely to result in the highest number of significant adverse ecological impacts when compared with all other options due to the creation of a completely new carriageway resulting in the greatest direct loss of habitat, severance and fragmentation of notable habitats, designated sites and resources for protected and notable species. In addition the creation of a new carriageway has the greatest potential to result in secondary effects associated with changes in water environment and noise.
Option E	In the absence of specific mitigation, Option E would be likely to result in a number of significant adverse effects. Using a simple GIS calculation ten potential significant adverse effects have been identified at this stage. These include CWSs (Beach Ditch and Engine Drain CWS, River Great Ouse CWS, Landbeach Pits and Willow Wood CWS), floodplain grazing marsh and lowland fen, bats, great crested newt, reptiles, hazel dormouse.
Option F	In the absence of specific mitigation, Option F would be likely to result in a low number of significant adverse effects. Using a simple GIS calculation four overall moderate adverse impacts have been identified relation to bats, great crested newt, reptiles and hazel dormouse. This relates to the likely loss of established vegetation associated with the carriageway dualling which is likely to support these species.
Option G	No moderate adverse impacts have been identified associated with Option G. Option G is likely to result in the least number of adverse effects for ecology. This would be because junction improvements avoid all CWS and would be likely to result in less habitat loss and associated effects to protected/notable species.

3.3.6 Required mitigation and enhancement opportunities

In line with good industry practice design proposals should incorporate primary, secondary and tertiary mitigation measures using a hierarchical system to address impacts on biodiversity resources:

- Loss or destruction of sites, habitats, and species;
- Fragmentation of sites, habitats, or populations of species;
- Loss of connectivity between biodiversity resources or introduction of barriers to movement;
- Disturbance and damage to sites, habitats or species, including emissions, noise, visual and
- Pollution;
- Changes to the systems on which sites, habitats and species depend;
- the effects of climate change.

Where practicable, the scheme footprint should be refined to avoid losses or reduction of CWS, HoPIs and habitat features of particular value for protected species (e.g. a strong hedgerow connecting woodland and/or supporting bat commuting, breeding birds, foraging/shelter for hazel dormouse, reptile and amphibians). Location should also avoid the fragmentation of sites/habitats or introduction of barriers to movement. This would apply specifically to significant losses/fragmentation effects on CWS and HoPIs in relation to Options A, B, D and E. Key areas where micro-siting should be given greater review to reduce the level of ecological effects relate to the dualling of existing, or creation of new crossing points over Great River Ouse CWS, Beach and Engine Drain CWS, and off-line alignments south of Cambridge Research Park.

Losses/damage/reduction of HoPIs and CWS would require compensation planting at a ratio of greater than 1:1 to be considered acceptable in terms of achieving a net gain to biodiversity (exact ratio is dependent on the habitat concerned and in agreement with stakeholders). Habitat compensation carries additional risk. Where practicable, the locations of habitat creation should be located as so to increase the size of existing higher quality habitat and increase connectivity in line with the Lawton principals of 'bigger, better, more joined-up'. Habitat creation areas could also be designed to provide multi-functional benefit e.g. replacing HoPIs whilst simultaneously providing replacement habitat for a suite of protected species e.g. woodland planting with strong hedgerows and ponds to replace losses of HoPIs whilst also creating connected functional replacement habitat for bats, birds and amphibians. There is an opportunity for habitat creation and/or enhancement on road verges including species rich grassland (in line with The National Pollinator Strategy, DEFRA, 2014[6]), strong tree lines to connect to existing woodland and provide flight lines and connectivity for bats, and foraging resource for other protected species e.g. great crested newt/ hazel dormouse, birds. The localised requirement of habitat creation would be determined following a more detailed assessment of effects.

Additional potential elements of a mitigation strategy for losses of CWS and/or habitats may include ecological enhancement and/or management of retained areas in consultation with stakeholders. Depending on ownership and management arrangements (e.g. if a CWS is managed by the local wildlife trust) it may be possible to achieve this through a commuted sum payment.

New crossing points over the River Great Ouse and other smaller watercourses would ideally require oversized culverts and mammal ledges to maintain connectivity for bats and riparian mammals and reduce the barrier effect they create. Any work over or adjacent to the River Great Ouse should adopt standard good practice (tertiary mitigation) to reduce noise and pollution which have the potential to

[6] Department for Environment Food & Rural Affairs The National Pollinator Strategy: for bees and other pollinators in England (November 2014) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794706/national-pollinator-strategy.pdf [Accessed 24th May 2020]

adversely affect protected or notable species, should maintain connectivity along the riparian corridor and may need to consider timing to avoid sensitive times of year (e.g. fish spawning).

Species specific mitigation strategies will also be required. The details of these would be informed by targeted surveys and detailed assessment. For bats, great crested newt, dormouse and otter these may require a European Protected Species Licence (EPSL); for other protected species e.g. badger and water vole a Natural England licence may be required. Species specific mitigation may require extensive habitat creation in advance of vegetation removal e.g. ponds and terrestrial habitat for great crested newt, artificial roosts and foraging habitat creation for bats. Some species mitigation e.g. great crested newt and reptiles may require a trapping out period which could result in the requirement for road closures depending on locations. Species mitigation is also seasonally constrained e.g. avoiding hibernation or breeding seasons of particular species groups which may carry additional timing constraints. The extent of likely habitat creation requirements to mitigate adverse effects to species is likely to correlate to the scale of habitat loss and fragmentation. Option D is likely to require the most significant species mitigation strategy, with Options G the least.

At the time of writing the District Licencing option for great crested newt is not open in Cambridgeshire, however the situation may change in the future which may reduce the requirement for great crested newt survey or mitigation in lieu of a lump sum payment. It should be noted that compensation habitat creation may still be required for other species e.g. reptiles which could normally benefit from the same habitat creation measures as great crested newt thus reducing the cost benefit. Should District Licencing be an option for this scheme in the future, a cost-benefit analysis may be required to compare this option against traditional surveys and mitigation for great crested newt.

3.3.7 Topic specific environmental risks

The following have been identified as biodiversity risks for the next stage of the project:

- Lowland fen habitat is considered irreplaceable (NPPF) (GOV, 2019), and there is a presumption against development resulting in the loss or deterioration of irreplaceable habitats, unless there are wholly exceptional reasons and a suitable compensation strategy exists.
- Loss of habitat that takes a long time to recreate or restore e.g. mature broadleaved deciduous woodland, is given a high multiplier in the Defra 2.0 Metric, and it may therefore become difficult to demonstrate net gain, in line with NPPF, should biodiversity metrics calculations be applied.
- It is assumed that an HRA Screening assessment would not identify likely significant effects, alone or in combination with other plans or projects, however this would need to be confirmed. An HRA Screening would require consideration of functional habitat that supports qualifying species.
- There would be potentially significant timing/cost constraints associated with mitigation/compensation measures for losses to habitats, non-statutory designated sites and protected species.
- The presence and likely scale of impact on protected species should be confirmed through survey data.
- The scale of secondary effects e.g. arising from changes to water environment, air quality and noise are unknown.

3.3.8 Preferred option

The preferred option in biodiversity terms would be Option G. This is the preferred option as, based on this high-level assessment there would be no moderate adverse impacts to identified ecological features. In particular, the reduced proposed working area, in comparison with other options, would result in the lowest risk for protected and notable species.

3.4 Cultural Heritage

This Section reports a comparative assessment of how the seven alternative route options may vary in their effect on cultural heritage, their strengths and weaknesses and a conclusion on which option is preferred. This has focused on the designated sites in close proximity to the different routes with the potential to be adversely affected as a result of the land take required for the Proposed Scheme and effects on setting from for example, noise and visual changes. This chapter is supported by Figures 1 to 1.27 in Appendix C.

3.4.1 Legislative and policy framework

Ancient Monuments and Archaeological Areas Act 1979 (as amended) - Statutory protection is afforded to cultural heritage assets through designation. Under the Ancient Monuments and Archaeological Areas Act 1979 (as amended), archaeological sites and monuments of national importance are designated as Scheduled Monuments.

Planning (Listed Buildings and Conservation Areas) Act 1990 - Details the statutory protection afforded to Listed Buildings. Section 66 states the special considerations affecting planning functions, including the consideration of planning permission for development affecting listed buildings or their settings by Local Planning Authorities (LPAs) or the Secretary of State. The Act also requires LPAs to designate areas of 'special architectural or historic interest' as Conservation Areas with the aim of preserving and enhancing their character and appearance. Historic England may need to be consulted with regard to proposed works within a Conservation Area and section 72(1) requires LPAs to pay particular attention to Conservation Areas in the planning process.

The Hedgerow Regulations 1997 - Affords protection to hedgerows which are deemed important for their ecological and archaeological/historic significance in England and Wales.

National Planning Policy Framework (NPPF) - Section 16 – Conserving and enhancing the historic environment, Paragraphs 189 to 202 which relate to proposals affecting heritage assets and considering potential impacts.

Local Policy

- South Cambridgeshire Local Plan, 2018 (Policies NH/14 and NH/15) seeks to ensure the protection of landscapes and their biodiversity for future generations and retain the special character of historic buildings and places while accommodating modern changes and new and growing settlements.
- East Cambridgeshire Local Plan 2015 (Policies ENV 1, ENV 11, ENV 12, ENV 13, ENV 14, ENV 15 and ENV 16) 'seeks opportunities to enhance or better reveal the significance of heritage assets through all appropriate means, applying the historic environment evidence base as part of a strategy for achieving positive outcomes for the historic environment. This will apply to investigating how heritage assets at risk, or potentially at risk, can be restored and brought back into beneficial use'.

3.4.2 Assessment Methodology, assumptions and limitations

At the SOBC stage the cultural heritage assessment has been based on a simple assessment using technical judgement and knowledge of previous schemes. A Desk Based Assessment has been completed which sets out the known assets within the study area. The Desk Based Assessment is based on data gathered from publicly available online records. HER data to supplement the below information will be procured at the next stage of the project. No specific site surveys have been undertaken at this stage. Where relevant the assessment has been supplemented with Highways England Design Manual for Roads and Bridges (DMRB) guidance LA 106 Cultural Heritage Assessment.

At the next stage of the environmental assessment, an assessment of the value of each asset within the study area will be undertaken using a 5-point scale of Very High, High, Medium, Low and Negligible. This

will be based on professional judgement guided by the criteria provided in DMRB LA 106, with the methodology for the assessment of the value of cultural heritage assets following that provided in DMRB LA 104 Environmental assessment and monitoring.

The following sources of data were used during the data gathering to establish the environmental baseline:

- National Heritage List England (NHLE) for information on the designated cultural heritage resource;
- Natural England National Historic Landscape Characterisation (HLC) data set for information in National HLCs (in the absence of HER Data);
- Information on conservation areas from East Cambridgeshire District Council and South Cambridgeshire District Council websites; and
- Geological information held by the British Geological Service (BGS).

The limitations of and assumptions made during this assessment were:

- No intrusive or non-intrusive archaeological investigations have been undertaken, which is considered appropriate for the purposes of this assessment.
- The assessment will be expanded at the next stage to include HER data. HER data has not been obtained at this stage or used in this assessment.
- Previously unknown archaeological sites will be present prior to construction of the Proposed Scheme.
- A degree of land take will be required to the east and west of the Existing A10 and where junction and slip road improvements have been identified.

3.4.3 Study Area

The study area has been defined as the footprint of each option plus a 200m radius surrounding area. The study area for this assessment is considered appropriate in regard to historic buildings and the historic landscape due to the nature of the proposed works and anticipated sensitivity of the receiving environment. A wider study area extending 1km was used to identify designated cultural heritage assets, the settings of which may be affected by the construction and / or operation of the Proposed Scheme.

3.4.4 Baseline Conditions

For the purposes of this report the cultural heritage resource has been divided into three sub-topics: archaeological remains, historic buildings and historic landscapes. Archaeological remains may be monuments or sites identified as having a degree of significance meriting consideration in planning decisions, because of their heritage interest (Highways England, 2019). Historic buildings may include groups of buildings, groups of separate or connected buildings (recognised for their architecture, homogeneity or their place in the landscape) identified as having a degree of significance meriting consideration in planning decisions, because of their heritage interest (Highways England, 2019). Historic landscapes maybe a place or area meriting consideration in planning decisions, because of its heritage interest (Highways England, 2019).

Based on the sources listed above, a total of 3 archaeological remains, 5 historic buildings, and 7 historic landscapes were identified within the 200m study area. A further 78 historic buildings and 6 archaeological remains were identified within the 1km study (outside the initial 200m study area). There are seven cultural heritage resources located within or adjoining the footprint of the Proposed Scheme these are as follows; five Grade II Listed Building - Milestones (List UIDs: 1127380, 1302189, 1127381, 1127361, 1302199), Grade II Listed Building - Gate Piers (List UID 1127361) and Romano-British Settlement at Chittering Scheduled Monument (List UID 1012359).

3.4.5 Likely significant effects

The likely significant effects for cultural heritage, that have been identified at this stage as a result of the Proposed Scheme options are set out in Table 3.4.1 Options assessed as having the potential for likely significant effects would be those which require the complete removal of milestones, loss of land associated with the Romano-British Settlement at Chittering Scheduled Monument and partial or complete removal of the gate piers. (see Appendix B, Figures 1 to 1.27 for details). All options with the exception of Option F and G have the potential to remove unknown (buried) archaeological remains.

Table 3.4.1 Summary of likely significant effects

Option	Summary of likely significant effects
Option A	Moderate adverse significant effects would be anticipated during the construction phase of Option A as a result of: • the complete removal of Milestone south of junction with Waterbeach (1127380), Milestone half mile south of Green End junction and Goose Hall (1302189), Milestone half mile north of Goose Hall (1127381) and Milestone one and one half miles north of Goose Hall (1302199); and • complete or partial removal of the Gate Piers (1127361) and loss of land associated with the Romano-British Settlement at Chittering Scheduled Monument. There would be no likely significant effects anticipated on the cultural heritage resources as a result of the operation of the proposed option. Minor adverse effects would be anticipated on the setting of cultural heritage resources where these would be visually impacted during both the construction and operation phases (see Section 3.5 Landscape).
Option B	As a result of the complete removal of Milestone south of junction with Waterbeach (1127380), Milestone half mile south of Green End junction and Goose Hall (1302189), Milestone half mile north of Goose Hall (1127381), Milestone one and one half miles north of Goose Hall (1302199), complete or partial removal of the Gate Piers (1127361) and loss of land associated with the Romano-British Settlement at Chittering Scheduled Monument moderate adverse significant effects would be anticipated during the construction phase. There would be no likely significant effects anticipated on the cultural heritage resource as a result of the operation of the proposed option. Minor adverse effects would be anticipated on the setting of cultural heritage resources where these would be visually impacted during both the construction and operation phases (see Section 3.5 Landscape).
Option C	As a result of the complete removal of Milestone half mile north of Goose Hall (1127381) moderate adverse significant effects would be anticipated during the construction phase. There would be no likely significant effects anticipated on the cultural heritage resource as a result of the operation of the proposed option. Minor adverse effects would be anticipated on the setting of cultural heritage resources where these would be visually impacted during both the construction and operation phases (see Section 3.5 Landscape).

Option	Summary of likely significant effects
Option D	There would be no likely significant effects anticipated on the cultural heritage resource as a result of the proposed Option D at this stage. As the option route is predominantly undeveloped land there is the potential to encounter unknown archaeology during the construction phase. There would be no likely significant effects anticipated on the cultural heritage resource as a result of the operation of the proposed option. Minor adverse effects would be anticipated on the setting of cultural heritage resources where these would be visually impacted during both the construction and operation phases (see Section 3.5 Landscape).
Option E	As a result of the complete removal of Milestone south of junction with Waterbeach (1127380), Milestone half mile south of Green End junction and Goose Hall (1302189), Milestone half mile north of Goose Hall (1127381), Milestone one and one half miles north of Goose Hall (1302199), complete or partial removal of the Gate Piers (1127361) and loss of land associated with the Romano-British Settlement at Chittering Scheduled Monument moderate adverse significant effects would be anticipated. There would be no likely significant effects anticipated on the cultural heritage resource as a result of the operation of the proposed option. Minor adverse effects would be anticipated on the setting of cultural heritage resources where these would be visually impacted both the construction and operation phases (see Section 3.5 Landscape).
Option F	As a result of the complete removal of Milestone south of junction with Waterbeach (1127380), Milestone half mile south of Green End junction and Goose Hall (1302189) moderate adverse significant effects would be anticipated during the construction phase. There would be no likely significant effects anticipated on the cultural heritage resource as a result of the operation of the proposed option. Minor adverse effects would be anticipated on the setting of cultural heritage resources where these would be visually impacted during both the construction and operation phases (see Section 3.5 Landscape).
Option G	There would be no likely significant effects anticipated on the cultural heritage resource as a result of the proposed option at this stage. Minor adverse effects would be anticipated on the setting of cultural heritage resources where these would be visually impacted during both the construction and operation phases (see Section 3.5 Landscape).

