A47 North Tuddenham to Easton

Scheme Assessment Report

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List of Acronyms

AADT	Annual Average Daily Traffic
AS14	Autumn Statement 2014
AST	Appraisal Summary Table
AQMA	Air Quality Management Areas
BCR	Benefit Cost Ratio
BGS	British Geological Society
BT	British Telecom

CCTV	Closed-circuit Television
CDM	Construction Design and Management Regulations
COBA	Cost Benefit Appraisal
CPO	Compulsory Purchase Order
CSR	Client Scheme Requirements
CWS	County Wildlife Site
DCO	Development Consent Order
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
EA	Environmental Assessment
EAST	Early Assessment and Sifting Tool
GNLP	Greater Norwich Local Plan
HA	Highways Agency (replaced by Highways England on 1 April 2015)
HADDMS	Highways Agency Drainage Data Management System
HAWRAT	Highways Agency Water Risk Assessment Tool
IAMIS	Integrated Asset Management Information System
ICD	Inscribed Circle Diameter
IDC	Investment Decision Committee
JCS	Joint Core Strategy
GCN	Great Crested Newt
KPI	Key Performance Indicator
KSI	Killed or Seriously Injured
LEP	Local Enterprise Partnership
LNR	Local Nature Reserve
MAC	Managing Area Contract
NCC	Norfolk County Council
NDD	Network Delivery and Development Directorate
NMU	Non-Motorised User
NSIP	Nationally Significant Infrastructure Project
OAR	Options Assessment Report
OME	Order of Magnitude Estimate
PCF	Project Control Framework
PCU	Passenger Car Unit
PERA	Preliminary Environmental Risk Assessment
PSSR	Preliminary Sources Study Report
RAG	Red, Amber, Green
RFC	Ratio to Flow Capacity
RIS	Roads Investment Strategy
SAC	Special Area of Conservation
SEP	Strategic Economic Plan
SOBC	Strategic Outline Business Case
SPA	Spatial Planning Arrangement
SRN	Strategic Road Network
SSR	Solutions Summary Report
SSSI	Site of Special Scientific Interest
TAME	Traffic Appraisal, Modelling & Economics
TAR	Technical Appraisal Report
TEE	Transport Economic Efficiency
TM	Traffic Management
TRADS	Traffic Flow Data System
TSR	Transport Summary Report
TSRGD	Traffic Signs Regulations & General Directions
TUBA	Transport appraisal and modelling tools
UXO	Unexploded Ordnance
VM	Value Management
WebTAG	Web based Transport Analysis Guidance
WLR	Western Link Road

Executive Summary

This report summarises the work done in PCF Stage 1 and PCF Stage 2 to identify a number of feasible options which solve the transport problem identified and to reduce these options to a practical number of options prior to public consultation (PCF Stage 1). In PCF Stage 2 the options were taken to public consultation following which further assessment work and route selection of the preferred route was undertaken.

The A47 and A12 trunk roads form part of the strategic road network and provide for a variety of local, medium and long - distance trips between the A1 and the eastern coastline. The corridor connects the cities of Norwich and Peterborough, the towns of Wisbech, Kings Lynn, Dereham, Great Yarmouth and Lowestoft and a succession of villages in what is largely a rural area.

Highways England (previously Highways Agency) is responsible for planning the long-term future and development of the Strategic Road Network and has identified through previous route feasibility studies key investment needs on the A47 corridor. The A47 North Tuddenham to Easton Dualling scheme was identified as one such location in the Department for Transport's Road Investment Strategy (RIS) which was published in December 2014.

Fourteen initial options were identified for consideration in Stage 1. An initial assessment was made of these options to identify their performance against environmental, engineering, transportation and economic criteria so that they could be compared and contrasted to allow the most feasible options to be taken forward. Four options from the 14 were selected for public consultation.

An updated local strategic transportation model has been developed based on the Norwich Area Transportation Strategy model which has been used to further assess the options and to provide transportation information to inform the economic analysis of each of the four options that were selected.

Following consideration of public and stakeholder comment and the assessment of the four options a preferred route was selected and a preferred route announcement was made in August 2017.

Following the preferred route announcement, transportation, economic and Environmental Assessments have been completed which verify the preferred route decision.

1 Introduction

1.1 Background

1.1.1 Highways England (previously the Highways Agency) is responsible for planning the long term future and development of the Strategic Road Network including its maintenance, operation and improvement. Highways England published its Strategic Business Plan (SPB) in response to the Government's Road Investment Strategy (RIS). The SBP sets out Highways England's main activities and strategic outcomes and sets out how Highways England will deliver the Investment Plan. Highways England's Delivery Plan builds on the SBP, setting out in detail how strategic outcomes will be delivered and success measured, while identifying future goals and plans. Highways England's strategic outcomes are:

- Supporting Economic Growth
- A Safe and Serviceable Network
- A More Free-Flowing Network
- Improved Environment
- An Accessible and Integrated Network

1.1.2 Highways Agency developed a Route Based Strategy approach to identify key investment needs on the Strategic Road Network.

1.1.3 The Route Based Strategy brought together both national and local priorities which have been captured in 18 Route-Based Strategy Evidence Reports, used to inform the Road Investment Strategy (RIS).