Table 3.4.2 Strengths and weaknesses for each of the proposed options

Option	Strengths / weakness
Option A	Strengths • The bypass section at Stretham would avoid the potential loss of land associated with a Grade II listed building. • Online elements would be in areas already disturbed by previous developments therefore there is limited potential to encounter unknown archaeology. • Heritage setting and historical landscapes would be unlikely to be affected significantly where existing infrastructure is already present. Weakness • This option would have the potential to significantly impact upon a Scheduled Monument which is of national importance. • It would result in the full or partial removal of cultural heritage resources. • There would be the potential for unknown archaeology to be encountered on undeveloped land. • There would be Changes to the historical setting of listed buildings at Landbeach.
Option B	Strengths • The bypass section at Stretham avoids the potential loss of land associated with a Grade II listed building. • Online elements would be in areas already disturbed by previous developments therefore there is limited potential to encounter unknown archaeology. • Heritage setting and historical landscapes would be unlikely to be affected significantly where existing infrastructure is already present. Weakness • This option would have the potential to significantly impact upon a Scheduled Monument which is of national importance. • It would result in the full or partial removal of cultural heritage resources. • There would be potential for unknown archaeology to be encountered on undeveloped land. • There would be changes to the historical setting of listed buildings at Landbeach.
Option C	Strengths • This option would avoid partial or full removal of all but one cultural heritage resource compared with options A and B. • Online and junction works would be in areas already disturbed by previous developments therefore there is limited potential to encounter unknown archaeology. • Heritage setting and historical landscapes would be unlikely to be affected significantly where existing infrastructure is already present. Weakness • This option would have potential for unknown archaeology to be encountered on undeveloped land. • There would be changes to the historical setting of listed buildings at Landbeach.

Option	Strengths / weakness
Option D	Strengths • This option would avoid full or partial removal of known cultural heritage resources adjoining the existing A10 corridor. Weakness • Given the full offline nature of the option there would be high potential that unknown archaeology would be encountered. • There would be changes to the historical setting of listed buildings and scheduled monuments in close proximity to the proposed route.
Option E	Strengths • The bypass section at Stretham avoids the potential loss of land associated with a Grade II listed building. • Online elements will be in areas already disturbed by previous developments therefore there is limited potential to encounter unknown archaeology. • Heritage setting and historical landscapes would be unlikely to be affected significantly where existing infrastructure is already present. Weakness • This option would have the potential to significantly impact upon a Scheduled Monument which is of national importance. • This option would result in the full or partial removal of cultural heritage resources. • There would be the potential for unknown archaeology to be encountered on undeveloped land.
Option F	Strengths • Online and junction works would be in areas already disturbed by previous developments therefore there is limited potential to encounter unknown archaeology. • Heritage setting and historical landscapes would be unlikely to be affected significantly where existing infrastructure is already present. Weakness • This option would result in the full or partial removal of cultural heritage resources.
Option G	Strengths • Junction works would be in areas already disturbed by previous developments therefore there is limited potential to encounter unknown archaeology. • Heritage setting and historical landscapes would be unlikely to be affected significantly where existing infrastructure is already present. Weakness • This option would result in the full or partial removal of a cultural heritage resource.

3.4.6 Required mitigation and enhancement opportunities

Design measures (primary mitigation) may lessen potential impacts on the settings of the cultural heritage resource. These measures may include sensitive embankment design and the sympathetic placement of gantries, signage and lighting.

Online dualling at Chittering should be carried out on the western side of the existing A10 only to avoid land-take from the Romano-British Settlement at Chittering Scheduled Monument. Where ingress into the boundary of the Romano-British Settlement at Chittering Scheduled Monument (options A and B) cannot be avoided mitigation will need to be discussed and agreed with the district council and Historic England. Examples of mitigation which may need to be considered include design and landscape proposals which reflect and strengthen local character.

To mitigate the impact (options A, B, C, E and F) on the Milestones adjoining the existing A10, historic building recording to Level 1 (Historic England, 2016) should be undertaken prior to construction to record the milestones in their current settings. Following the recording of the assets they should be removed to a suitable storage facility prior to relocation as near as is possible to its original location on the completion of construction works.

To mitigate the impact (options A, B and E) on the Gate Piers (1127361), historic building recording Level 1 (Historic England, 2016) should be undertaken prior to construction to record the building in its current setting. Where removal is not required the asset should be clearly demarcated and appropriate signage and protective fencing erected.

At subsequent assessment stages where the preferred option is known to include archaeological remains and/or greenfield land both non-invasive and invasive archaeological evaluations would be required to determine the presence or absence of previously known and unknown (buried) archaeological remains. These may be followed by set piece archaeological excavations depending on the significance of the remains identified.

3.4.7 Topic specific environmental risks

Topic specific risks for cultural heritage would be as follows;

- The development of green-field land may result in the discovery of unknown (buried) archaeology which may require costly mitigation;
- Loss of land associated with the scheduled monument should be avoided with any mitigation discussed at the pre-application stage of the scheme; and
- The use of HER data to supplement that described above may change the results of the assessment.

3.4.8 Preferred option

From a cultural heritage perspective and at this stage of the Proposed Scheme the preferred option would be that that has the least potential to significantly effect known and unknown cultural heritage resources. This would be Option G.

3.5 Landscape

This Section reports a comparative assessment of how the seven alternative route options may vary in their effect on landscape and visual, their strengths and weaknesses and a conclusion on which option is preferred. This has focused on the number of properties in close proximity to the different routes with the potential to be adversely affected by permanent changes in views and wider landscape effect. This chapter is supported by Figures 1 to 1.27 in Appendix C.

3.5.1 Legislative and policy framework

The following legislation and national and local policies are relevant to the topic;

- Commons Act 2006 and Commons Registration Act 1965 - These Acts define and protect Common land.
- Countryside and Rights of Way Act 2000 (CROW Act) - An area of outstanding natural beauty (AONB) is land designated and protected by the CROW Act. Public Rights of Way (PRoW) and open access land are defined and protected under the CROW Act.
- Planning (Listed Buildings and Conservation Areas) Act 1990 - Listed buildings and conservation areas are identified and protected under this act.
- The Town and Country Planning (Tree Preservation) (England) Regulations 2012 - Tree Preservation Orders are made under these acts.
- National Planning Policy Framework (NPPF) 2019 - Policy 13 Protecting Green Belt Land. Paragraph 133 states, 'The Government attaches great importance to Green Belts. The fundamental aim of Green Belt policy is to prevent urban sprawl by keeping land permanently open; the essential characteristics of Green Belts are their openness and their permanence'.
- Local Plans;
    - South Cambridgeshire Local Plan - NH/2: Protecting and Enhancing Landscape Character NH/6: Green Infrastructure 119, NH/7: Ancient Woodlands and Veteran Trees and NH/8: Mitigating the Impact of Development in and adjoining the Green Belt.
    - East Cambridgeshire Local Plan - Policy ENV 1: Landscape and settlement character and Policy ENV 10: Green Belt.

3.5.2 Assessment Methodology, assumptions and limitations

This assessment is based on readily available web-based data sources and a baseline survey by a landscape architect. Local datasets not available online, such as Tree Preservation Orders, have not been obtained from local planning authorities. No field survey has been undertaken to verify potential effects. The assessment is high-level with professional judgement and previous experience of similar schemes used to supplement the below guidance in order to produce a qualitative assessment of the likely significant effects from a landscape perspective.

The follow guidance has been used to inform the assessment:

- Design Manual for Roads and Bridges (DMRB) LA 107 Landscape & visual effects revision 2, Highways England, February 2020.
- Design Manual for Roads and Bridges (DMRB) LD 117 Landscape design revision 0, Highways England, March 2020.
- Guidelines for Landscape and Visual Impact Assessment Third Edition (GLVIA3), Landscape Institute and IEMA, 2013.

3.5.3 Study Area

The initial environmental assessment reported in this section has considered a study area covering a buffer of approximately 2km from the existing A10 for online options and 2km from the proposed centreline of offline options. Whilst options may be visible, landscape and visual effects beyond this distance would not be likely to be significant.

3.5.4 Baseline Conditions

There are no nationally designated areas of outstanding natural beauty (AONB) or national parks within 2km of the proposed options; or local landscape designations within the study area.

The Cambridge Green Belt extends from the A14 near Milton to the southern edge of Waterbeach. Although green belts are not a landscape designation, they are relevant to this assessment due to the need to consider effects on their openness.

Cultural heritage designations are set out in detail within section 2.4. The contribution of heritage features to landscape character is relevant to landscape assessment. There are numerous conservation areas, several scheduled monuments and listed buildings within the study area. The latter are particularly concentrated within the historic core of settlements. Notable heritage features sensitive to potential landscape and visual effects include Denny Abbey grade I listed building and scheduled monument at Waterbeach; Stretham Windmill grade II, a local landmark close to the A10; and Stretham Old Engine scheduled monument on the banks of the river Great Ouse east of Stretham.

There are a number of public rights of way (PRoW) within the study area, many of which are associated with tracks or drove roads. Most notable is the Ouse Valley Way long distance footpath which follows the river Great Ouse and coincides with the Rothschild Way within the study area. Milton Country Park lies immediately to the east of Milton and north of the A14 and other local areas of public open space, such as playing fields, are found within the settlements in the study area.

The northern part of the study area falls within National Character Area (NCA) 46 The Fens (Natural England, 2015). The landscape is characterised by mainly flat low-lying land with a distinct rectilinear field pattern defined by ditches and dykes, and long open views. This character is particularly strong within the river Great Ouse floodplain to the south of Wilburton and at Grunty Fen which separates the higher ground at Wilburton and Witchford. Tree cover is generally sparse and, apart from some scrubby disjointed vegetation marking the line of some ditches, is mostly associated with settlements on slightly higher ground and along road corridors, notably the A10. The river Great Ouse meanders west to east through the study area, canalised by embankments either side to contain the watercourse from the lower adjacent fields. Moorings, including those for leisure and some residential uses, are common along the river and there are small marinas at Twenty Pence Road and Stretham Ferry Bridge. Features such as ditches, droves and embankments are associated with the historic draining of fenland and are integral to the character of the landscape.

To the south the study area falls within NCA 88 Bedfordshire and Cambridge Claylands (Natural England, 2014). This is broad, gently undulating, lowland plateau dissected by shallow river valleys that gradually widen as they approach The Fens NCA in the east. It is predominantly a commercially farmed landscape, with large scale arable fields often divided by ditches. Similar to The Fens NCA, tree cover is limited to scrubby disjointed vegetation marking the line of some ditches. More substantial belts and groups of trees are found within and around settlements and along road corridors, notably the A10. Larger areas of tree planting are associated with the Cambridge Research Centre and the area to the east of the A10 at Waterbeach, both of which exhibit a parkland like character with open waterbodies and a mix of native and ornamental trees. There is also a substantial belt of woodland planting wrapping around the north-west of Milton which acts as a buffer to the A10.

The Campaign for Rural England's (CPRE) Light Pollution and Dark Skies mapping indicates that the urban influence of built development results in light pollution and night blight, notably at Milton on the edge of

Cambridge and more locally at the Cambridge Research Park which are amongst the brightest skies. Elsewhere other settlements, including the southern edge of Ely, are moderately bright, whilst the more remote areas are identified as being darker with the darkest skies in the study area immediately to the north of the river Great Ouse associated with the low-lying area south of Wilburton. The larger junctions along the A10, which are those considered for improvement, are lit. Tranquillity is likely to follow a similar pattern to dark skies with the least tranquil areas close to urban areas and major roads, however detailed CPRE tranquillity mapping was not available at the time of this assessment.

3.5.5 Likely significant effects

Landscape and visual effects typically relate to the physical characteristics and components of the landscape which form its character (for example landform, vegetation and buildings) or visual impacts resulting from the changes in views of the landscape experienced by people, who are potentially sensitive receptors. Key sensitive visual receptors include residents in the surrounding settlements and those in scattered rural properties; and users of public rights of way (PRoW), long distance paths, public open space and publicly accessible parks and gardens.

Table 3.5.1 Summary of likely significant effects

Option	Summary of likely significant effects
Option A	There would be likely to be significant adverse landscape and visual effects where the route is offline crossing the area between Landbeach and Waterbeach, including significant impacts on views from Landbeach conservation area. There would be likely to be an impact on the openness of the Cambridge Green Belt, particularly if the road is on embankment. Significant adverse effects would be also likely to arise from local bypasses west of Stretham and Little Thetford, particularly where the route crosses the A1123 Wilburton Road. There would be likely to be localised landscape and visual effects associated with the online dualling and new and improved junctions along the remainder of the route. These effects would primarily relate to the loss of existing vegetation opening up views of the road and its traffic to sensitive visual receptors.
Option B	There would be likely to be significant adverse landscape and visual effects where the route is offline crossing the area between Landbeach and Waterbeach, including significant impacts on views from Landbeach conservation area. There would be likely to be an impact on the openness of the Cambridge Green Belt, particularly if the road is on embankment. Significant adverse effects would be likely to arise from local bypasses east of Stretham and west of Little Thetford, particularly where the route crosses the A1123 Wilburton Road, and is potentially visible from the Ouse Valley Way long distance path. This section may also affect the landscape setting of the Stretham Old Engine scheduled monument. There would be likely to be localised landscape and visual effects associated with the online dualling and new and improved junctions along the remainder of the route. These effects would primarily relate to the loss of existing vegetation opening up views of the road and its traffic to sensitive visual receptors.

Option	Summary of likely significant effects
Option C	There would be likely to be significant adverse landscape and visual effects where the route is offline crossing the area between Landbeach and Waterbeach, including significant impacts on views from Landbeach conservation area. For the remaining part of the route there would be likely to be localised landscape and visual effects associated with the proposed junction improvements and online dualling near Cambridge Research Park. These effects would primarily relate to the loss of existing vegetation opening up views of the road and its traffic to sensitive visual receptors. There would be likely to be an impact on the openness of the Cambridge Green Belt, particularly if the road is on embankment.
Option D	Significant landscape and visual effects would be likely as the full offline option would need to be on embankment across visually sensitive areas such as the river Great Ouse floodplain and other low-lying fenland areas. Road and river crossings would be elevated and widely visible, whilst mitigation through planting would be uncharacteristic in this open landscape. There would be likely to be an impact on the openness of the Cambridge Green Belt, particularly if the road is on embankment. This option would potentially be detrimental to tranquil areas and areas of darker skies.
Option E	Significant adverse effects would be likely to arise from local bypasses west of Stretham and Little Thetford, particularly where the route crosses the A1123 Wilburton Road. There would be likely to be localised landscape and visual effects associated with the online dualling and new and improved junctions along the remainder of the route. These effects would primarily relate to the loss of existing vegetation opening up views of the road and its traffic to sensitive visual receptors.
Option F	There would be likely to be localised landscape and visual effects associated with the proposed junction improvements and online dualling. These effects would primarily relate to the loss of existing vegetation opening up views of the road and its traffic to sensitive visual receptors. There would be no change outside of these areas so the effects on the wider landscape would not be significant.
Option G	There would be likely to be localised landscape and visual effects associated with the proposed junction improvements. These effects would primarily relate to the loss of existing vegetation opening up views of the road and its traffic to sensitive visual receptors. There would be no change outside of these areas so the effects on the wider landscape would not be significant.