1.1.4 In 2014 AECOM carried out feasibility studies for Highways Agency and the Department for Transport (DfT) to identify issues on the Strategic Road Network on the A47/A12 Corridor between the A1 west of Peterborough and Lowestoft (south of the A47's junction with the A12). The study was completed in three stages that, overall, broadly aligned with Steps 5 to 9 of the DfT's Transport Analysis Guidance (WebTAG).

1.1.5 Twenty two locations were identified that were considered to have current or imminent problems and these were considered further at high level using criteria from the DfT's Early Assessment and Sifting Tool (EAST). AECOM developed the Options Assessment Report (OAR) for each scheme and from this recommended a solution for which Strategic Outline Business Cases (SOBC) were produced.

1.1.6 As a result of this work, an initial case was made to carry out the following improvements:

- A47 Wansford to Sutton Dualling
- A47 Guyhirn Junction Improvements
- A47 North Tuddenham to Easton Dualling
- A47 Thickthorn Interchange Improvements
- A47 Blofield to North Burlingham Dualling

- A12 Junction Improvements[1]

1.1.7 This study was published on the DfT website and can be found at:-

https://www.gov.uk/government/publications/a47-and-a12-corridor-feasibility-study-technical-report

1.1.8 In December 2014, the DfT published the RIS for 2015-2020. The RIS sets out the list of schemes that are to be developed by Highways England over the period of April 2015 to March 2020. The RIS confirmed the Dft's commitment to the schemes listed above for the A47/A12 Corridor.

1.1.9 Following the publication of the RIS, AECOM produced a high-level appraisal of benefits for the identified schemes on behalf of the DfT. This work was summarised in the A47 / A12 Corridor Feasibility Study (March 2015).

1.1.10 In April 2015 Highways England assumed responsibility for the Strategic Road Network and for delivering the Government's vision for that network as set out in the RIS. As a result, Highways England took ownership of the previously DfT lead Strategy, Shaping and Prioritisation phase of scheme development.

1.1.11 Amey, supported by AECOM, were appointed to lead on the work to be carried out on the A47 and A12 in Norfolk in March 2015, to jointly progress the six schemes which comprise the A47 Improvements Programme through Project Control Framework (PCF) Stage 0. This was completed in October 2015 and the Amey/AECOM team were retained to complete PCF Stage 1 for all six schemes.

1.1.12 Each of the six schemes have been progressed separately but collaboratively under this approach.

1.1.13 This report will focus on:

A47 North Tuddenham to Easton

1.1.14 Hereafter A47 North Tuddenham to Easton will be known as the Scheme.

1.2 Project Control Framework

1.2.1 Highways Agency, introduced PCF for their Major Projects directorate in 2008. The framework sets out how major highways schemes should be managed and delivered with consistent products and a well-defined and consistent approach to project governance.

1.2.2 This Scheme Assessment Report covers the work done in the Options Phase and covers both PCF Stage 1 and PCF Stage 2 (the stages highlighted orange in **Table 1-1** below).

[1] This combines the schemes previously known as A47/A12 Vauxhall Junction improvements and A12 package of roundabout improvements

Table 1-1 – Major Projects Lifecycle

PCF Stage	Delivery Item	Phase
PCF Stage 0	Strategy, Shaping and Prioritisation	Pre-project
PCF Stage 1	Option Identification	Options Phase
PCF Stage 2	Option Selection	
PCF Stage 3	Preliminary Design	Development Phase
PCF Stage 4	Statutory Procedures and Powers	
PCF Stage 5	Construction Preparation	
PCF Stage 6	Construction, Commissioning and Handover	Construction Phase
PCF Stage 7	Close Out	

1.3 The identified problem

1.3.1 The RIS announced the Scheme as "dualling of the single carriageway section of the A47 between Norwich and Dereham, linking together two existing sections of dual carriageway"

1.3.2 The section of the A47 between North Tuddenham and Easton experiences peak period congestion. Growth in Peterborough and Norwich will exacerbate this condition.

1.3.3 The A47 North Tuddenham to Easton (eastbound) has an average speed significantly lower than the daily average during the AM peak. This is an indicator of congestion and affects journey reliability on the link.

1.3.4 Due to the lack of nearby alternative routes, the route resilience on this link is an issue.

1.3.5 The key problem is defined in the Feasibility Study (February 2015) for North Tuddenham to Easton as follows: *"It is predicted that the link stress on this link is currently an issue. In both peaks by 2021 there will be a link stress of over 100% in both peaks"*

1.3.6 Dualling of the section of the A47 between North Tuddenham and Easton offers a solution to the congestion and will allow economic growth in the area.

1.4 Purpose of this Report

1.4.1 The purpose of this Scheme Assessment Report (SAR) is to:

- present the unpublished PCF Stage 1 Technical Appraisal Report (TAR)
- report on the options development work completed during PCF Stage 2
- review the non-statutory public consultation responses
- recommend a Preferred Route

1.4.2 One of the outputs of PCF Stage 1 is the Technical Appraisal Report (TAR) which brings together technical, operational, safety, traffic, economic and environmental assessments and forms the basis for recommendations for which option(s) should be taken forward for Public Consultation during PCF Stage 2.

1.4.3 In PCF Stage 2 the Scheme Assessment Report is produced which normally includes a summary of the TAR (from PCF Stage 1) along with reporting on the non-statutory public consultation and consultation results and on any further surveys investigations and assessment work undertaken on the scheme. The Scheme Assessment Report also recommends a Preferred Route.