Table 3.5.2 Strengths and weaknesses for each of the proposed options

Option	Strengths / weakness
Option A	Strength • Some of the route would be online and already heavily influenced by existing A10 so would be less damaging to the landscape compared with the full offline option. Weakness • There would be likely to be significant adverse landscape and visual effects where the route is offline crossing the area between Landbeach and Waterbeach, particularly if the road and its traffic would be elevated on embankment. It would be highly visible and out of character in the low-lying open landscape with likely significant adverse effects on views from Landbeach conservation area. • Where the route is widened online the loss of mature roadside vegetation is likely to open up views of the road from properties along the A10 and potentially change the character of this relatively well treed corridor. • The dualling of the river Great Ouse crossing close to Stretham Ferry Marina is particularly sensitive. An unsympathetic crossing combined with loss of screening vegetation could give rise to significant adverse landscape and visual effects in this location. • Bypassing Stretham to the west would be likely to be highly visible in the open landscape particularly where the road and its traffic would be elevated across the A1123 Wilburton Road. • The short bypass north of Little Thetford would reduce the impacts of the road and traffic properties fronting the A10 in this area.
Option B	Strength • Some of the route would online and already heavily influenced by existing A10 so would be less damaging to the landscape compared with an offline option. Weakness • There would be likely to be significant adverse landscape and visual effects where the route is offline crossing the area between Landbeach and Waterbeach, particularly if the road and its traffic would be elevated on embankment. It would be highly visible and out of character in the low-lying open landscape with likely significant adverse effects on views from Landbeach conservation area. • Where the route is widened online the loss of mature roadside vegetation is likely to open up views of the road from properties along the A10 and, potentially change the character of this relatively well treed corridor. • The dualling of the river Great Ouse crossing close to Stretham Ferry Marina is particularly sensitive. An unsympathetic crossing combined with loss of screening vegetation could give rise to significant adverse landscape and visual effects in this location. • Bypassing Stretham to the east would be likely to be highly visible in the open, low lying landscape of the river Great Ouse floodplain, particularly

Option	Strengths / weakness
	where the road and its traffic would be elevated across the A1123 Newmarket Road. • Views of the elevated road would be likely from the Ouse Valley Way long distance path and the landscape setting of the Stretham Old Engine scheduled monument. • The short bypass north of Little Thetford would reduce the impacts of the road and traffic properties fronting the A10 in this area.
Option C	Strength • For most of the route potential adverse effects would be focussed where junctions already exist. Except for the roundabout at Stretham, the existing junctions would be in locations where there would be few sensitive visual receptors. Where there would be sensitive visual receptors in close proximity to the junctions, they would be likely to already experience some views of the junctions at these locations; disturbance from traffic and the effects of lighting. There would be no change outside of junction locations so the effects on the remainder of the A10 and the wider landscape would not be significant. • The effects of online dualling to the west of Milton would be largely screened by the existing substantial tree belt along the western edge of the village. Weakness • Near the Cambridge Research Park the loss of mature roadside vegetation may open up views of the road from properties along the A10 and, potentially change the character of this part of the relatively well treed corridor. • There would be likely to be significant adverse landscape and visual effects where the route is offline crossing the area between Landbeach and Waterbeach, particularly if the road and its traffic would be elevated on embankment. It would be highly visible and out of character in the low-lying open landscape with likely significant adverse effects on views from Landbeach conservation area.
Option D	Strength • The effects of online dualling to the west of Milton would be largely screened by the existing substantial tree belt along the western edge of the village. • The reduction in traffic on the existing A10 would potentially decrease disturbance and visual impacts on existing residents and provide opportunities to enhance the existing road corridor. Weakness • Most of the offline route would be likely to be on embankment due to the low-lying character of the landscape and the requirement to cross local roads and the river Great Ouse. The road and traffic would be likely to be elevated and widely visible resulting in potentially significant adverse visual effects on sensitive receptors including residents on the western edge of the Landbeach; southern side of Cottenham; and western side of Stretham and

Option	Strengths / weakness
	Little Thetford; along with users of the Ouse Valley Way long distance footpath, and users of leisure and residential craft on the river itself, including at Twentypence Marina. • The offline option would cross the existing distinctive rectilinear field pattern at an angle potentially leaving many remnant triangular field corners no longer viable for commercial agriculture. Whilst planting these could help mitigate some views of the road it would change the character of the landscape. • The disturbance from the road along with headlights and lighting at junctions would be detrimental to the most tranquil parts of the study area with the darkest skies.
Option E	Strength • Most of the route would be online and already heavily influenced by existing A10 so would be less damaging to the landscape compared with options that have a greater proportion of the route offline. • The effects of online dualling to the west of Milton would be largely screened by the existing substantial tree belt along the western edge of the village. Weakness • Where the route is widened online, the loss of mature roadside vegetation is likely to open up views of the road from properties along the A10 and, potentially change the character of this relatively well treed corridor. • The dualling of the river Great Ouse crossing close to Stretham Ferry Marina is particularly sensitive. An unsympathetic crossing combined with loss of screening vegetation could give rise to significant adverse landscape and visual effects in this location. • Bypassing Stretham to the west would be likely to be highly visible in the open landscape, particularly where the road and its traffic would be elevated across the A1123 Wilburton Road. • The short bypass north of Little Thetford would reduce the impacts of the road and traffic properties fronting the A10 in this area.
Option F	Strength • For most the route potential adverse effects would be focussed where junctions already exist. Except for the roundabout at Stretham, the existing junctions would be in locations where there would be few sensitive visual receptors. Where there would be sensitive visual receptors in close proximity to the junctions, they would be likely to already experience some views of the junctions at these locations; disturbance from traffic and the effects of lighting. There would be no change outside of junction locations so the effects on the remainder of the A10 and the wider landscape would not be significant. • The effects of online dualling to the west of Milton would be largely screened by the existing substantial tree belt along the western edge of the village. Weakness

Option	Strengths / weakness
	• The loss of mature roadside vegetation between Milton and the Cambridge Research Park would be likely to open up views of the road from properties along the A10 and, potentially change the character of this relatively well treed corridor.
Option G	Strength • Potential adverse effects would be focussed on areas along the existing A10 where junctions already exist. Apart from the roundabout at Stretham, the existing junctions would be in locations where there would be few sensitive visual receptors. Where there would be sensitive visual receptors in close proximity to the junctions, they would be likely to already experience some views of the junctions at these locations; disturbance from traffic and the effects of lighting. • There would be no change outside of junction locations so the effects on the remainder of the A10 and the wider landscape would not be significant. Weakness • Localised tree loss would open up views of the road.

3.5.6 Required mitigation and enhancement opportunities

The approach to design should apply the principles established in the DMRB LD 117 Landscape Design by creating opportunities to conserve and enhance the landscape character; and establishing a landscape strategy (design vision) and/or a set of defined landscape objectives for the project early on as an essential part of the design process.

Mitigation measures should consider the following:

- The horizontal alignment should be designed to reduce the effects on landform, retain vegetation, field pattern, landscape features and to reduce the effects on views.
- Offline routes including junctions and structures should be kept as low as possible in the landscape to limit visual intrusion.
- Refinement of the design of earthworks and mounding to create natural gradients and slopes that achieve better integration with the surrounding landform, where space and material are available.
- Use of sensitive lighting design such as horizontally mounted full cut-off flat glass lanterns.
- Where appropriate planting should be used to break up the scale of the road, screen structures, traffic and lighting and help integrate the road into the existing landscape pattern.
- Use of planting to link into existing field boundary vegetation to provide screening and integration into the local pattern and character, as well as connection of existing wildlife corridors.
- The use of locally indigenous native and non-native plants as appropriate to reflect the distinctive local character, such as near the Cambridge Science Park.
- Retention of views to local landmarks through breaks in the planting to help create a sense of place and legibility for vehicle travellers, where possible.

3.5.7 Topic specific environmental risks

Topic specific risks for landscape and visual would be as follows:

- Extensive areas of tree planting, such as woodland and plantation, would be uncharacteristic in the open landscape. It will be difficult to screen views of offline options without the planting itself potentially having an adverse effect on landscape character.
- Visual effects could increase if requirements to reduce flood risk in low lying areas, notably the river Great Ouse crossing and floodplain, require embankments to be replaced with extensive lengths of viaduct. Planting to screen the road and its traffic would not be possible in these locations.
- For offline options it is possible that the distinctive pattern of ditches and agricultural drainage is disrupted so that the existing land use which defines the character of the landscape is affected. This is a particular risk on areas of fenland which are reliant on a system of ditches and dykes to drain the land.
- There would potentially be substantial secondary landscape and visual effects if materials for construction for offline options were sourced from borrow pits, which would be likely to result in the creation of large permanent open waterbodies. The future use of these waterbodies in an otherwise commercial arable landscape is uncertain, and it is unlikely they can be assimilated effectively into the landscape.
- Potential effects on trees and root protection zones. This risk particularly applies for junction improvements and online dualling. Works within the highway corridor have the potential to cause the loss of or effect the stability of trees outside of the highway boundary, including trees owned by third parties, exacerbating views of the road and causing potential safety issues. An early arboriculture survey is recommended for the preferred option.

3.5.8 Preferred option

Option G would be least damaging as landscape and visual effects would be local to the junction improvements, where mitigation through replacement planting can be achieved. There would be no change to other parts of the A10 and the wider landscape. Therefore, this would be the preferred option for landscape and visual receptors.

3.6 Noise and Vibration

This Section reports a comparative assessment of how the seven alternative route options may vary in their affect on Noise and Vibration, their strengths and weaknesses and a conclusion on which option is preferred. This has focused on the number of properties in close proximity to the different routes with the potential to be adversely affected by permanent increases in traffic flows and therefore, vehicle noise. This chapter is supported by Figures 1 to 1.27 in Appendix C.

3.6.1 Legislative and policy framework

The following legislation, national and local policies apply to this topic;

- National Planning Policy Framework (NPPF) (2019) - Noise and vibration is referred to in paragraphs 180 to 182;
- Planning Practice Guidance (PPG) - Planning Practice Guidance relating to relevant NPPF policies are included under 'Noise', paragraphs 001 to 012;
- Noise Policy Statement for England (NPSE) - The NPSE was published in March 2010 by the Department for Environment Food and Rural Affairs (DEFRA) and is the overarching statement of noise policy for England; and
- Noise Action Plan (outside first round agglomerations), Environmental Noise (England) Regulations 2006 as amended, 2010, Defra – Defra produced the Noise Action Plan in March 2010 (updated in 2019) to address the effects of noise from major roads in England under the terms of the Environmental Noise (England) Regulations 2006.
- Local Plans
    - East Cambridgeshire Local Plan – A second review of the Local Plan was published in April 2020 from the East Cambridgeshire District Council; and
    - South Cambridgeshire Local Plan – The Local Plan was adopted by South Cambridgeshire District Council on 27 September 2018.

3.6.2 Assessment Methodology, assumptions and limitations

At this stage a qualitative assessment has been undertaken based on the principles outlined within DMRB LA 111 for scoping. This process relies on professional judgement. No noise modelling has been undertaken to inform this assessment. Transport Analysis Guidance (Department for Transport, TAG UNIT A3 Environmental Impact Appraisal, August 2019) was also followed for the qualitative assessment. An Appraisal Summary Table (AST) has been provide for each different option. The associated WebTAG workbooks cannot be completed due to no noise model being developed. This has meant that no monetised evaluation can be provided for the options.

The assessment has not considered the effect of topography on any of the options. When considering the impact for the options the possible change in speed and/or traffic flow has not been considered as this information is not available. No site visit or noise surveys have been undertaken to inform this assessment.

Some dwellings may be eligible for Noise Insulation however, the number of properties affected and that meet the qualifying criteria cannot be calculated at this stage.

3.6.3 Study Area

For this level of assessment, LA 111 does not provide a set definition for the study area of an option, and this will vary between each option. The study area for each option should consider the noise sensitive receptors that are potentially affected by operational noise changes generated by the option. These potential changes would be caused by the location of the road in relation to sensitive receptors. Guidance

within LA 111 suggests that 600m is usually sufficient for most projects during later assessment stages, but that this can be reduced or extended to ensure it is proportionate to the risk of likely significant effects. Given the nature of the area (i.e. level ground and some quiet rural areas) where noise could propagate over large distances or be intrusive on a quite area, an approximate distance of 1km from each option and the existing road has been used as a study area for each option.

3.6.4 Baseline Conditions

The following baseline sources have been used during the data gathering:

- England Noise Map Viewer (Extrium, 2018); and
- Google maps.

The desktop study has identified that the dominant source of environmental noise affecting the existing A10 corridor is road traffic on the A10 and some of the connecting roads. Further from the A10 corridor, where some of the bypass routes will potentially pass, the baseline noise climate would be less dominated by a single noise source. In these areas the baseline noise level would be lower. There would still be contributions from road traffic noise but also from other sources such as agricultural activities, aircraft and wildlife.

Under Environmental Noise Directive (2002/49/ EC) member states were required to draw up action plans for major roads to aid in the management of environmental noise. As part of this process, 'Important Areas' have been identified in the vicinity of the Proposed Scheme.

There are 14 noise important area (NIA) along the A10 between Milton Interchange and A142 Witchford Road. There are no railway NIAs in the surrounding area.

As the existing A10 and the route options pass through semi-rural areas, 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. The noise receptors are indicated within the Environmental Constrains Plan.

Sensitive receptors for humans include residential properties in Milton, Landbeach, Waterbeach, Stretham, Little Thetford and Ely. There are also several individual dwellings along the route, including some located immediately adjacent to the A10.

3.6.5 Likely significant effects

Based upon the current findings of the Initial Environmental Assessment, potentially significant effects would be anticipated. A number of residential receptors and community facilities within the vicinity of the options, and these could experience adverse impacts as a result of increased noise during operation. These significant effects could be beneficial or adverse and will be due to the re-distribution of traffic. Beneficial effects would be possible where the traffic is being reduced on a road near to the sensitive receptors. Conversely, adverse effects would be possible where a road is moved closer to sensitive receptors or where there is an increase in traffic using a road.

In order to compare each of the Proposed Scheme options, an indication of the number of properties within 100m either side of the existing A10 and each route alignment is provided in Table 3.6.1. A distance of 100m has been chosen as beyond this it is unlikely that any significant effects would be identified. While these receptors have the potential to be affected by the Proposed Scheme options, it does not mean that the resulting impacts at these receptors would be significant. For the options where there would be bypasses, the property counts only reflect those within 100m of what would be the new A10 and do not include those properties within 100m of any existing sections of the A10 that may remain open once bypassed. Although such sections would have less traffic, there would still be noise from vehicles using the road and properties exposed.

Table 3.6.1 Number of properties within 100m of the existing A10 and each route alignment

Option	Number of properties within 100m
Existing A10	723 properties within 100m of the existing A10
Option A	420 properties within 100m of proposed A10 alignment
Option B	434 properties within 100m of proposed A10 alignment
Option C	604 properties within 100m of proposed A10 alignment
Option D	132 properties within 100m of proposed A10 alignment
Option E	548 properties within 100m of proposed A10 alignment
Option F	723 properties within 100m of proposed A10 alignment
Option G	723 properties within 100m of proposed A10 alignment

The predicted changes in traffic along the route have been examined to determine the likely extent of changes in noise. It has been assumed that for the offline (bypass) sections there will be a large reduction in traffic on the bypassed section of road and a beneficial effect. This examination of traffic has therefore focussed on the areas of online improvements (dualling) and where traffic may change on a section of existing road due to changes at other locations.

The potential effects from the different options are summarized below.

Table 3.6.2 Summary of likely significant effects

Option	Summary of likely significant effects
Option A	There would be a reduction in noise at a large number of receptors caused by the redistribution of traffic onto the proposed offline (bypass) elements of the option. Where the bypass route would move the road closer to individual or small groups of receptors where the noise level would currently be low, there would be large increases in noise at a small number of receptors (e.g. west of Milton, Stretham, and Little Thetford). The online dualling elements of the option would increase the noise by what could be a noticeable amount at receptors along the existing route. Overall, the effect of the option would be likely to be minor beneficial.
Option B	There would be a reduction in noise at a large number of receptors caused by the redistribution of traffic onto the proposed bypass. Where the bypass route moves the road closer to individual or small groups of receptors where the noise level would currently be low, there would be large increases in noise at a small number of receptors (east of Milton, Stretham, and Little Thetford). The online dualling

Option	Summary of likely significant effects
	elements of the option would increase the noise by what could be a noticeable amount at receptors along the existing route. Overall, the effect of the option would be likely to be minor beneficial.
Option C	The bypass element of the option would reduce noise impacts to settlements that would be close to the highway infrastructure (Between Milton - Ely Road and Denny End Road intersection). Increases in noise would be likely as a result of the introduction of a new offline road which brings the noise source closer to individual or groups of dwellings (e.g. Landbeach). The improvements to the junctions would be unlikely to change the noise level at nearby sensitive receptors. For the elements of the option where the road would be unchanged there could be an increase in noise, but this may not be by a noticeable amount. Overall, the effect of the option would be likely to be minor beneficial.
Option D	The fully offline bypass route would reduce noise impacts to settlements that would be close to the highway infrastructure (Stretham, Little Thetford, Waterbeach, Landbeach). There would be a potential increase in noise on some receptors in Stretham (Cross white Farm area), Little Thetford (Ren Fen Road, Bedwell Hey Farm), Landbeach (Middle Farm) and Cottenham (Hedgerows Farm, Two Bit Farm, and Mitchell Hill Farm). Overall, the effect of the option would be likely to be moderate beneficial.
Option E	There would be a reduction in noise at a large number of receptors (Stretham and Little Thetford) caused by the redistribution of traffic onto the proposed bypass. Where the bypass route moves the road closer to individual or small groups of receptors where the noise level would currently be low, there would be be large increases in noise at a small number of receptors. The online dualling elements of the option would be increase the noise by what could be a noticeable amount at receptors along the existing route. Overall, the effect of the option would be likely to be neutral.
Option F	The online dualling of the southern section to Cambridge Research Park would increase the noise between Milton Interchange and the Waste Treatment Site, affecting the residential properties close to the A10. This increase in noise may be by a noticeable amount. For the elements of the option where the road would be unchanged there could be an increase in noise, and this may also be by a noticeable amount. The improvements to the junctions would be unlikely to change the noise level at nearby sensitive receptors. Overall, the effect of the option would be likely to be minor adverse.
Option G	This option involves junction only improvements (A142 Witchford Road Roundabout, A142 Angel Drove roundabout, A1123 Stretham roundabout, Waste Treatment Site, Cambridge Research Park, Denny End Road, Butt Lane, and Milton Interchange). The increase in traffic caused by the junction improvements would be unlikely to generate noticeable changes in noise. Overall, the effect of the option would be likely to be neutral.

Table 3.6.3 Strengths and weaknesses for each of the proposed options

Option	Strengths / weakness
Option A	Strengths • A large number of sensitive receptors would experience a reduction in noise due to the redirection of traffic onto the bypasses elements of the option. • Around half of the Noise Important Areas along the route would be mitigated. • This option has the second lowest number of properties within 100m of the route alignment. Weaknesses • Sensitive receptors along the online dualling sections would be predicted to experience an increase in noise. • Mitigation in the form of noise barriers would be likely to be needed in some locations along the online dualling sections. • Some Noise Important Areas may experience an increase in noise. • Some dwellings may be eligible for Noise Insulation (the number of properties affected / qualifying cannot be calculated at this stage).
Option B	Strengths • A large number of sensitive receptors would experience a reduction in noise due to the redirection of traffic onto the bypass elements of the option. • Around half the Noise Important Areas along the route would be mitigated. Weaknesses • Sensitive receptors along the online dualling sections would be predicted to experience an increase in noise. • Mitigation in the form of noise barriers would be likely to be needed in some locations along the online dualling sections. • Some Noise Important Areas may experience an increase in noise. • Some dwellings may be eligible for Noise Insulation (the number of properties affected / qualifying cannot be calculated at this stage).
Option C	Strengths • Some sensitive receptors would experience a reduction in noise due to the bypass. • Some Noise Important Areas along the route would be mitigated by the redirection of the traffic Weaknesses • Sensitive receptors along the unaffected areas of the route would be predicted to experience some increase in noise, including the Noise Important Areas. • Some dwellings may be eligible for Noise Insulation (the number of properties affected / qualifying cannot be calculated at this stage).
Option D	Strengths • A large number of sensitive receptors would experience a reduction in noise due to the bypasses.

Option	Strengths / weakness
	• All the Noise Important Areas along the route would be likely to be mitigated. • The option has the fewest number of properties within 100m of the alignment. Weaknesses • Isolated dwellings close to the bypass route may experience and increase in noise and may require mitigation. • Some dwellings may be eligible for Noise Insulation (the number of properties affected / qualifying cannot be calculated at this stage).
Option E	Strengths • Sensitive receptors near the two bypass routes would experience a reduction in noise, and this would also mitigate several Noise Important Areas. Weaknesses • Sensitive receptors along the online dualling sections would be predicted to experience an increase in noise. • Mitigation in the form of noise barriers would be likely to be needed in some locations along the online dualling sections. • Some Noise Important Areas may experience an increase in noise. • Some dwellings may be eligible for Noise Insulation (the number of properties affected / qualifying cannot be calculated at this stage).
Option F	Strengths • None. Weaknesses • Sensitive receptors along the online dualling sections would be predicted to experience an increase in noise. • Mitigation in the form of noise barriers would be likely to be needed in some locations along the online dualling section. • Sensitive receptors along the unaffected areas of the route will experience little change in noise, including the Noise Important Areas. • Some dwellings may be eligible for Noise Insulation (the number of properties affected / qualifying cannot be calculated at this stage).
Option G	Strengths • The increase in traffic caused by the junction improvements would be predicted to generate little increases noise. Weaknesses • Sensitive receptors along the unaffected areas of the route will experience little change in noise, including the Noise Important Areas. • Some dwellings may be eligible for Noise Insulation (the number of properties affected / qualifying cannot be calculated at this stage).

3.6.6 Required mitigation and enhancement opportunities

Mitigation would be likely to be required for the offline and online options in order to meet the aims of the Noise Policy Statement for England (NPSE). This mitigation would be likely to be in the form of noise insulation (tertiary mitigation) and noise barriers or bunds (primary mitigation), that would work to reduce the noise propagation from the road to the sensitive receptors. For options with online dualling, mitigation may be required where the noise source is increased at sensitive receptors along the route that are already exposed to high levels of noise. For options with sections of bypass, mitigation may be required if the new alignment moves the noise source closer to sensitive receptors that are currently experiencing low levels of noise.

For all options there would be scope for enhancement through noise barriers. Those options that involve bypasses (e.g. Options A, B, and D) present the greatest enhancement possibilities as the noise source can be moved away from sensitive receptors. Options with mostly online dualling (e.g. Options C, E and F) would present possibilities for enhancement where receptors along the route can be protected by noise barriers. Option G (junctions only) would present little or no opportunity for enhancement.

At this stage of the assessment it is not possible to place a cost estimate on likely mitigation or enhancement. In order to undertake this exercise, more accurate route alignments would be required, together with an indication of likely changes in traffic flow and/or speed.

3.6.7 Topic specific environmental risks

There are not considered to be any topic specific risks associated with any of the proposed options following the implementation of the above proposed mitigation.

3.6.8 Preferred option

Option D would be the preferred option as this would be likely to reduce the noise level at the highest number of sensitive receptors and mitigate the highest number of Noise Important Areas. This option has the fewest number of properties within 100m of the alignment.

3.7 Population and Human Health

This Section reports a comparative assessment of how the seven alternative route options may vary in their effect on Population and Human Health, their strengths and weaknesses and a conclusion on which option is preferred. This has focused on the number of human receptors and land uses associated with human activity in close proximity to the different routes with the potential to be adversely affected by the construction and operation of the Proposed Scheme.

3.7.1 Legislative and policy framework

The Countryside and Rights of Way (CRoW) Act 2000 (The CRoW Act) - Regulates all public rights of way (PRoW) and ensures access to them is maintained. It requires local highway authorities to publish a Rights of Way Improvement Plan (RoWIP), which should be reviewed every ten years. The Act also obliges the highway authority to recognise the needs of the mobility impaired when undertaking improvements. Walkers, cyclist and horse-riders (WCH) who currently use the routes surrounding the proposed options should, therefore, be considered during the design process of the Proposed Scheme.

Equalities Act 2010 - The Act provides a legal framework to protect the rights of individuals and advance equality of opportunity for all. It provides the UK with a discrimination law which protects individuals from unfair treatment and promotes a fair and more equal society.

National Planning Policy Framework (NPPF), updated February 2019 - The NPPF recognises that the purpose of the planning system is to strive towards sustainable development, which can be achieved when economic, social and environmental gains are sought jointly. At the heart of the NPPF is a presumption in favor of sustainable development where the proposal accords with the Local Development Plan.

The following specific sections of the NPPF are also relevant to this assessment:

- Section 8, paragraph 91 – “Planning policies and decisions should aim to achieve healthy, inclusive and safe places which are safe and accessible… through the use of clear and legible pedestrian routes, and high quality public space, which encourage the active and continual use of public areas.”
- Section 8, paragraph 98 - “Planning policies should protect and enhance public rights of way and access, including taking opportunities to provide better facilities for users, for example by adding links to existing rights of way networks including National Trails.”
- Section 9, paragraph 103 - “Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions and improve air quality and public health. However, opportunities to maximise sustainable transport solutions will vary between urban and rural areas, and this should be taken into account in both plan-making and decision-making.”

Local Plans – The South Cambridgeshire Local Plan aims to meet the following overarching principals of sustainability relevant to this topic:

- Economic – contributing to building a strong, responsive and competitive economy by ensuring that sufficient land of the right type is available in the right places and at the right time to support growth and innovation; and by identifying and coordinating development requirements, including the provision of infrastructure;

- Social – supporting strong, vibrant and healthy communities, by providing the supply of housing required to meet the needs of present and future generations; and by creating a high quality built environment, with accessible local services that reflect the community’s needs and support its health, social and cultural wellbeing.

The strategic objectives of the East Cambridgeshire Local Plan relevant to this topic are as follows:

- Support the local economy and help create more jobs in the district, which meet local employment needs, reduces out-commuting, and helps to increase the sustainability and self-containment of communities in East Cambridgeshire.
- Provide a range of new housing in appropriate locations, which meets local housing needs as far as possible.
- Support and enhance the vitality and viability of town and village centres, as places for shopping, leisure and community activities.
- Ensure that new development is of high quality and sustainable design which reflects local character and distinctiveness, provides attractive and safe environments, and is supported by appropriate facilities and services.

3.7.2 Assessment Methodology, assumptions and limitations

A high-level, desk-based assessment has been undertaken with reference to Highways England's DMRB LA 112 Population and Human Health and experience gained from schemes of a similar nature. In accordance with LA 112 the assessment has also reviewed the potential for impacts on human health during construction and operation but at this stage of the Proposed Scheme does not evaluate the potential for significant effects on human health.

The following data sources have been used to compile the baseline conditions;

- Ariel imagery and open data source OS Maps;
- Public Health England Local Authority Health Profiles for 2016 to 2018;
- Public Health England Mortality Figures for 2018/2019; and
- Office for National Statistics (ONS).

Limitations and assumptions for this topic were;

- No site visits have been undertaken and, therefore, the assessment was based only on a desk-based assessment of publicly available data and data collected by the Design Team as part of the design development to date.
- At this stage, confirmed construction traffic routes are not available to inform the assessment and therefore professional judgement has been used to consider the likely construction routes within the study area. Compound and traffic management details are also yet to be determined to inform consideration of any likely resulting impacts on land-use and accessibility. Qualitative consideration has been given to the likelihood of what the changes could mean in terms of accessibility / community severance and impacts on (Walking, Cycling and Horse Riding) WCH during construction and operation of the Proposed Scheme.
- No public or stakeholder consultation has been undertaken.
- LA 112 does not currently provide a framework for the assessment of potentially significant effects on human health receptors and therefore this assessment only includes an appraisal of whether the Proposed Scheme has the potential for adverse, neutral or beneficial impacts on human health receptors.

3.7.3 Study Area

The study area for the assessment of population and human health was as defined within LA 112. With regards to the land-use and accessibility element, LA 112 states that 'the study area shall be based on the construction footprint/project boundary (including compounds and temporary land take) plus a 500m area surrounding the project boundary.' However, it also states that 'where likely effects are identified outside the 500m area surrounding the project boundary, the study area should be extended accordingly

and where effects are unlikely to occur within the 500m area surrounding the project boundary, the study area should be reduced accordingly'. Professional judgement was, therefore, applied accordingly.

With regards to the human health element, LA 112 states 'the study area shall be defined based on the following: 1) the extent and characteristics of a project, and 2) the communities/wards directly and indirectly affected by the project.' On this basis and given the stage of assessment / design process, the East and South Cambridgeshire District Council Area was deemed to provide an appropriate study area for the collection of data to identify the general health profile of the affected area. Professional judgement was applied in identifying suitable study areas for the reporting of environmental conditions relevant to human health as set out within paragraph 3.21 of LA 112.

3.7.4 Baseline Conditions

Land use and accessibility

The identified land use within the study area is deemed to be mixture of semi-rural and agricultural landscape in nature overall; with a large proportion of the study area dominated by the existing settlements along the A10. Land use to the east of the Proposed Scheme is more open and rural in nature comprising predominantly of open farmland and protected fen land, while land use to the west is a mixture of varying sized semi-rural settlements and open farmland. To the south and north of the A10 are the cities of Cambridge and Ely. Consequently there are extensive areas dominated by residential properties and farmsteads with a number of commercial and business land uses (including the Cambridge Research Park and Amey waste management park). Community facilities are predominantly focused within the settlements and include education, healthcare provisions, places of worship, community land uses and recreational land uses.

Key population centres in the study area include:

- Milton;
- Landbeach;
- Waterbeach;
- Stretham;
- Little Thetford; and
- Ely.

There are multiple sites located within the study area that have been identified as development sites in the South Cambridgeshire Local Plan 2018 for either housing or employment development. In addition to these allocated developments sites, there are numerous sites with extant permission for housing include the development of up to 6,500 homes on the Waterbeach Barracks.

There are multiple Public Rights of Ways (PRoWs) within the study area, including bridleways, over 20 designated footpaths and 2 long distance footpaths (Great Ouse Way and Rothschild Way).

Human Health

The Proposed Scheme is located within the local authority boundaries of East Cambridgeshire (East Cambs) and South Cambridgeshire (South Cambs) District Councils.

The total residential population of East Cambs authority area is estimated to be 89,362, with an estimated population of 157,519 in the South Cambs authority area[7]. Both authorities have a 50:50 ratio of males to females. Population estimates by broad age group (2018) indicate that 19.9% of East Cambs and 19.3% of South Cambs and the population is over the age of 65 years old, compared to the national average of 18.2%. 18.7% (East Cambs) and 18.9% (South Cambs) of the population is aged 0-15 years old

[7] ONS, 2018

compared to an average 19.2%, resulting in a lower percentage of the population being aged 16-64 (61.4% and 61.8% respectively) compared to the national average 62.6%. Consequently, under 30% of the total population of both areas combined fall within the groups identified to be more vulnerable / with increase susceptibility to heath issues, based on criteria outlined in LA 112.

The percentage of people aged 16-64 in employment is reported to be approximately 81.3% for East Cambs and 85.2% for South Cambs, compared to the national average of 75.6% in 2018/2019 (Source ONS APS, 2019).

The health of people with the East and South Cambridgeshire authority areas is varied compared with the England average. Approximately 9.1% (East Cambs) and 8.1% (South Cambs) of children live in low income families, compared to the national average of 17%. Life expectancy for both men and women in Copeland is lower than the England average. The number of people killed or seriously injured casualties, per 100,000 people, on England's roads is higher in both authority area (67.1 and 63.6) than the national average of 42.6 per 100,000 people.

Public Health England (2018) report a 21.9 (East Cambs) and 17.7 (South Cambs) per 100,000 mortality rate for the 2016-2018 period due to respiratory disease (all persons under 75). Public Health England (2018) report that the fraction of mortality attributable to particulate air pollution in persons aged is 5.3% to 5.4% compared to 5.2% nationally. There are no declared Air Quality Management Areas (AQMAs) within the study area as detailed within Section 3.1 of this report.

As set out within Section 3.6 there are a number of Noise Important Areas (NIAs) within the study area. NIAs with respect to noise from major roads are where the 1% of the population that are affected by the highest noise levels from major roads are located, according to the results of strategic noise mapping.

Section 3.5 reports a high degree of visual amenity within the study area, with a variety of features contributing to the existing visual interest.

Based on the above health profile and baseline data for health determinants, the sensitivity of the East/South Cambridgeshire community was identified to be medium overall[8], given the comparisons with the national figures for England.

3.7.5 Likely significant effects

Based on the current baseline information the likelihood that a change in health determinants as a result of the construction or operation of the Proposed Scheme in an adverse way would be limited. When considered in comparison to the overall sensitivity of the East/South Cambridgeshire Community the health outcome is likely to be neutral. There would be the potential for positive health outcomes where traffic was diverted away from human receptors. At the next stage of assessment the plausibility of the Proposed Scheme generating an impact on the health of individuals and communities should be evidenced using a source-pathway-receptor model[9].

Table 3.7.1 Summary of likely significant effects

Option	Summary of likely significant effects
Option A	Housing – There would be the potential for moderate adverse significant effects due to permanent land-take from private housing land (construction and operation) and changes in access to private residential properties (construction and operation).

[8] Based on the low, medium, high sensitivity categories set out within section 3 of LA 112.