1.4.4 In order to meet the RIS target date for start of works on the scheme in March 2020, Highways England took the decision, that where it was necessary to maintain programme, that PCF Stages could be overlapped. This has allowed overall progress on the programme to be achieved by allowing formal technical assessment and completion of reporting from PCF Stage 1 to continue into PCF Stage 2. At the start of PCF Stage 1 it was also assumed that PCF Stage 3 would commence whilst PCF Stage 2 reporting and close out work was being completed. With the publication of the Highways England Delivery Plan Update 2017-2018 the start of works date has been changed 2021/2022.

1.4.5 In line with the decision to keep the project on programme and overlap PCF Stages, Highways England decided to not complete the TAR prior to the start of PCF Stage 2. As a result, the PCF Stage 1 TAR had an incomplete status at the end of PCF Stage 1. To ensure the history and development of the Options Phase is reported in full, this document includes a more detailed report of PCF Stage 1 than might usually be included in a Scheme Assessment Report. This document has therefore been structured as follows;

Chapter 1	introduction (this Section)
Chapters 2 – 19	reports on the PCF Stage 1 work and includes the majority of the incomplete TAR document, presenting the information as it was known at the time, including any limitations and recognition of unknown factors.
Chapter 20	reports the conclusions of PCF Stage 1 and transition to PCF Stage 2
Chapter 21 - 35	reports on the PCF Stage 2 work including the determination of the preferred route
Chapter 36	reports the conclusions of PCF Stage 2 and recommendations for next steps

1.5 Overview of Timeline of PCF Stages and the Document

Chapter 2-19 (December 2015 to November 2016)

1.5.1 PCF Stage 1 commenced in December 2015 and continued until November 2016. As described in Chapter 9 of this report, the Option Identification stage (PCF Stage 1) included developing and expanding new designs based on those that were determined at PCF Stage 0 (completed October 2015). PCF Stage 1 included a sifting of these options at an Options Review Meeting (ORM) (see Chapter 11) in June 2016. These options were then assessed in terms of performance from a technical, operational, safety, traffic, economic and environmental perspective

1.5.2 The assessment work undertaken following the options review meeting (ORM) informed the recommendations for the options that should progress to PCF Stage 2 and be presented at the non-statutory public consultations. The information from stage 1 was deemed sufficient to allow Highways England to proceed to PCF stage 2. The available qualitative and quantitative information was robust enough to provide a clear decision on the options being taken forward.

Chapter 20 (December 2016)

1.5.3 The conclusion of PCF Stage 1 and the transition to PCF Stage 2 is reported in Chapter 20 and includes the governance process that was followed to ensure the scheme could progress to the next stage.

Chapter 21 to Chapter 27 (January 2017 to June 2017)

1.5.4 Following a review of the commercial information available at the end of PCF Stage 1, it was determined that all the sifted options from PCF Stage 1 were unaffordable when compared to the scheme budgets allocated as part of the RIS 1 commitments. PCF Stage 2 therefore commenced with a value management review of the sifted options to determine if a viable affordable option could be promoted. The value management exercise is described in Chapter 21. In parallel, although limited by the value management exercise, PCF Stage 2 commenced in January 2017. Early PCF Stage 2 activities included the engineering development of the sifted option assessments (Chapter 23) as well as preparing for the Non-Statutory Public Consultation; the latter is covered in Chapters 24 and 25.

1.5.5 A further review of the programme pressures and requirements to meet the March 2020 deadline lead to Highways England bringing forward the programmed date for the Preferred Route Announcement. The determination of the preferred route and a summary of the available information at the time of the decision, is presented in Chapter 27.

Chapter 28 to Chapter 35 (June 2017 to October 2017)

1.5.6 In order to validate the early Preferred Route Decision, assessment work continued beyond the Preferred Route Announcement, this is reported in Chapters 28 to 35. Any variance from previous assumptions or issues associated with the early determination of the Preferred Route are captured in these sections.

Chapter 36 (November 2017)

1.5.7 Chapter 36 presents the conclusions from PCF Stage 2 and recommendations for future stages.

2 Planning Brief

2.1 Introduction

2.1.1 This section summarises relevant national and local policies which were considered during the design and appraisal of the Scheme during PCF Stage 1 – Options Identification.

2.2 National Policy

National Policy Statement for National Networks

2.2.1 The National Policy Statement for National Networks (NPSNN) sets out the need for Nationally Significant Infrastructure Projects (NSIPs) on the national road and rail networks in England, and the Government's policy to deliver these projects. The National Policy Statements supplement the National Planning Policy Framework. NPSNN sits alongside the Road Investment Strategy.

2.2.2 There is an assumption within NPSNN that significant improvements to the road network will be necessary in order to support the Government's vision for the national networks. Paragraph 2.21 of the document sets out a range of alternatives to major improvements to the network including Maintenance and Asset Management, Demand Management and Modal Shift. However, it is concluded that at a strategic level there is a compelling need for development of the national road network.

2.2.3 The NPSNN states that the assessment of the proposed scheme should consider the balance of potential benefits and adverse impacts (paragraph 4.3). Benefits to be considered include the facilitation of economic development, job creation, housing and environmental improvement, and any longer-term or wider benefits. Assessment of adverse impacts should include longer-term and cumulative adverse impacts, as well as planned mitigation of these impacts.

2.2.4 The NPSNN requires environmental, safety, economic and social impacts should be considered at a national, regional and local level. The information provided will be proportionate to the development (paragraph 4.4).