[9] IEMA. IEMA health in EIA, 'Health in Environmental Impact Assessment: A primer for a proportionate approach, 2017'

Option	Summary of likely significant effects
	Community land and assets - There would be the potential for moderate adverse significant effects due to permanent land-take from community land (construction and operation). Employment - There would be the potential for moderate adverse significant effects due to permanent land-take from commercial land (construction and operation) and changes in access to businesses (construction and operation). Agricultural land holdings – There would be the potential for moderate adverse significant effects due to permanent land-take from agricultural land holdings (construction and operation). WCH – There would be the potential for large adverse significant effects due to the severance of existing WCH routes (both during construction and operation).
Option B	Housing – There would be the potential for moderate adverse significant effects due to permanent land-take from private housing land (construction and operation) and changes in access to private residential properties (construction and operation). Community land and assets - There would be the potential for moderate adverse significant effects due to permanent land-take from community land (construction and operation). Employment - There would be the potential for moderate adverse significant effects due to permanent land-take from commercial land (construction and operation) and changes in access to businesses (construction and operation). Agricultural land holdings – There would be the potential for moderate adverse significant effects due to permanent land-take from agricultural land holdings (construction and operation). WCH – There would be potential for large adverse significant effects due to the severance of existing WCH routes (both during construction and operation).
Option C	Housing – There would be the potential for moderate adverse significant effects due to permanent land-take from private housing land (construction and operation) and changes in access to private residential properties (construction and operation). Community land and assets - There would be the potential for moderate adverse significant effects due to permanent land-take from community land (construction and operation). Employment - There would be the potential for moderate adverse significant effects due to permanent land-take from commercial land (construction and operation) and changes in access to businesses (construction and operation). Agricultural land holdings – There would be the potential for moderate adverse significant effects due to permanent land-take from agricultural land holdings (construction and operation).

Option	Summary of likely significant effects
	WCH – There would be the potential for large adverse significant effects due to the severance of existing WCH routes (both during construction and operation).
Option D	Housing – No significant effects anticipated. Community land and assets - No significant effects anticipated. Employment - No significant effects anticipated. Agricultural land holdings – There would be the potential for moderate adverse significant effects due to permanent land-take from agricultural land holdings (construction and operation). WCH – There would be the potential for large adverse significant effects due to the severance of existing WCH routes (both during construction and operation).
Option E	Housing – There would be the potential for moderate adverse significant effects due to permanent land-take from private housing land (construction and operation) and changes in access to private residential properties (construction and operation). Community land and assets - There would be the potential for moderate adverse significant effects due to permanent land-take from community land (construction and operation). Employment - There would be the potential for moderate adverse significant effects due to permanent land-take from commercial land (construction and operation) and changes in access to businesses (construction and operation). Agricultural land holdings – There would be the potential for moderate adverse significant effects due to permanent land-take from agricultural land holdings (construction and operation). WCH – There would be the potential for large adverse significant effects due to the severance of existing WCH routes (both during construction and operation).
Option F	Housing – There would be the potential for moderate adverse significant effects due to permanent land-take from private housing land (construction and operation) and changes in access to private residential properties (construction and operation). Community land and assets - There would be the potential for moderate adverse significant effects due to permanent land-take from community land (construction and operation). Employment - There would be the potential for moderate adverse significant effects due to permanent land-take from commercial land (construction and operation) and changes in access to businesses (construction and operation). Agricultural land holdings – There would be the potential for moderate adverse significant effects due to permanent land-take from agricultural land holdings (construction and operation).

Option	Summary of likely significant effects
	WCH – No significant effects anticipated.
Option G	Housing – No significant effects anticipated. Community land and assets - No significant effects anticipated. Employment - No significant effects anticipated. Agricultural land holdings – No significant effects anticipated WCH – No significant effects anticipated.

Table 3.7.2 Strengths and weaknesses for each of the proposed options

Option	Strengths / weakness
Option A	Strengths • Opportunities to improve WCH routes and existing community severance issues. Weakness • This option would have the potential to significantly impact upon a number of a residential, commercial and agricultural receptors both temporarily and permanently.
Option B	Strengths • Opportunities to improve WCH routes and existing community severance issues. Weakness • This option would have the potential to significantly impact upon a number of a residential, commercial and agricultural receptors both temporarily and permanently.
Option C	Strengths • As with Option G there would be limited impacts upon residential and commercial receptors with impacts from the waste treatment facility towards the north centred around the junctions. Weakness • With this option there would be limited potential opportunities for reducing community severance and enhancing WCH routes.
Option D	Strengths • This option would have less impact upon residential and commercial receptors compared with online elements of options. • This option would not impact upon community land. Weakness • This option would have the highest potential for impacting on agricultural holdings including the potential loss of farmsteads at Long Drove.

Option	Strengths / weakness
	• This option would result in the severance of the highest number of PRoWs in comparison with other options.
Option E	Strengths • This option would have opportunities to improve WCH routes and existing community severance issues. Weakness • This option would have the potential to significantly impact upon a number of a residential, commercial and agricultural receptors both temporarily and permanently.
Option F	Strengths • There would be impacts on receptors from the waste treatment to the A142 Witchford Road roundabout focused around the junction where there are limited receptors. Weakness • There would be limited potential opportunities for reducing community severance and enhancing WCH routes.
Option G	Strengths • This option would have the least impact upon on population and human health receptors in comparison with the other 6 options. Weaknesses • This option would not provide any potential opportunities for reducing community severance and enhancing WCH routes.

3.7.6 Required mitigation and enhancement opportunities

Measures would need to be implemented to reduce the impacts of the Proposed Scheme (all options (except Option G)) on population and human health receptors.

It is anticipated that traffic management, such as diversion routes, adequate and clear signage and other best practice measures, would be used to reduce the potential impacts of travel disruption on road users, WCH and access to housing, community land / assets, employment and agricultural land holdings during the construction period, as far as is reasonably practicable. The provision of CCTV and message signs to restrict speeds and close lane would manage traffic flows and would assist in helping to reduce adverse effects on vehicle-based travellers (accessibility) during the construction phase. The proposed options would be designed to satisfy current standards and designed to contribute to an enhanced road user experience, alleviating congestion and providing greater journey reliability throughout this section of the network.

Public consultation will assist in informing the Stakeholder Engagement Team / Design Team on any community-based issues that might not otherwise be apparent and any requirements for mitigation or opportunities for compensatory measures. Once a preferred option is selected, a review should be undertaken to determine how the effects of severance or effects on accessibility could potentially affect any committed developments identified in the area that may have come forward since this initial assessment has been undertaken.

Careful consideration of construction compound locations to minimise distance between the compound location(s) and the works area should be undertaken. Construction sites and compounds should be appropriately fenced off to restrict access to site personnel only and to ensure the safety of the general public is maintained.

Appropriate information and protection measures will be necessary to mitigate against any potential adverse effects on users of existing WCH routes during construction.

In relation to any permanent and temporary land-take required for construction purposes, the proposed options should be further developed to reduce land-take, where practicable and possible. The right to compensation and methods and procedures for assessing appropriate levels of such, will need to be identified in relation to the National Compensation Code. Where appropriate, land required to facilitate temporary construction activities and not required during the operation of the Proposed Scheme should be returned to its former use and reinstated accordingly. Where necessary, continued consultation should be undertaken with landowners, occupiers and agents, as the impacts on day-to-day activities are managed and reduced as far as practicably possible.

There is the potential to enhance existing WCH routes and provide additional WCH routes to support the ambitions of the combined authority with relation to sustainable and active travel and reducing carbon emission within the region. Cycleways would be proposed to be delivered for both the all options with the exception of the junction only option (Option G). However, the construction of a cycleway as part of the online options may increase the area of land-take required resulting in greater likely significant effects. With all options there is the potential to provide public realm improvements to settlements within the study area and to enhance land use and accessibility.

3.7.7 Topic specific risks

At this stage of the assessment the overall footprint of each option has yet to be determined, where an option route footprint includes the demolition of residential, commercial or agricultural buildings the potential significant effects would be likely to be large to very large. The right to compensation and methods and procedures for assessing appropriate levels of such, will need to be identified in relation to the National Compensation Code.

3.7.8 Preferred option

From the perspective of the Population and Human Health topic the preferred option would be Option G as this would involve the least amount of temporary and permanent land-take and changes to access for all receptors.

3.8 Geology and Soils

This Section reports a comparative assessment of how the seven alternative route options may vary in their effect on Geology and Soils, their strengths and weaknesses and a conclusion on which option is preferred. This has focused on the underlying geological conditions both under and in close proximity to the existing A10 and option footprints.

3.8.1 Legislative and policy framework

This assessment has taken into account relevant legislation and planning policy at national and local levels, as described below.

Legislation – Part IIA of the Environmental Protection Act 1990, Environmental Permitting (England and Wales) Regulations 2016, Water Framework Directive (Council Directive 2000/60/EC); implemented in England by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 and Wildlife and Countryside Act 1981, as amended.

National Planning Policy Framework 2019 (NPPF) - The NPPF states that 'planning policies and decisions should contribute to and enhance the natural and local environment by: a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan)… e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.' (Paragraph 170)
The policy also states that 'planning policies and decisions should ensure that: a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation); b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and c) adequate site investigation information, prepared by a competent person, is available to inform these assessment. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.' (Paragraphs 178 and 179)
The NPPF also provides guidance relating to geological conservation. The guidance indicates that the assessment should ensure that the effects on internationally, nationally and locally designated sites of geological conservation are considered. This includes taking advantage of opportunities to conserve geological interests. Guidance within the Government Circular: Biodiversity and Geological Conservation – Statutory Obligations and their Impact within the Planning System (ODPM 06/2005, Defra 01/2005) is referred to.

Local Plans - East Cambridgeshire Local Plan 2015: 'Policy ENV 9 sets out the criteria against which developments with potential pollution, contamination and waste implications will be considered. The Council will seek to ensure that levels of all are kept to a minimum and are acceptable to human health and safety, the environment and the amenity of adjacent or nearby land users. Environmental Health legislation regulates many forms of pollution, but it is clearly preferable to prevent conflict from new development arising in the first place'. South Cambridgeshire Local Plan 2018: Policy SC/11: Contaminated Land states: 'Where development is proposed on contaminated land or land suspected of being impacted by contaminants the Council will require developers to include an assessment of the extent of contamination and any possible risks. Proposals will only be permitted where land is, or can be made, suitable for the proposed use.'

3.8.2 Assessment Methodology, assumptions and limitations

A high-level desk-based assessment has been undertaken to identify the potential for significant effects to occur as a result of impacts from the Proposed Scheme on soils and geology. DMRB guidance for

Environmental Assessment and Monitoring (LA 104) and Geology and Soils (LA 109) and Contaminated Land Report 11, Model Procedures for the Management of Land Contamination (CLR 11) (Department for Environment, Food and Rural Affairs (Defra) and Environment Agency, 2004) have been used to guide the assessment framework and baseline data collection.

Assumptions and limitations related to this topic were:

- Consultation with regulators has not yet taken place. Data requests to local authorities, the EA and other relevant parties will take place in later stages of the project;
- No site walkovers or scheme-specific intrusive investigations have taken place, these will be undertaken at later stages of the project where appropriate;
- The assessment to identify potentially contaminative land uses has not included the review of 1:2,500 historical mapping which will be undertaken when route selection has taken place;
- At this stage, the assessment is based solely on desk-based information, which is considered appropriate and proportionate at this stage of the assessment. As such, a high level of uncertainty remains;
- The ALC assessment is based on 1:250,000 mapping and does not take into account the footprints of current development;
- Assessment on groundwater does not take into account the presence or thickness of superficial deposits, and therefore the assessment is considered conservative; and
- The potential locations of temporary contractor's working areas, compounds and access roads are currently unknown and as such, are not considered in this assessment.

3.8.3 Study Area

The study area for the Geology and Soils assessment at this stage is defined as a combined 250m buffer from all the Proposed Scheme options, including the online and offline options.

The 250m buffer zone has been chosen based on National House Building Council and EA guidance[10]. The buffer is considered appropriate and proportionate in the context of the scheme, taking into account the distance over which contamination can potentially migrate.

3.8.4 Baseline Conditions

Geology and Soils

The bedrock geology within the study area can broadly be divided into three areas; the south, the centre and the north of the study are. The southern extent of study area (Milton to the Cambridge Research Park) is underlain by Gault Formation and Upper Greensand Formation (undifferentiated) - Mudstone, Sandstone and Limestone. The centre of the study area, heading north towards Stretham is a mixture of Lower Greensand Group - Sandstone And Mudstone and West Walton Formation, Ampthill Clay Formation And Kimmeridge Clay Formation (undifferentiated) - Mudstone, Siltstone And Sandstone with an isolated deposit of Gault Formation And Upper Greensand Formation (undifferentiated) - Mudstone, Sandstone And Limestone. The northern extend of the study area is West Walton Formation, Ampthill Clay Formation And Kimmeridge Clay Formation (undifferentiated) - Mudstone, Siltstone And Sandstone with isolated deposits of Lower Greensand Group - Sandstone And Mudstone.

Superficial deposits are present across the majority of the southern and central extents of the of the study area, with a single Till - Diamicton formation to the west of Little Thetford and at the A142 Witchford Road junction. The southern extent of the study area is River Terrace Deposits, 2 - Sand And Gravel, with

[10] NHBC and Environment Agency (2008). Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66: 2008

Alluvium - Clay, Silt, Sand And Gravel superficial deposits recorded along the existing A10 River Great Ouse crossing. A small deposit of Peat is recorded to the north of Chittering.

The ALC system[11] defines six grades of soils. Grades 1, 2 and subgrade 3a are determined as BMV. BMV agricultural land is the most flexible in terms of the range of crops that can be grown; the level and consistency of yield and the cost of obtaining it, and offers the best prospect for both food and non-food crop production. As no detailed scheme-specific surveys are available it is assumed that Grade 3 land is subgrade 3a.

The study area is a mixture of Grade 2 and subgrade 3a soils with an isolated area of non-agricultural grade land at the Waterbeach Airfield and areas of Grade 1 soils bounding the River Great Ouse.

Controlled Waters

The following named surface water courses are present within the study area (south to north);

- Thirteenth Public Drain;
- Beach Ditch;
- Engine Drain;
- Fourth Sock Drain and
- River Great Ouse.

Lower Greensand Group - Sandstone And Mudstone formations are principal aquifers, which are defined as units which have high intergranular and/or fracture permeability and usually provide a high level of water storage and may support water supply and/or river base flow on a strategic scale.

River Terrace Deposits, 2 - Sand And Gravel and Alluvium - Clay, Silt, Sand And Gravel are classified as Secondary A superficial aquifers. Till – Diamicton formations are classified as Secondary (undifferentiated) superficial aquifers.

Human receptors

The current land use for the study area is mixed, including urban and agricultural land, towns, villages and commercial areas, see Section 3.7.4 for key populations.

Environmental receptors

There are no statutory designated sites which are considered of geological importance within the study area.

Land use – potentially contaminative land uses

There are 3 authorised landfills located within the study area, there are no historical landfills located within 250m of the . A thorough historical land use assessment will be undertaken in later stages of this project including a review of historical maps.

The Zetica unexploded ordnance regional risk map[12] shows the study area is located in an area of Low Bomb Risk.

[11] Agricultural Land Classification of England and Wales: Revised criteria for grading the quality of agricultural land, MAFF, 1988

[12] https://zeticauxo.com/downloads-and-resources/risk-maps/

3.8.5 Likely significant effects

This section presents a summary of the key significant effects associated with each route option. As no surveys or reviews of historical mapping or ground condition reports have been undertaken likely significant effects would be based on the potential of encountering unknown contamination.

Table 3.8.1 Summary of likely significant effects

Option	Summary of likely significant effects
Option A	Offline elements have the potential for the loss or reduction in quality of grade 1, 2 and 3 agricultural land. Where mitigation cannot be provided this would result in a moderate to large significant effect. There would be the potential to impact upon the health of construction and maintenance workers and adjacent site users where potentially unknown contamination is encountered, following the implementation of mitigation no likely significant effects would be anticipated. There would be the potential to impact upon groundwater (superficial and bedrock) and surface water from the disturbance of potentially unknown contamination is disturbed.
Option B	Offline elements have the potential for the loss or reduction in quality of grade 1, 2 and 3 agricultural land. Where mitigation cannot be provided this would result in a moderate to large significant effect. There would be the potential to impact upon the health of construction and maintenance workers and adjacent site users where potentially unknown contamination is encountered, following the implementation of mitigation no likely significant effects would be anticipated. There would be the potential to impact upon groundwater (superficial and bedrock) and surface water from the disturbance of potentially unknown contamination is disturbed.
Option C	Offline elements have the potential for the loss or reduction in quality of grade 1, 2 and 3 agricultural land. Where mitigation cannot be provided this would result in a moderate to large significant effect. There would be the potential to impact upon the health of construction and maintenance workers and adjacent site users where potentially unknown contamination is encountered, following the implementation of mitigation no likely significant effects would be anticipated. There would be the potential to impact upon groundwater (superficial and bedrock) and surface water from the disturbance of potentially unknown contamination is disturbed.
Option D	The offline nature of the option has the potential to result in the loss or reduction of quality of grade 1, 2 and 3 agricultural land. Where mitigation cannot be provided this would result in a moderate to large significant effect.