2.2.5 All projects should be subject to an options appraisal. The options appraisal should consider viable modal alternatives and may also consider other options (paragraph 4.27). Section 6 of the North Tuddenham to Easton Evidence Review (July 2015) responds to this requirement.

2.2.6 Section 5 of NPSNN gives guidance for decision making relating to impacts on environment, habitat, landscape, accessibility and existing infrastructure. In relation to environmental impacts, the guidance is clear that development consent should not be granted for schemes which will have a detrimental impact on irreplaceable habitats, including ancient woodland (paragraph 5.32).

2.2.7 It is expected that schemes subject to a Development Consent Order (DCO) will be examined against criteria set out in Section 5 of NPSNN.

2.2.8 Given the scale and length of the link of the A47 North Tuddenham to Easton section which is proposed to be dualled (based on the announced solution in the RIS), it is considered that the dualling scheme will meet the criteria for a National Significant Infrastructure Project and will therefore require development consent under the Planning

Act 2008 . In this case, the application for development consent will be judged primarily against the NPSNN, according to the decision-making framework set out in the Planning Act 2008.

The Road Investment Strategy

Strategic Vision

2.2.9 The DfT's Road Investment Strategy (RIS) defines a national programme of improvements to the Strategic Road Network (SRN).

2.2.10 The RIS introduces long-term strategic planning and funding for the SRN, underpinned by a significant increase in investment. It is the ambition of Highways England to substantially modernise the SRN within 25 years and this vision for improvement is outlined in more detail through the Key Performance Indicators (KPI's) in Table 2-1.

2.2.11 The RIS states that 127 major schemes will be taken forward over the course of the first RIS period (2015-2020), in order to deliver benefits quickly.

Investment Plan

2.2.12 The RIS sets out a number of specific locations for improvements to the SRN. The A47 North Tuddenham to Easton scheme is included, based on evidence gathered in the A47 & A12 Corridor Feasibility Study (February 2015).

2.2.13 As part of the Spending Review announcement made in June 2013, DfT committed to undertaking six feasibility studies to help identify and fund solutions to tackle some of the most notorious and long-standing road hot spots in the country. These studies included work at six locations within the A47/A12 corridor.

2.2.14 The study considered and analysed the evidence available on the current problems faced by each location and the potential issues or future pressures that may arise. The work identified the priority needs for investment and reviewed a number of potential investment options and their performance in tackling those issues. Further work and analysis looked at the strength of the economic case for the investment and their deliverability within the first RIS period.

2.2.15 An investment package worth over £300 million on the A47/A12 corridor is outlined in the RIS Part 2: Investment Plan, Page 25. Page 16 of the Road Investment Strategy: Investment Plan describes the 6 corridor feasibility studies which "investigated the priorities for the routes and tested that potential improvements demonstrate a robust case for investment, offer value for money and are deliverable" the document indicates that "summaries of these studies will be published shortly (these summaries have now been published in the Feasibility Summary Report - Section 8).

2.2.16 Page 25 and 26 of the Road Investment Strategy: Investment Plan detail the announced investment package for improvements along the A47/A12 corridor. This lists the A47 North Tuddenham to Easton scheme as one of the schemes which make up the package of improvements as:

"A47 North Tuddenham to Easton – dualling of the single carriageway section of the A47 between Norwich and Dereham, linking together two existing sections of dual carriageway."

2.2.17 Page 42 of the Road Investment Strategy: Investment Plan lists the same scheme description for A47 North Tuddenham to Easton under "Committed Schemes - Newly announced in this Investment Plan"

Performance Specification

2.2.18 The RIS provides a Performance Specification and Key Performance Indicators (KPIs) for Highways England.

2.2.19 Table 2-1 summarises the Key Performance Indicators as they apply to each point of the Performance Specification.

2.2.20 The RIS requires Highways England to develop detailed Performance Indicators (PIs) to provide further detail on how the Company is progressing on each KPI.

Table 2-1 Road Investment Strategy – Performance Specification and Key Performance Indicators

Topic	Measure	Key Performance Indicator Target	Performance Indicator
Making the Network Safer	The number of KSIs on the SRN	Ongoing reduction of at least 40% by end of 2020 against 2005-09 average baseline	Suite of PIs to illustrate the impact of activities undertaken by the Company, and the influence of external factors with regard to making the SRN safer. These should include: • Incident numbers and causation factors for motorways; • Casualty numbers and causation factors for APTRs; and • IRAP based road safety investigations, developed in conjunction with the Department, to feed into subsequent Route Strategies.
Improving User Satisfaction	The percentage of NRUSS respondents who are Very or Fairly Satisfied.	Achieve a score of 90% by 31 March 2017 and then maintain or improve it.	Suite of PIs to provide additional information about the performance of factors that influence user satisfaction.
Supporting the Smooth Flow of Traffic	Network availability: the percentage of the SRN available to traffic.	Maximise lane availability so it does not fall below 97% in any one year	Suite of PIs to illustrate the impact of the activities undertaken by the Company, and the influence of other external factors, on traffic flow. This should include, at a minimum, reliability of journey times.
	Incident Management: percentage of motorway incidents cleared within one hour.	At least 85% of all motorway incidents cleared within 1 hour	
Encouraging Economic Growth	Average Delay (time lost per vehicle)	No Target Set	Suite of PIs to help demonstrate and evaluate what activities have been taken to support the economy. These should, at a minimum, include metrics on: • Being an active and responsive part of the planning system;

Topic	Measure	Key Performance Indicator Target	Performance Indicator
			• Supporting the business, and freight and logistics sectors; and • Helping the government support small and medium sized enterprises.
Deliver Better Environmental Outcomes	Noise: Number of Noise important areas mitigated	At least 1,150 Noise Important Areas over RP1	Suite of PIs to provide additional information about environmental performance. These should, at a minimum, include: • Air quality; and • Carbon dioxide, and • other greenhouse gas emissions for the company and its supply chain that occur as they carry out work on the SRN.
	Biodiversity: Delivery of improved biodiversity as set out in the Company's Biodiversity Action Plan	Publish Biodiversity Action Plan by 30 June 2015 & report annually against the Plan to reduce net biodiversity loss on ongoing annual basis	
Helping Cyclists, walkers and other vulnerable users	The number of new and upgraded crossings	No Target Set	Suite of PIs to demonstrate the safety of the SRN for cyclists, walkers, and other vulnerable users.
Achieving Real Efficiency	Cost savings: savings on capital expenditure	At least £1.212 billion over RP1 on capital expenditure.	Suite of PIs to demonstrate that the portfolio is being developed and the Investment Plan delivered in a timely and efficient manner. These should include the progress of major schemes and programmes in construction through reporting CPI and SPI for schemes at Project Control Framework Stage 5 and beyond.
	Delivery Plan progress: progress of work relative to forecasts set out in the Delivery Plan, and annual updates to the Plan, and expectations at the start of RP1	Meet or exceed expectations	

Highways England Strategic Business Plan (2015-2020)

2.2.21 Highways England's Strategic Business Plan (SBP) responds directly to the Road Investment Strategy and describes how Highways England will "go about delivering the requirements of a demanding Performance Specification".

2.2.22 The SBP defines KPIs against which the performance of Highways England will be measured, based on the Performance Specification included in the RIS.

2.2.23 Section 4 of the SBP gives the background to the subsequent publication of the Route Strategies for the entire national network, the relevant Route Strategy for the A47 Corridor being the East of England Route Strategy.

Highways England Delivery Plan (2015-2020)

2.2.24 Highways England's Delivery Plan builds on the SBP and sets out in detail how the strategic outcomes and the Investment Plan will be delivered.

2.2.25 The A47 North Tuddenham to Easton Dualling is listed under the "Major Improvements Investment Plan Scheme Schedule 2015-2020" as one of the "Schemes identified following the outcomes from the six feasibility studies". The Feasibility Study relevant to the A47 corridor being The A47/A12 Corridor Feasibility Study (February 2015).

2.3 Local Policy

New Anglia LEP Strategic Economic Plan (SEP)

2.3.1 New Anglia LEP's Strategic Economic Plan set out to address the regions' shortfalls and growth opportunities. The plan demonstrated the housing and employment commitments and potential growth locations with reference to specific improvements on the strategic road network in order to achieve this.

2.3.2 The New Anglia Strategic Economic Plan is produced by the New Anglia LEP and provides a plan for growth in Norfolk and Suffolk.

2.3.3 Section 6.94 of the plan describes the A47 Alliance which "brings together stakeholders from all along the route including GCGP LEP, has a list of priorities, a number of which are already programmed for 2015-2021. These could release at least 10,000 jobs and at least an increase in GVA of £400m per annum across the New Anglia area. We welcome the Government's commitment to Route Based Strategies across the whole of the trunk road network and to the Feasibility Study (February 2015) on the A47. These studies, together with the SEP, should provide the basis for future investment decisions on the trunk road network."

Norfolk County Council Local Transport Plan (2011-2026) (NCC LTP)

2.3.4 The NCC LTP includes a number of objectives which seek to address transport issues for which the measures include:

- Co-ordinating bus and rail links to improve access into the town centre.
- Improving access to employment and services by public transport, cycling and walking, particularly from the deprived areas by promoting specific workplace buses and other initiatives as part of workplace travel plans, where possible.
- Improving strategic access to the area by road and rail, including the entry and exit points, which in turn may reduce the real and perceived remoteness of the area that may be inhibiting economic growth.

2.3.5 The document shows that the Norwich area is significantly constrained and that a Northern Distributor Road, running from the A47 in the east at Postwick to the A1067 in the north-west, is vital to help unlock development to the north-east of the city and improve connectivity between North Norfolk and the trunk road network. Delivery of the Postwick Hub will alleviate current capacity issues, serve new development at Broadland Gate and form the junction between the Northern Distributor Road and the A47. These improvements will also free up capacity on the existing road network in the city centre, providing the scope to implement a package of complementary measures including bus priority, walking and cycling improvements.

Joint Core Strategy for Broadland, Norwich and South Norfolk, 2011

2.3.6 The Joint Core Strategy (JCS) for Broadland, Norwich and South Norfolk is the key planning policy document for the Greater Norwich area. It forms part of the Local Plans for the districts of Broadland, Norwich and South Norfolk setting out the broad vision for the growth of the area and containing strategic policies for the period 2008 – 2026.

2.3.7 The complete adopted Joint Core Strategy for Broadland, Norwich and South Norfolk comprises the JCS document adopted in March 2011, as amended by the Broadland Part of the Norwich Policy Area: Local Plan, adopted in January 2014.