Option	Summary of likely significant effects
	There would be the potential to impact upon the health of construction and maintenance workers and adjacent site users where potentially unknown contamination is encountered, following the implementation of mitigation no likely significant effects would be anticipated. There would be the potential to impact upon groundwater (superficial and bedrock) and surface water from the disturbance of potentially unknown contamination is disturbed.
Option E	Offline elements have the potential for the loss or reduction in quality of grade 1, 2 and 3 agricultural land. Where mitigation cannot be provided this would result in a moderate to large significant effect. There would be the potential to impact upon the health of construction and maintenance workers and adjacent site users where potentially unknown contamination is encountered, following the implementation of mitigation no likely significant effects would be anticipated. There would be the potential to impact upon groundwater (superficial and bedrock) and surface water from the disturbance of potentially unknown contamination is disturbed.
Option F	No significant effects would be anticipated.
Option G	No significant effects would be anticipated.

As all the options have similar strengths and weakness an assessment of each option has not been undertaken to avoid duplication, instead strengths and weaknesses have been summarised in the below paragraph.

Options A to E would have the potential to encounter unknown contamination due to the offline elements of the options. Options F and G compromise of either just junction improvements (Option G) or a mixture of junction improvements and online dualling (Option F). Land around the junctions and A10 corridor has been disturbed by previous development and contamination is unlikely to exist to a degree that would significantly effect the surrounding environment or human health. This would be considered a strength in comparison to Options A to E.

3.8.6 Required mitigation and enhancement opportunities

As surveys have yet to be undertaken there remains a level of uncertainty regarding ground conditions and historical land uses within the area and therefore, at this stage specific mitigation cannot be recommended. The following tertiary mitigation measures however, should be implemented to protect the health and safety of construction and maintenance workers and adjacent site users and prevent harm occurring to environmental receptors:

- Mitigation for the loss of good quality soils through a soil management plan which may include the redistribution of higher quality soils in lower soil quality areas (subject to contamination testing).
- Standard safe working practices, such as wearing correct personal protective equipment and using dust suppression measures during construction and maintenance; and

- Pollution prevention controls and standard measures for the protection of the environment during construction and maintenance, such as provision of spill kits and control of run off.

3.8.7 Topic Specific Risk

No topic specific risks have been identified at this stage of the assessment, this should be reviewed following the completion of ground investigation surveys and the procurement of ground condition reports to highlight the risk of contaminated land.

3.8.8 Preferred option

From the perspective of the Geology and Soils topic the preferred option would be either Option F or Option G as these options have the least potential to impact upon geology and soils and encounter contamination to a degree that would significantly effect the surround environment or impact upon human health.

3.9 Material Assets and Waste

This Section reports a comparative assessment of how the seven alternative route options may vary in their effect on Material Assets and Waste, their strengths and weaknesses and a conclusion on which option is preferred. This has focused on the availability of materials and potential for the scheme to generate different waste streams.

3.9.1 Legislative and policy framework

Legislation and national and local policies relevant to this topic are detailed below.

Legislation - The EU Circular Economy Package, 2018, Revised European Union (EU) Waste Framework Directive (2008/98/EC), Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste, The Environmental Protection Act 1990, The Environmental Permitting (England and Wales) Regulations 2016 (as amended), The Waste (England and Wales) Regulations 2011 (as amended), The Landfill (England and Wales) Regulations 2002 (as amended), The Hazardous Waste (England and Wales) Regulations 2005 (as amended).

National policy - Department for International Development 2017 Agenda 2030: Delivering the Global Goals, HM Government 2018 A Green Future: Our 25 Year Plan to Improve the Environment, Defra 2018 Resources and Waste Strategy for England, Waste Management Plan for England 2013, National Planning Policy Framework, 2019 (Chapters 3 and 17 respectively) and National Planning Policy for Waste 2014.

Local Policy – Cambridgeshire and Peterborough Mineral and Waste Development Framework 2011.

3.9.2 Assessment Methodology, assumptions and limitations

A high-level assessment has been undertaken to identify potential effects on material assets and waste from the delivery of the Proposed Scheme. This has been supplemented and guided by DMRB Volume 11, Section 3, Part 13 'LA 110 Material assets and waste'. LA 110 requires that an environmental assessment shall report on the construction phase and first year of operational activities (opening year). Operational impacts have not been assessed in the assessment as it has been assumed that no significant maintenance activities would occur during the opening year, and thus no significant materials consumption or waste generation is likely to be realised.

3.9.3 Study Area

In accordance with LA 110, the assessment of material assets and waste has utilised two geographically different study areas (the primary study area and secondary study area) to examine:

- The use of primary (the construction footprint), secondary (likely provenance of construction materials) and recycled construction materials; and
- The generation and management of waste.

The primary study area is the footprint of the proposed option, for online options this includes 18m each side of the existing carriageway. Professional judgement (a balance of the proximity principle and value for money principle) has been applied in deriving the second study areas.

3.9.4 Baseline Conditions

The East of England Aggregates Working Party (EEAWP) is the body charged with data collection to facilitate planning by Mineral Planning Authorities, national government agencies and the aggregate industry. The latest (2016) report 'East of England Aggregates Working Party – Annual Monitoring Report 2018' produced by the EEAWP provides sales and reserves data from January to December 2018. For the year 2018 EEAWP reported sales of 12.37 Million tonnes (Mt) of land-won sand and gravel (for which 3,199 thousand tonnes was sold in Cambridgeshire and Peterborough) and 0.22 Mt of Crushed Rock. At the end of 2018 reserves of land-won sand and gravel stood at 121.1 Mt with a reserve of 4.3 Mt for crushed rock. The EEAWP report also reported individual land banks, based on a 10 year average, of

approximately 17.5 years and 12.1 years respectively for sand and gravel and crushed rock in Cambridgeshire and Peterborough. As of the end of 2018 there were 15 sand and gravel quarries and 3 specialist limestone quarries in Cambridgeshire and Peterborough.

As of the end of 2018, there was a total of 15 permitted aggregate recycling facilities in Cambridgeshire and Peterborough. The EEAWP report as with previous years that obtaining accurate figures in respect of the volumes produced within the East of England if difficult and therefore volumes have been omitted.

The Cambridgeshire & Peterborough Minerals & Waste Core Strategy Development Plan[13]identifies Sand and Gravel Mineral Safeguarding Areas within the first study area. The available waste management infrastructure available to accept the waste likely to be generated during construction has been ascertained through a review of the Environment Agency (2018) 'Waste Management in the East of England: Data Tables'.

The total annual permitted throughput or capacity reported by Environment Agency (2018) for the East of England and Cambridgeshire respectively are detailed in Table 3.9.1 for transfer, treatment, metal recycling and incineration sites.

[13] http://www.bgs.ac.uk/mineralsUK/planning/resource.html

Table 3.9.1: Total permitted throughput or capacity of waste management sites in the study area, 2018

Site type	East of England (000s tonnes)	Cambridgeshire sub-region (000s tonnes)
Transfer (annual throughput)		
Hazardous waste transfer stations	1,049	295
Household, industrial, commercial waste transfer stations	2,990	580
Clinical	180	3
Civic amenity sites	538	102
Non-biodegradable waste transfer stations	498	4
Treatment and metal recycling (annual throughput)		
Material recovery	1,302	168
Physical treatment	4,396	618
Physico-chemical treatment	964	376
Chemical treatment	1,078	-
Composting	906	296
Biological treatment	2,175	582
Metal recycling	2272	122
Incineration (annual capacity)		
Co-incineration of hazardous waste	-	-
Co-incineration of non-hazardous waste	-	-
Hazardous waste incineration	-	-
Municipal and/or industrial & commercial incineration	266	-
Biomass / waste wood incineration	286	-

Based on this data there will be significant opportunity for appropriate wastes arising during the construction of the proposed options to be recycled or subject to other recovery via appropriate means, subject to the waste hierarchy.

For wastes which cannot be reused, recycled or otherwise recovered, disposal to landfill would be required. Environment Agency (2018) details total remaining landfill capacity in East of England and Cambridgeshire in 2018, and is presented in Table 3.9.2.

Table 3.9.2: Total landfill capacity available in the study area, 2018

Site Type	East of England (000s cubic metres)	Cambridgeshire sub-region (000s cubic metres)
Hazardous merchant landfill	-	-
Hazardous restricted landfill	-	-
Non-hazardous landfill with SNRHW cell[14]	5,711	1,873
Non-hazardous landfill	25,092	7,702
Non-hazardous restricted	-	-
Inert landfill	20,342	3,106
Total	51,145	12,681

Although there is a reducing trend for landfill disposal, there is significant landfill capacity on both a regional and sub-regional basis. This means that any waste that is destined for landfill would most likely find available regional capacity. It is also of note that even where wastes are accepted at landfill some may, subject to their properties, be used for reuse, recycling or recovery within landfill cover or other engineering rather than subject to and accounted as disposal.

3.9.5 Likely significant effects

Constructing each of the proposed route options would generate adverse effects with regards to Material Assets and Waste, when compared with a 'Do Minimum' scenario.

It is not possible, until the engineering aspects of each of the proposed route options have been identified (e.g. in the form of a Bill of Quantities), to identify precisely the environmental effects associated with material assets and waste during the construction of the proposed route options.

Based on experience of previous projects, the proposed route options under consideration, and the layout of the site suggest that the materials used, and wastes generated are likely to include the following;

Material Used

- General fill / landscaping fill;
- Capping materials;
- Bituminous materials for road construction;
- Road markings (thermoplastic materials);
- Granular stone sub base;
- Drainage products – pipes, chambers and gully pots (including metal covers or grates), plastic, clayware or precast concrete;
- Drainage products – storm cells and interceptors (likely to be plastic);
- Granular stone bedding and backfill to drainage pipes;
- Traffic signage;
- Steel safety barriers;
- Steel for use in structures;
- Precast concrete – kerbs;
- Concrete for various purposes including drainage, sign foundations, in situ drainage channels and structures;
- Timber (e.g. formwork, falsework); and
- Traffic signal posts and heads, electrical cables, ducts, inspection chambers.

Waste generated

- Vegetation, tree and scrub removal (non-hazardous);
- Excavated materials (inert, non-hazardous or hazardous);

[14] Some non-hazardous sites can accept some Stable Non-Reactive Hazardous Wastes (SNRHW) into a dedicated cell, but this is usually a small part of the overall capacity of the site.

- Concrete waste (inert);
- Mixed inert waste (inert);
- Mixed construction and demolition waste (non-hazardous);
- Canteen / office / ad hoc waste (non-hazardous);
- Mixed packaging (non-hazardous);
- Virgin and non-virgin timber (non-hazardous);
- Plastics (non-hazardous);
- Metals (non-hazardous);
- Miscellaneous aqueous liquids wastes (non-hazardous);
- Miscellaneous hazardous waste;
- Hydraulic oils (hazardous); and
- Waste electrical and electronic equipment (hazardous or non-hazardous).

Based on the significance criteria detailed within LA110 and the baseline conditions presented in Section 3.9.4 it is unlikely that the construction of any of the Proposed Scheme options would meet all the significance criteria descriptors necessary to realise significant effects on material assets and waste.

3.9.6 Required mitigation and enhancement opportunities

Mitigation measures would include, but not be limited to, the following:

- Producing a Responsible Sourcing Plan (RSP) to maximise the responsible sourcing of construction materials and products with proven sustainability credentials that minimise adverse impacts on people and their environment. The plan shall specify, the:
- Use of key material elements (asphalt, concrete, aggregate, steel, aluminum and plastics) responsibly sourced from suppliers with industry recognised responsible sourcing certification for that material (e.g.: certification to BRE BES 6001, or membership of a sector specific scheme that complies to BSI BS 8902);
- Use of timber and wood-derived products that are sustainably sourced from independently verifiable legal and sustainable sources (i.e. originating either from independently verified legal and sustainable sources or from a licensed Forest Law Enforcement Governance and Trade partner);
- Use of alternatives to primary materials, where available and permitted by the Specification for Highway Works. This could include materials that already exist on site or can be sourced from other projects / suppliers; and ensuring that any aggregates imported to site comprise re-used, secondary or recycled content at levels in line with the 'East of England regional guideline for aggregates provision 2005-2020' target of 30%; and
- Minimal use of hazardous materials that have the potential to harm human health or the environment; and that might cause problems for future reuse, recycling and recovery.
- Implementation of a Site Waste Management Plan (SWMP) to evidence how the design and construction of the Proposed Scheme: has adopted the waste hierarchy of prevention, reuse, recycling other recovery and disposal; and supports the target of ensuring that at least 90% of non-hazardous C&D waste is subjected to material recovery to support the target of reducing landfill to a maximum of 10% of all waste by 2035, as required by the Defra (2018) 'Resources and Waste Strategy for England'.

3.9.7 Topic specific risks

No topic specific risks identified at this stage.

3.9.8 Preferred option

Given that all options would be unlikely to result in a significant effect upon material assets and waste there is no preferred option for this topic.

3.10 Road Drainage and the Water Environment

This Section reports a comparative assessment of how the seven alternative route options may vary in their effect on the Road Drainage and Water Environment, their strengths and weaknesses and a conclusion on which option is preferred. This has focused on the presence of waterbodies and the potential for proposed scheme to impact upon flood risk, water quality and hydromorphological processes.

3.10.1 Legislation and guidance

National Planning Policy Framework (NPPF) (2012) – Sets out the UK Government's planning policies for England and how they should be applied. Under the NPPF inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk. This is achieved through application of the Sequential Test which steers new development to areas with the lowest risk of flooding. Where this is not possible the Exception Test is applied.

The Planning practice guidance on flood risk and coastal change sets out the requirements for Exception Test whereby new development in areas at risk of flooding must demonstrate it provides wider benefits that outweigh the risk of flooding and that it is designed to be safe for its lifetime without increasing flood risk elsewhere.

In accordance with the vulnerability classification presented in the flood risk and coastal change PPG, the proposed development is classified as 'essential infrastructure'. Essential infrastructure crossing areas of flood zone 3a and/or 3b is required to satisfy the Exception Test.

DEFRA Adapting to Climate Change: Advice to Flood & Coastal Risk Management Authorities (2011) – Provides guidance on climate change allowances up to the year 2115 based on UKCP09 data. Under this guidance all essential infrastructure should consider the Upper Estimate (90th percentile) for climate change allowance. The guidance states that within the Anglian district and under the Upper (90th) percentile, which is required for the assessment of all essential infrastructure, peak river flood flows are anticipated to increase by 65% by the 2080s (covering the lifetime of the Proposed Scheme).

Land Drainage Act (1994) – Sets out the responsibilities and requirements under riparian ownership whereby a watercourse is maintained in such a condition that the free flow of water is not impeded.

The EU Water Framework Directive – establishes protection of waterbodies via a commitment to achieve and maintain a good qualitative and quantitative status of all waterbodies.

3.10.2 Assessment methodology, assumptions and limitations

Fluvial and surface water flood risk has been assessed using the EA Flood Map for Planning and the EA Risk of Flooding for Surface Water Map. Whilst these provide an understanding of current flood risk they do not show the flood risk across the lifetime of the Proposed Scheme and the expected change associated with the effects of Climate Change.

This assessment has made certain assumptions concerning the mitigation measures necessary to prevent an increase in flood risk from the development. These are based on NPPF policy requirements and the requirements of local flood Risk Management Authorities (RMAs); the Environment Agency, Internal Drainage Board and Lead Local Flood Authority. These requirements distil to the principal that the development will not be permitted to proceed if it results in an increase in flood risk and/or adverse impact to the aquatic environment.

In absence of the 1% Annual Exceedance Period (AEP) peak flow for each watercourse, a review of catchment size was used to infer flows and the type of structure required. The UK SUDS flow estimation tool calculates that a catchment area of 1ha in the vicinity of Landbeach (TL 47352 65255) yields a present day 100 year peak flow of 8.04l/s using FEH methods.