2.3.8 Para 3.19 of the JCS acknowledges the congestion issues on the A47 to the west of Norwich caused by the single carriageway sections of the road through the area

> *"The A47 to the west provides strategic road access to the Midlands and North. It is mostly single carriageway in Norfolk and suffers from congestion and safety issues. Significant growth is proposed at East Dereham and King's Lynn."*

2.3.9 Policy 6 of the JCS seeks to improve the transportation system in order to develop the role of Norwich as a Regional Transport Node, particularly through the implementation of the Norwich Area Transportation Strategy, and will improve access to rural areas. One of the ways this will be achieved is "by promoting improvements to the A11 and A47" The policy recognises that supported strategic improvements to aid delivery and economic success include A47 improvements to reduce the significant stretches that remain single carriageway.

South Norfolk Local Plan,

2.3.10 In addition to the Joint Core Strategy the Local Plan is made up of various documents; each of which is developed in consultation with the community of South Norfolk before it is finally adopted.

2.3.11 The following Development Plan Documents were adopted by the Council on 26 October 2015 and now form part of the development plan for South Norfolk:

- Site Specific Allocations and Policies Document
- Wymondham Area Action Plan
- Development Management Policies Document
- Long Stratton Area Action Plan

Greater Norwich Local Plan

2.3.12 South Norfolk Council, Broadland District Council, Norwich City Council and Norfolk County Council are working together to prepare the Greater Norwich Local Plan (GNLP).

2.3.13 The Greater Norwich Local Plan builds on the joint working arrangements for Greater Norwich, which have delivered the current Joint Core Strategy (JCS) for the area. The JCS plans for the housing and job needs of the area to 2026 and the GNLP will ensure that these needs continue to be met to 2036.

2.3.14 Similar to the JCS the GNLP will include strategic planning policies to guide future development and plans to protect the environment. It will look to ensure that delivery of development is done in a way which promotes sustainability and the effective functioning of the whole area.

2.3.15 In addition to strategic planning policy the Greater Norwich Local Plan will also allocate land for development. Initial work to develop the Greater Norwich Local Plan has begun and the councils have begun preparing evidence to enable them to assess the main needs and constraints of the three districts.

Broadland District Council Local Plan

2.3.16 Broadland's current local plan is made up of several documents:

- Joint Core Strategy DPD (Broadland, Norwich and South Norfolk) adopted 2011, amendments adopted January 2014
- Development Management DPD adopted August 2015
- Site Allocations DPD adopted May 2016
- Growth Triangle Area Action Plan adopted July 2016

2.3.17 These documents set out the general and specific planning policies and also contain detailed local policies. They aim to help planning officers and applicants to achieve a high standard of development in the district and they are the main guide to determining planning applications.

2.3.18 The Local Plan highlights sections of congested single carriageway on the A47 as requiring improvement to dual status.

2.3.19 The Local Plan supports these improvements by restricting development of land adjacent to the single carriageway sections for potential future improvements by Highways England.

2.3.20 The frequency and quality of HGV and Road Side Services are highlighted as below standard on the A47. The Local Plan highlights recommendations of a minimum of 12 miles and maximum of 24 miles apart for services, which the A47, in general, does not meet.

Breckland District Local Plan (1999)

2.3.21 The adopted Local Plan comprises of a suite of Development Plan Documents that set out the strategic planning policies for the whole of the authority's administrative area. These development plan documents have been prepared under the provisions of the Planning and Compulsory Purchase Act 2004. The adopted Development Plan Documents are listed below:

2.3.22 **The Core Strategy and Development Control Policies Document**, adopted in 2009, outlines the vision and overall objectives for development in Breckland up to 2026 and sets out where new housing and other development should be focused. The Core Strategy also contains the district-wide Development Control policies for Breckland that will inform future planning decisions. These cover specific topics such as affordable housing, housing density, employment, retail, tourism, protecting rural facilities, re-use of rural buildings, flood risk, and protecting the natural and built environment.

2.3.23 **The Site Specifics Policies and Proposals DPD**, adopted in early 2012, allocates areas of land for different uses to deliver the requirements of the Breckland Core Strategy and thus meet the development needs of the District up to 2026.

Breckland District Local Plan (2011 – 2036)

2.3.24 Breckland Council is preparing a new Local Plan. Once adopted this will guide development in the district over the coming years, supporting the Council's vision for Breckland to develop and thrive. The new Local Plan will set out the policies against which future planning applications are assessed.

2.3.25 Producing a new Local Plan will enable Breckland to identify a 'five year housing land supply'; this will give the Council greater control over where development happens.