The 1% AEP peak flow for Landbeach was then uplifted to account for Climate Change (CC), as discussed above.

By determining the likely catchment size to the point at which the highway crosses each watercourse a 100 year flood flow could be estimated and type of structure required at each crossing assumed based on the following;

- For catchments of less than 0.3km² where the peak 100 year +CC flow could be passed by a culvert of 450mm to 900mm (i.e. flow of less than 225l/s (0.225m³/s), highways would cross watercourses by culvert requiring little in the way of approach ramps;

- For catchments of between 0.3km² and 2.2km²) where the peak 100 year +CC flow could be passed by a culvert of 900mm diameter or a 1.2m x 1.2m box culvert (i.e. flow up to 1,700l/s (1.7m³/s), watercourses would be crossed by structure/box culvert and where all box culverts of 1.2m x 1.2m or greater would require approach ramps.

- For catchments where the peak 100 year +CC flow could be passed by a structure/box culvert greater than 1.2m (i.e. catchment area > 2.2km²), watercourses would be crossed by a bridge requiring the soffit to be 600mm above the 100 year plus climate change flood levels and approach ramps; and,

- For catchments where the peak 100 year + CC flow results in significant out of bank flow with nearby local vulnerable land uses, watercourses would be crossed by viaduct.

Where crossings require an elevated section of road or approach ramp and are located within Flood Zone 3, compensatory storage will be required.

In addition, where approach structures including ramps are required in areas of flood plain to carry the highway over 'over bridges' compensatory storage will be required.

3.10.3 Study Area

There are a significant number of fluvial and surface water flood sources between the southern and northern ends of the scheme corridor which result in flood risk to and potentially arising from the development. These include the River Great Ouse (Main River), numerous Internal Drainage Board drains and Ordinary Watercourses.

The study area for the water environment has been defined by the land take of scheme corridor. For online sections of options this comprises a 18.8m width along the linear length of the option, or 9.4m buffer from the centreline of the road. For offline sections of options this comprises a 27.1m width along the linear length of the option, or 13.55m buffer from the road centreline.

The majority of the study area between the southern and northern ends of the existing A10 alignment consists of arable land, intersected with small areas of development comprising industrial estates, farms and villages such as Landbeach, Waterbeach, Stretham and Little Thetford.

3.10.4 Baseline Conditions

The majority of the scheme corridor is in Flood Zone 1 (less than 1 in 1000 Annual Exceedance Probability (AEP)) which indicates a low risk of flooding. However, there are sections of the various alignments which have a higher risk of flooding. Approximately 2.2km of the existing A10 alignment is shown to pass through Flood Zone 2 (1 in 1000 % to 1 in 100 AEP) and approximately 2km of the alignment passes through Flood Zone 3 (the length of this also with Flood Zone 3B (functional floodplain) is currently unknown).

The Environment Agency's Risk of Flooding from Surface Water Map shows the majority of the scheme corridor is located in areas of very low risk of flooding (less than 1 in 1000 AEP) however there are isolated areas where a medium (1 in 100 AEP) and high risk (1 in 30 AEP) of flooding are experienced.

The scheme corridor lies within the Old West River (GB205033043375) and Ely Ouse (South Level) (GB205033000070) surface water bodies of South Level and Cut-off channel catchment. Where the Old West River drains into the Ely Ouse (South Level). For the purpose of reporting on the water quality of the watercourses within the study area, the WFD chemical quality has been referenced from the Environment Agency's Catchment Data explorer. This identifies the Old West River and Ely Ouse (South Level) water bodies to have 'good' chemical quality but achieve moderate overall status due to their heavily modified and artificial hydromorphological designations respectively.

The Cam and Ely Woburn Sands Water Framework Directive Groundwater body is located in the region, stretching southwest to northeast across the existing A10 at Chittering. However, no part of the scheme corridor lies within a groundwater source protection zone and so it is not anticipated that the Proposed Scheme will have any impact on groundwater quality.

3.10.5 Likely Significant Effects

Any increase in the area of road and impermeable surfaces, either through widening of the existing A10 through online options, or the creation of new offline routes, would result in an increase in surface water runoff. In accordance with Defra guidance on climate change allowances highway drainage systems would need to be sized appropriately with consideration for a potential 40% increase in rainfall intensity to prevent an increase in surface water flooding from the development. Furthermore, there is the potential that increases in road surfaces could increase the discharge of road pollutants into the environment. These would need to be managed appropriately to ensure there is no derogation of the watercourse in accordance with the Water Framework Directive.

The risk of flood water displacement or impedance of flow routes is possible in locations where embankments would be required to raise the scheme above existing watercourses or roads and structures would be required to carry the highway over watercourses. Suitably sized culverts would be required to pass water through these structures and compensatory flood storage provided where floodplain volume is lost and there is a potential of increasing flood risk.

Table 3.10.1 Summary of likely significant effects

Option	Summary of likely significant effects
Option A	The majority of Option A would be located within Flood Zone 1, which indicates a low risk of flooding from fluvial sources. However, there would be sections of the option at a high and medium risk of fluvial flooding from a number of IDB drains and Ordinary Watercourses throughout the route. Approximately 200m of the option would be located within Flood Zone 3 and approximately 4km within Flood Zone 2. The Environment Agency's Risk of Flooding from Surface Water Map shows most of the option would be located in areas of very low risk of flooding however there would be isolated areas where a medium and high risk of flooding would be experienced. Option A would cross the River Great Ouse using the existing A10 bridge, (although it would need to be widened), an unnamed watercourse and six IDB Drains. All of the IDB drain crossings would require a box culvert to convey flows, requiring the road to be raised. Two of these crossings would be located within Flood Zone 3 and would require compensatory storage to avoid any increase in flood risk further downstream. Furthermore, it would be proposed that Waterbeach Road would be

Option	Summary of likely significant effects
	crossed via an overbridge. As any embankment associated with this structure would fall within Flood Zone 3, compensatory storage would also be required. This option would take the same route through Flood Zone 3 as the existing A10, therefore there would be expected to be minimal change in surface water flood risk to vulnerable receptors with this option. Widening of the online sections of the road may increase the size of the required structures within Flood Zone 3 at the existing crossing over the River Great Ouse. Option A would have the potential to increase flood risk given multiple structures would be required within the functional floodplain to cross watercourses and roads. Furthermore, whilst this option would utilise parts of the existing A10 there would be the risk of increasing surface water flooding if drainage was not adequately sized. IDB drains fall within artificial and heavily modified catchments and are managed under by the Ely Drainage Board. Option A would be likely to have a negligible impact on watercourse hydromorphology or flow paths for these watercourses due to their transient nature. However, there would be the potential for Option A to impact the River Great Ouse where the existing crossing would be proposed to be widened which may restrict flow, increase siltation or scour along the River. The Proposed Scheme would have a negligible impact on groundwater. There are no source protection zones within the vicinity of the study area.
Option B	Most of Option B would be located within Flood Zone 1, which indicates a low risk of flooding from fluvial sources. However, there would be sections of the option at a high and medium risk of fluvial flooding from several IDB drains and Ordinary Watercourses throughout the scheme route. Approximately 200m of the option would be located within Flood Zone 3 and approximately 4km within Flood Zone 2. The Environment Agency's Risk of Flooding from Surface Water Map shows most of the option would be located in areas of very low risk of flooding however there would be isolated areas where a medium and high risk of flooding would be experienced. This option would cross the River Great Ouse using the existing A10 bridge, (although it would need to be widened), the Thetford Catchwater, an unnamed watercourse and ten IDB drains. All of the IDB drain crossings would require a box culvert to convey flows requiring the road to be raised. Two of these crossings would be located within Flood Zone 3 and would require compensatory storage to avoid any increase in flood risk further downstream. Furthermore, it would be proposed that Waterbeach Road would be crossed via an overbridge. As any embankment associated with this structure would fall within Flood Zone 3, compensatory storage would also be required. Widening of the online sections of the road may increase the size of the required structures within Flood Zone 3 at the existing crossing over the River Great Ouse. Option B would have the potential to increase flood risk given multiple structures would be required within the functional floodplain to cross watercourses and roads. Furthermore, whilst this option would utilise parts of the existing A10 there would be the risk of increasing surface water flooding if drainage was not adequately sized.

Option	Summary of likely significant effects
	IDB drains fall within artificial and heavily modified catchments and would be managed under by the Ely Drainage Board. Option B would be likely to have a negligible impact on watercourse hydromorphology or flow paths for these watercourses due to their transient nature. However, there would be the potential for this option to impact the River Great Ouse where the existing crossing would be proposed to be widened which may restrict flow, increase siltation or scour along the River. The Proposed Scheme would have a negligible impact on groundwater. There are no source protection zones within the vicinity of the study area
Option C	Option C extends along the A10 around Milton to Cambridge Science Park. Most of the option would be located within Flood Zone 1, which indicates a low risk of flooding from fluvial sources. However, there would be sections of the option at a high and medium risk of fluvial flooding from a number of IDB drains and Ordinary Watercourses throughout the route. Approximately 2km of the option would be located within Flood Zone 3 and approximately 4km within Flood Zone 2. The Environment Agency's Risk of Flooding from Surface Water Map shows the majority of the option would be located in as of very low risk of flooding however there would be isolated areas where a medium and high risk of flooding would be experienced. This option would cross five IDB drains requiring box culverts to convey flows and associated raising of the road. Two of these crossings would be located within Flood Zone 3 and would require compensatory storage to avoid any increase in flood risk further downstream. Furthermore, it is proposed that Waterbeach Road would be crossed via an overbridge. As any embankment associated with this structure would fall within Flood Zone 3, compensatory storage would also be required. Option C would have the potential to increase flood risk given multiple structures would be required within the functional floodplain to cross watercourses and roads. Furthermore, whilst this option would utilise parts of the existing A10 there would be the risk of increasing surface water flooding if drainage was not adequately sized. IDB drains fall within artificial and heavily modified catchments and are managed under by the Ely Drainage Board. Option C would be likely to have a negligible impact on watercourse hydromorphology or flow paths for these watercourses due to their transient nature. Option C would be anticipated to have a low risk of increasing flood risk to vulnerable receptors The Proposed Scheme would have a negligible impact on groundwater. There are no source protection zones within the vicinity of the study area.
Option D	The majority of Option D would be located within Flood Zone 1, which indicates a low risk of flooding from fluvial sources. However, there would be sections of the option at a high and medium risk of fluvial flooding from a number of IDB drains and ordinary watercourses throughout the route.

Option	Summary of likely significant effects
	Approximately 4km of the option would be located within Flood Zone 3 and approximately 4.6km within Flood Zone 2. The Environment Agency's Risk of Flooding from Surface Water Map shows the majority of the option would be located in areas of very low risk of flooding however there would be isolated areas where a medium and high risk of flooding would be experienced. This option would cross the River Great Ouse, the Grunty Fen Catchment, an unnamed watercourse and 31 IDB drains. All of the 31 IDB drain crossings and the unnamed watercourse crossing would require box culverts to convey the catchment flow necessitating sections of raised highway. A new bridge to cross the River Great Ouse would be required along with compensatory storage in 14 locations where structures that allow the Proposed Scheme to cross a watercourse fall within Flood Zone 3 and to avoid any increase in flood risk further downstream. Given this option would be largely offline, it would require multiple sections of raised embankments and would create a large area of additional impermeable road surfaces and the potential for high surface water flood risk. IDB drains fall within artificial and heavily modified catchments and are managed under by the Ely Drainage Board. Option D would be likely to have a negligible impact on watercourse hydromorphology or flow paths for these watercourses due to their transient nature. However, this option would have significant impact to the River Great Ouse where a new structure would be required to cross the watercourse. This would have the potential to restrict flow, increase siltation and scour along the River. The Proposed Scheme would have a negligible impact on groundwater. There are no source protection zones within the vicinity of the study area.
Option E	The majority of Option E would be located within Flood Zone 1, which indicates a low risk of flooding from fluvial sources. However, there would be sections of the option at a high and medium risk of fluvial flooding from a number of IDB drains and ordinary watercourses throughout the route. Approximately 1km of the option would be located within Flood Zone 3 and approximately 2.5km within Flood Zone 2. The Environment Agency's Risk of Flooding from Surface Water Map shows most of the option would be located in areas of very low risk of flooding however there would be isolated areas where a medium and high risk of flooding would be experienced This option would cross the River Great Ouse using the existing A10 bridge, the Thetford Catchwater an unnamed watercourse and one IDB drain which would require a box culvert to convey the catchment flow. Given the option would be largely online there would be few embankments required to cross existing roads. Therefore, the flood risk as a result of this option would be likely to remain low. Furthermore, the IDB drain that would need to be crossed is not located in an area at risk of flooding meaning compensatory storage would be unlikely to be required for the watercourse.

Option	Summary of likely significant effects
	Given that there would be little new road being created it would be expected that the effect of this option would be a minimal change in flood risk to vulnerable receptors. IDB drains fall within artificial and heavily modified catchments and are managed under by the Ely Drainage Board. Option E would be likely to have a negligible impact on watercourse hydromorphology or flow paths for the IDB drain due to its transient nature. However, there would be the potential for this option to impact the River Great Ouse where the existing crossing would be proposed to be widened which may restrict flow, increase siltation or scour along the River. The Proposed Scheme would have a negligible impact on groundwater. There are no source protection zones within the vicinity of the study area.
Option F	Option F would consist of only a short length of dualling from Milton along the A10 to the A142 Witchford Road Roundabout. The entirety of the option would be located within Flood Zone 1, which indicates a low risk of flooding from fluvial sources. The Environment Agency's Risk of Flooding from Surface Water Map shows most of this option would be located in areas of very low risk of flooding however there would be isolated areas where a medium and high risk of flooding would be experienced. Option F would cross one IDB drain as part of the online section of the A10. This would require the highway to be raised in order to accommodate a box culvert sufficient to convey the catchment flows. However, as it would fall outside of a flood zone compensatory storage for the watercourse crossing would be unlikely to be required. As this option would follow the existing A10 there would be few additional impacts associated with the option. However any widening of the road would be likely to result in an increase in impermeable road surface and the potential for increased surface water flood risk. IDB drains fall within artificial and heavily modified catchments and are managed under by the Ely Drainage Board. Option F would be likely to have a negligible impact on watercourse hydromorphology or flow paths for the IDB drain due to its transient nature The Proposed Scheme would have a negligible impact on groundwater. There are no source protection zones within the vicinity of the study area.
Option G	Option G would comprise improvements to a number of the existing junctions situated along the A10. The majority of the existing A10 road alignment is in Flood Zone 1 (less than 0.1% Annual Exceedance Probability (AEP)) which indicates a low risk of flooding. However, there would be sections of the alignment which would have a higher risk of flooding. Approximately 2.2km of the existing alignment of the A10 passes through Flood Zone 2 (1 in 1000 to 1 in 100 AEP) and approximately 2km of the alignment passes

Option	Summary of likely significant effects
	through Flood Zone 3 (1 in 100 AEP). The Environment Agency's Risk of Flooding from Surface Water Map shows the majority of the scheme is located in areas of very low risk of flooding (less than 1 in 1000 AEP) however there would be isolated areas where a medium (1 in 100 AEP) and high risk (1 in 30 AEP) of flooding would be experienced. All of the existing junctions fall within Flood Zone 1, any improvements should be designed to minimise any intrusion into the floodplain to avoid an increase in flood risk. The Proposed Scheme would have a negligible impact on hydromorphology or groundwater. There are no source protection zones within the vicinity of the study area and it is assumed that junction improvements would not impede on localised watercourses.

Table 3.10.2 Strengths and weaknesses for each of the proposed options

Option	Strengths / weakness
Option A	Option A would impact on flood risk through introduction of numerous new structures and associated raised sections of highway in the floodplain would require compensatory storage.
Option B	Option B would impact on flood risk through introduction of numerous new structures and associated raised sections of highway in the floodplain would require compensatory storage.
Option C	Option C would impact on flood risk through introduction of numerous new structures and associated raised sections of highway in the floodplain would require compensatory storage.
Option D	Option D would have the greatest impact on flood risk and hydromorphological characteristics of the River Ouse due to requirement for a new bridge. Numerous new culverts in areas of flood risk with associated embanked sections of road would require compensatory storage. Over bridges in floodplain would also require compensatory storage.
Option E	Option E would have limited impact on flood risk and hydromorhological characteristics of local watercourses. Unlikely for there to be a requirement for compensatory storage associated with structures crossing watercourses.
Option F	Option F would have limited impact on flood risk and hydromorhological characteristics of local watercourses. Unlikely for there to be a requirement for compensatory storage associated with structures crossing watercourses.