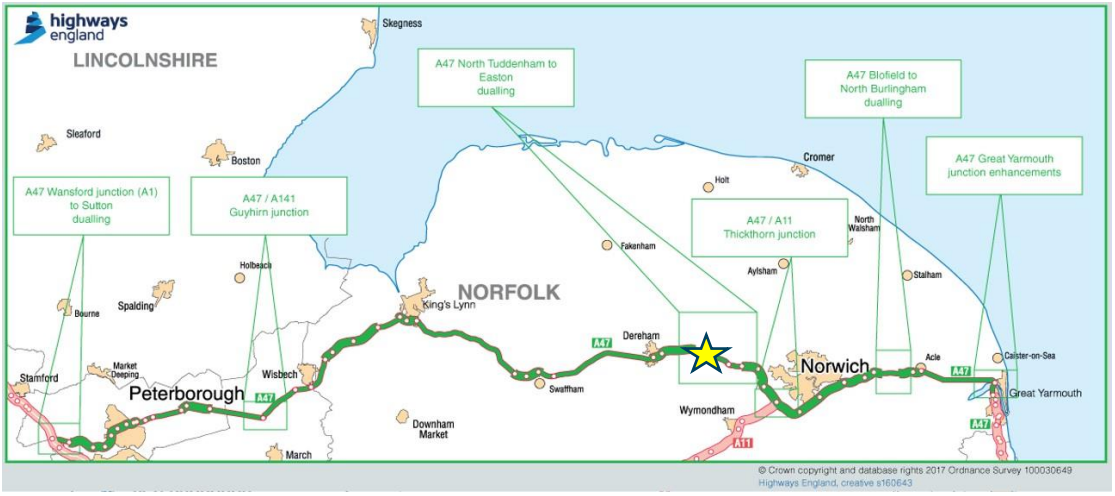
3 Existing Conditions

3.1 Description of the Locality

A47 Corridor

3.1.1 The A47 and A12 trunk roads form part of the strategic road network and provide for a variety of local, medium and long distance trips between the A1 and the eastern coastline. The corridor connects the cities of Norwich (population over 210,000) and Peterborough (population over 180,000), the towns of Wisbech, Kings Lynn, Dereham, Great Yarmouth and Lowestoft and a succession of villages in what is largely a rural area. The route also passes through the Broads National Park. The location plan of the A47 corridor is in Figure 3-1 and the A47 North Tuddenham to Easton Scheme is indicated with a yellow star.

Figure 3-1 – Location Plan



3.1.2 Norwich and Peterborough have developed service-based economies and the towns along the route have retained market town and other functions including agricultural-related industry. In recognition of the potential on the eastern coast, the Chancellor announced in the 2011 budget the establishment of the Great Yarmouth and Lowestoft Enterprise Zone particularly for energy related businesses to maximise support for the offshore energy sector. In December 2013, the Government announced a city deal for Greater Norwich to enable knowledge based industries to develop.

3.1.3 There has been a rapid growth over the past decade and the area is expected to continue to grow. The cities of Peterborough and Norwich attract additional traffic along the route, particularly during the morning and evening peak periods.

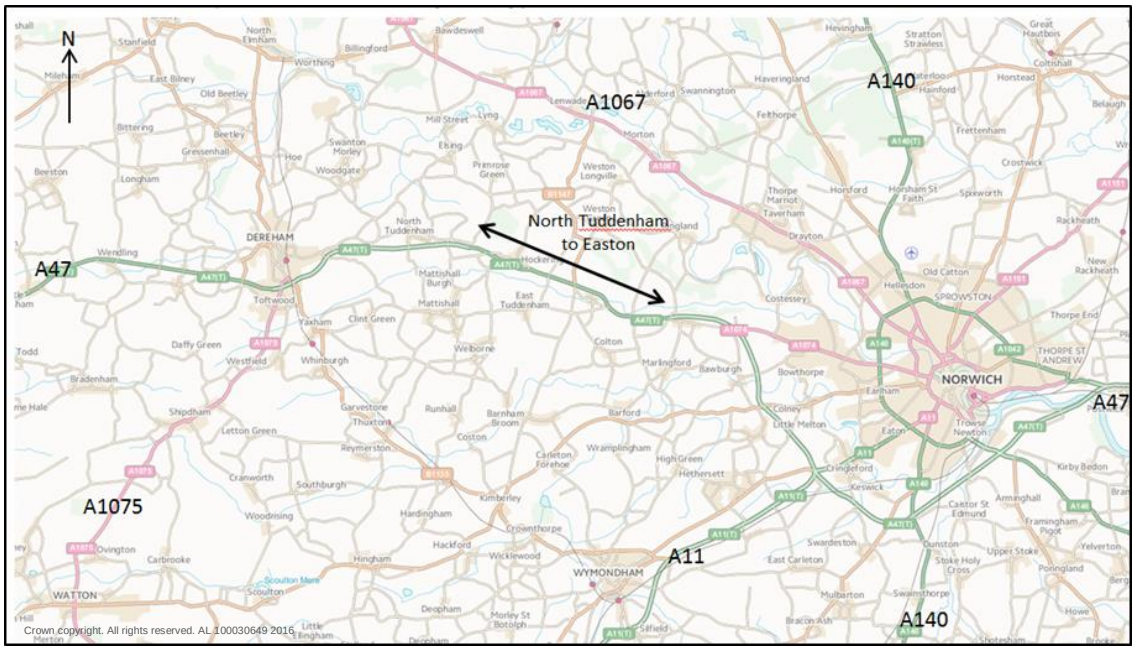
3.1.4 Comprehensive improvement of the A47 is a strategic aspiration of local MPs, local government, business and other stakeholders who have organised themselves to form the A47 Alliance. The aim is to capitalise on the potential economic benefits of improved accessibility to the Midlands and the North as well as address safety issues.

Locality of the Scheme

3.1.5 The North Tuddenham to Easton section of the A47 is located approximately 8km to the west of Norwich. The 7.9km single carriageway section of the A47 forms a part of the main arterial highway route connecting Norwich to the west.