Option	Strengths / weakness
Option G	Option G would have least impact on flood risk and would require the least surface water management measures due to limited increases in highway footprint.

3.10.6 Required mitigation and enhancement opportunities

The following mitigation measures have been considered in this assessment and would need to be incorporated into the design:

- Structures required to facilitate the highway crossing watercourses must be designed to pass the 100 year +Climate Change (CC) flood flow, with their soffits set 300mm-600mm above the 100 year +CC flood level;
- Structures should ideally clear span the main channel and should do so perpendicular to the channel (i.e. avoid skew bridges);
- Structure abutments should be set a minimum of 8m back from the top of bank;
- Approach ramps in areas of flood risk should not increase flood risk elsewhere requiring compensatory storage;
- Structures should be designed so as not to impede flow;
- Highway drainage systems would be required to ensure there is no increase in rates of runoff (compared to the pre-developed condition) to the receiving environment for all events up to and including the 100 year +CC storm event, requiring attenuation features.
- Water discharged from the development to the receiving environment would require treatment to ensure there is no derogation of the receiving watercourses.

In addition to these requirements, design standards from the Design Manual for Roads and Bridges (CD 529, 'Design of outfall and culvert details') have also been used with respect to culverts and their sizing.

Compensatory storage for the encroachment of embanked sections of highway into the floodplain would be required to varying degrees for Options A, B, C & D.

3.10.7 Topic Specific Risks

The following topic specific risks have been identified:

- Appropriately sizing structures to ensure effective drainage/flow of watercourses
- Provision of compensatory storage to mitigate for any increased flood risk due to the construction of embanked highway in the floodplain
- Ensuring appropriate surface water drainage design to treat volume and quality of water prior to discharge to receiving environment

3.10.8 Preferred option

Option G would result in the least impact to the baseline (in terms of flood risk, water quality and hydromorphological characteristics) of watercourses compared with all other options. Therefore, this would be the preferred option for Road Drainage and the Water Environment.

4 Summary of initial environmental assessment

For the summary of the environmental assessment a 6-point scale has been used to provide an overall score to each of the options based on the likely significant effects reported in each topic section. This is to allow an easy comparison of the potential overall likely significant effects and opportunities of the proposed options. The RAG rating has been supplemented by a ranking of the options per topic with 1 being the preferred option to be taken forward based on the topics assessment findings and 7 being the option which would be considered to be most likely to adversely effect identified environmental receptors.

Table 4.1.1 Assessment criteria for Table 4.1.2

Score colour code	6-point effect scale
Red	Significant adverse effect – unlikely to be able to mitigate
Red / Amber	Potential significant adverse effect – mitigation maybe possible
Amber	Slight adverse effect. Effect not significant with typical mitigation
Amber / Green	Slight beneficial effect. Effect not significant
Green	Significant beneficial effect
Neutral	No effect or a neutral effect due to the balancing out of positive and negative effects

Table 4.1.2 Summary of Environmental Assessment including overall RAG scores per option

	Summary of environmental assessment	RAG and option rating						
		Option A	Option B	Option C	Option D	Option E	Option F	Option G
Air Quality	Air quality monitoring indicates that AQOs would be unlikely to be exceeded within the areas administered by ECDC and SCDC. Whilst exceedances of AQOs would be considered unlikely in the vicinity of the A10 or any of the Proposed Scheme options, changes in traffic flows over the wider area as a result of each option have the potential to affect air quality outside of the study area considered within this assessment. Further assessment is required, when traffic data would be available, in order to consider the potential for each	3 - 869 properties within 200m of proposed A10 alignment All options similar wider effects (except option G)	2 - 867 properties within 200m of proposed A10 alignment All options similar wider effects (except option G)	5 - 1,159 properties within 200m of proposed A10 alignment All options similar wider effects (except option G)	1 - 358 properties within 200m of proposed A10 alignment All options similar wider effects (except option G)	4 - 1,034 properties within 200m of proposed A10 alignment. All options similar wider effects (except option G)	7 - 1,324 properties within 200m of proposed A10 alignment All options similar wider effects (except option G)	6 - 1,323 properties within 200m of proposed junction improvements and existing A10 alignment

	Summary of environmental assessment	RAG and option rating						
		Option A	Option B	Option C	Option D	Option E	Option F	Option G
	option to affect air quality further afield (e.g. within the A14 Corridor AQMA and / or Oxford).							
Climate	Option A (95,566,278 tCO2e) is the preferred option as it has the lowest overall whole life carbon impacts with approximately a 200,000 tCO2e saving over 60 years (approx. 3,500 tCO2e per year) when compared to the highest emission Do something Option of Option F (95,770,384 tCO2e), which has the highest whole life carbon impacts. It is however noted that in the context of this road scheme when compared to the UK overall carbon budget, none of the options presented is more than a minor impact but equally carbon emissions would be a global receptor and hence should be considered.	1 – Lowest carbon impact	4	6	5	2	7 – Highest carbon impact	3
Biodiversity	Option G would be the smallest magnitude of change in terms of biodiversity due to the refined project footprint working area (compared to the other options) and associated lowest risk for direct and indirect effects to statutory and non-statutory designated sites, notable habitats, protected and notable species. Option D would be the most magnitude of change in terms of biodiversity due to the entire scheme comprising an offline route that would result in significant direct habitat loss, fragmentation, severance, and associated direct and indirect effects to statutory and non-statutory designated sites, notable habitats, protected and notable species. The remaining routes A, B, C, E and F all comprise a	5 - thirteen moderate adverse impacts	6 - similar to A with additional risk of secondary effects – also slightly longer offline route	3 - six moderate adverse impacts	7 - twenty moderate adverse impacts	4 - ten moderate adverse impacts	2 - four moderate adverse impacts	1 - no moderate adverse impacts

	Summary of environmental assessment	RAG and option rating						
		Option A	Option B	Option C	Option D	Option E	Option F	Option G
	combination of route dualling and/or proposed short offline sections. These all have the potential to result in significant moderate effects on statutory and non-statutory designated sites, notable habitats, protected and notable species, however the scales of these would be unlikely to be as significant as a complete new offline route (Option D).							
Cultural Heritage	All options have the potential to result in significant effect to cultural heritage resources to varying degrees, offline options have the potential to significantly effect unknown archaeology whereas online options have the potential to result in the partial or full removal of historic buildings.	5 – Would impact upon the setting of cultural heritage resources and result in the removal or partial removal of five listed buildings	5 – Would impact upon the setting of cultural heritage resources and result in the removal or partial of five listed buildings. Has a greater potential for encountering unknown archaeological than Option A	3 – Would impact upon the setting of cultural heritage resources and result in the removal of one listed building	2 – No impact on known cultural heritage resources. Would impact upon the setting of cultural heritage resources	7 – would result in the loss or partial loss of the highest number of cultural heritage resources	4 – Would impact upon the setting of cultural heritage resources and result in the removal of two listed buildings	1 – No impacts on cultural heritage resources
Landscape	Option G would be least damaging option overall followed by Option F as these options would be confined to the existing A10 corridor. Partially offline options become increasingly damaging and potentially highly visible in the open landscape, with Option B to the east of Stretham being the most damaging of these due to the sensitive nature of the landscape. The full offline Option D would be the most damaging overall.	5 – moderate adverse overall (large adverse locally at Landbeach and to the west of Stretham)	6 – moderate adverse overall (large adverse locally at Landbeach and to the east of Stretham)	3 – moderate adverse overall (large adverse locally to Landbeach)	7 – large adverse (most damaging)	4 - moderate adverse overall (large adverse locally to the west of Stretham)	2 – slight adverse	1 – slight adverse (least damaging)

	Summary of environmental assessment	RAG and option rating						
		Option A	Option B	Option C	Option D	Option E	Option F	Option G
Noise and Vibration	All options would have changes to the number of people exposed to high levels of noise, with some options potentially increasing this number and some decreasing. The options would create opportunities to mitigate some or all of the Noise Important Areas along the existing A10 route corridor. Neither option would present any 'show stoppers' in terms of noise and vibration impacts although some may generate significant effects. Overall it is considered that option D is best in terms of noise as this option would move the route away from the highest number of receptors.	3 – Minor beneficial due to the road moving away from some sensitive receptors	2 – Minor beneficial due to the road moving away from some sensitive receptors	4 - Minor beneficial due to the road moving away from some sensitive receptors	1 – Moderate beneficial due to the road moving away from many sensitive receptors	5 – Neutral due to some benefit from bypasses by increase in noise from online dualling	7 – Minor adverse due to an increase in noise from online dualling	6 – Neutral due to no noticeable change in traffic flow
Population and Health	Offline elements of options have the potential to significantly impact upon land use and accessibility for agricultural holdings. Online options which include the dualling of the existing carriage way have the potential to significantly impact upon land use and accessibility for private, commercial and community receptors. All options where not designed properly have the potential to significantly impact upon community severance however, this can be mitigated as part of the design of the preferred option.	6 – Moderate and large adverse impacts on all subtopics.	7 - Moderate and large adverse impacts on all subtopics requires greatest amount of agricultural land take out of options A, B and E	3 – Moderate and large adverse impacts to receptors between Milton and the Cambridge Science Park	4 – Moderate adverse impacts on Agriculture and large adverse impacts on WCH	5 - Moderate and large adverse impacts on all subtopics, requires least amount of agricultural land take out of options A, B and E.	2 – Moderate and large adverse impacts on the least number of receptors compared to other options, no impacts on WCH.	1 – No impacts anticipated
Geology & Soils	The offline option/elements of options have the potential to reduce the quality of grade 1,2 and 3 soils. There is also the potential for encountering unknown contamination where historical records are no complete or where material from previous development spoils may be present. Given the already developed nature of the land surrounding the junctions and the need for limited land-take	5 – Potential to encounter unknown contamination for offline elements	6 - Potential to encounter unknown contamination for offline elements	3 – Limited source-pathway-receptor potential where online works would be proposed; offline element	7 – has the great potential to encounter historic contamination and highest degree of sensitive receptor	4 – footprint is predominantly already developed/disturbed land therefore less potential for significant	2– limited source-pathway-receptor potential	1 – limited source-pathway-receptor potential

	Summary of environmental assessment	RAG and option rating						
		Option A	Option B	Option C	Option D	Option E	Option F	Option G
	outside of the existing highway boundary option G has the least potential for impacting upon geology, soils and human health.			has the potential to encounter unknown contamination		contamination to occur.		
Material Assets and Waste	Based on the significance criteria detailed within DMRB LA110 and the baseline conditions presented in Section 3.9.4 it is unlikely that the construction of any of the Proposed Scheme options would meet all the significance criteria descriptors necessary to realise significant effects on material assets and waste.	5 – Likely to generate waste that cannot be recycled on site where the existing road is also replaced.	6 Likely to generate that cannot be recycled on site where the existing road is also replaced. would generate more excavation waste than option A.	2 – Offline is likely to generate less waste that cannot be used insitu compared with Option F. Junction works would generate limited volumes of waste and use limited material. waste that cannot be	4 – Waste generated would predominantly be recyclable soils that would be likely to be used in situ.	7 – Likely to generate the largest volumes of waste that cannot be recycled on site where the existing road is also replaced.	3 – Junction works would generate limited volumes of waste and use limited material. Where the existing A10 is to be resurface this may generate landfillable waste.	1 – Likely to generate the least volumes of waste and use the least amount of new material
Road Drainage and the Water Environment	Delivering of new highway through areas of floodplain with associated implications for designing highway to be safe in times of flood and mitigate for displaced flood water. Ensuring drainage of the highways results in no increase in flood risk (maintaining or bettering current rates of discharge to receiving environment/watercourses). Ensuring adequate treatment of runoff from the highway to ensure there is no derogation of receiving watercourses.	4 - Fewer crossings through flood zone with the potential to increase flood risk	6 - Option has a considerable length within FZ3, as well as a number of watercourse crossings requiring compensatory storage.	5 - Fewer crossings through flood zone than B but more than C with the potential to increase flood risk	7 - Significant increase in hardstanding areas and compensatory storage required to mitigate floodplain loss when crossing watercourses.	3 - Option is largely online, watercourse crossing falls outside of flood zones, compensatory storage not required	2 - The option follows the existing A10.	1 - Minimal intrusion into the water environment with only junction improvements

5 Conclusion and Next Steps

5.1 Preferred Environmental Option

The conclusion of the initial environmental assessment is that the likely environmental effects of many of the options under consideration for the Proposed Scheme would be broadly comparable in terms of the likely significant environmental effect with likely risks around flooding, ecology, heritage and noise.

Option G would be the preferred environmental option as it would require only junction upgrades and so would be the least intrusive and require the smallest amount of land take. Consequently, when compared with the other options the likely significant effects of Option G would be less.

For similar reasons Options C and F would be the next preferred options. These options would combine junction improvements and restricted lengths of dualling (not the whole length of the A10). Consequently, the adverse environmental effects would be less than options that involve dualling along the majority of the length of the A10.

However, although these options (Options C and F) would generally be preferred they would be the least preferred in carbon terms. This would be because, (along with G), they would be the least effective in reducing congestion and as they would also have higher embodied carbon within the materials required, compared with Option G, so the carbon impacts would be largest for these options compared with the others.

The options involving extended lengths of dualling either on-line or off-line would be very comparable in environmental terms (Option A, B, D and E).

Option B and Option E would be the least preferred due to the potential for adverse effects upon population and health, biodiversity and cultural heritage.

Option D, the full off-line option would be strongly preferred for some topics specifically noise and air quality because traffic would be removed from the existing A10 and existing residential receptors. This would have beneficial effects for those receptors. However, this option would also be likely to have the largest adverse effects associated with land take (because it would have the largest footprint) and as a result was least preferred for biodiversity, landscape and water environment. It would also have a large carbon impact (3rd highest whole life carbon impact) as it would need a completely new dual carriageway to be built.

Option A would be the option that has neither the largest adverse effects or the greatest potential benefits and so in the ranking of options was consistently in the middle of the options. However, it would be the preferred option in terms of carbon.

For an option that involved full dualling from Milton Interchange to Ely Option A or Option D would be the preferred options based on the current level of information and assessment. Of all the options Option G would be the preferred and Options B and E the least preferred.

5.2 Development of the preferred option

The findings of the SOBC concluded that based on a cost: benefit ratio there would be a viable scheme to be developed at the next stage of the project. The next stage would involve identifying a preferred option which would then be developed into the preliminary design and be subject to a planning application for the Proposed Scheme. During this phase the following environmental work would be undertaken:

- Influence the design development to reduce environmental effects on e.g. flood risk and residential receptors.
- Obtain further baseline date for the shortlisted options (such as ecological records centre data).
- Undertaken site surveys such as ecology surveys.
- Undertake noise and air quality modelling.
- Undertake the screening and scoping stage of the EIA.
- Consultation on the EIA screening and scoping with the relevant stakeholders and interested third parties.
- Complete the environmental assessment required to support the planning permission.

5.3 Environmental Impact Assessment (EIA) likely to be required?

The Town and Country Planning (Environmental Impact Assessment) Regulations 2017, Schedules 1 and 2 describe development schemes which either are considered large scale schemes and therefore require a compulsory EIA (Schedule 1) or are smaller scale schemes for which an EIA is only required if the scheme is likely to give rise to significant environmental effects. Based on the options described in Section 2.4 the construction of a new road of 4 lanes or more or the dualling of an existing road of two lanes or less to provide 4 lanes or more would be considered a Schedule 1 development and would therefore require an EIA. For Option G where improvements to the existing junctions plus associated site compounds and haul roads would be greater than 1 hectare the Proposed Scheme will require screening against the criteria in Schedule 3 of the EIA Regs.

5.4 Is a Habitat Regulations Assessment (HRA) likely to be required?

For all options, with the exception of Options, C, F, G, a Habitat Regulations Assessment (HRA) Screening assessment (Stage 1 HRA) is required to assess the potential for the proposals to result in significant effects to the European Designated Sites described in the Biodiversity Section.

Of particular note, construction work over the River Great Ouse associated with Options A, B, D and E has the potential to adversely affect harbour seal (a qualifying feature of The Wash and North Norfolk Coast SAC). Due to low numbers of this species in the River Great Ouse it is anticipated that effects on the SAC would be unlikely to be significant and would not trigger the requirement for an Appropriate Assessment (Stage 2 HRA), however this would need to be confirmed through HRA Screening. The HRA Screening would require consideration of functional habitat that supports qualifying species for this and other European Sites listed in the Biodiversity Section.