3.1.6 The section of road is therefore an important highway link for both local commuter traffic to and from the west of Norwich as well as providing the main route in the area for longer distance trips across the country travelling east and west. The scheme location is shown on **Figure 3-2** below showing its regional context to the west of Norwich

Figure 3-2 – Locality of the Scheme



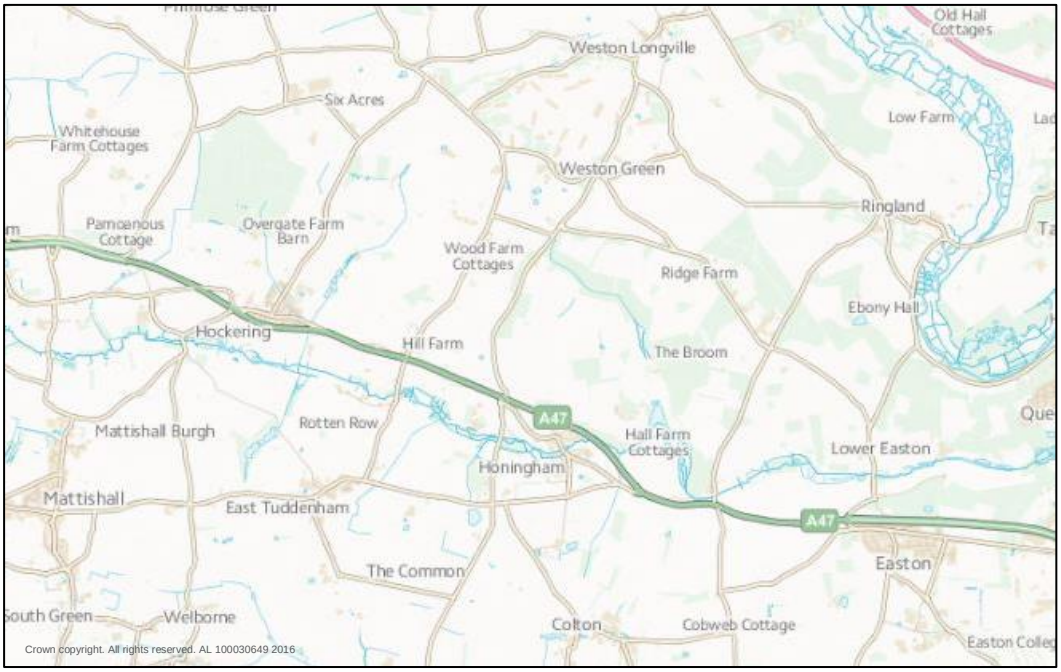
3.2 Existing Highway Network.

3.2.1 The following sections describe the existing highway network, the plan in **Figure 3-3** shows the existing road network along the Scheme. Larger scale plans highlighting some of the key features along the Scheme are included in **Appendix A**.

3.2.2 Travelling from west to east towards Norwich the A47 narrows from dual carriageway to single carriageway at the eastern outskirts of the town of North Tuddenham.

3.2.3 The 7.9 km section of rural all-purpose single carriageway passes to the south of the village of Hockering and to the north of the village of Honingham returning to dual carriageway to the north west of the village of Easton. The section of single carriageway road is generally between 7.3 and 7.9m with central marking to delineate east and west bound traffic.

Figure 3-3 Local Highway Network



3.2.4 Travelling from the west the existing A47 alignment has a large right hand radius and downhill gradient allowing the road to route to the south of Hockering. The road then bends into a tight S-curve and rises as it passes Hockering village and straightens as it heads down towards Honingham and over the River Tud. As the road passes to the north of Honingham it bends to the right via a large radius and rises towards the Norwich Road roundabout. The final section of single carriageway falls and curves through a tight left right S curve before rising and bending with a large radius as it approaches Easton Roundabout after which the A47 returns to a two-lane dual carriageway.

3.2.5 The single carriageway section is generally at existing ground level or on low level 0-2m embankment. Embankment heights rise slightly to 2-3m on the approaches to the crossing of the River Tud. There is a section of false cutting locally where the road passes close to St Peter's church at the east end of the scheme.

3.2.6 The A47 is subject to the national speed limit of 60mph on the single carriageway section.

3.2.7 There is a pedestrian crossing point on the A47 for connecting the kerbed footway provision on Mattishall Lane and The Street. There is footway provision on the northern verge of the A47, connecting pedestrian movements between Hockering and Sandy Lane through Park Lane. Between Norwich Road junction and Blind Lane there is footway provision on the northern verge. There is also footway provision locally at the Easton junction.

3.2.8 There are a number of side roads joining the A47 along the scheme length, via at grade priority simple and right turn lane T junctions, from west to east the following side roads and junction types are noted:

- Low Road – minor T junction
- Mattishall Lane – T junction
- The Street west of Hockering village - ghost island junctions right turn for westbound traffic

- Mill Lane – minor T junction
- The Street east of Hockering village - ghost island junction right turn for westbound traffic
- Egress from Hockering towards east 'Give Way' for eastbound traffic
- Park Lane - minor T junction
- Sandy Lane and Church Lane – crossroad / minor T junctions
- Wood Lane and Berry's Lane - ghost island right turns in both directions
- Blind Lane and the Taverham Lane - minor T junctions

3.2.9 There is restricted access for Heavy Goods Vehicles (HGV) into Hockering (signed on the A47 at junctions).

3.2.10 There are a number of farm and field accesses and direct property accesses onto the route. A number of accesses from farm tracks are also present on both sides of the A47 along with direct accesses from the A47 into surrounding fields, properties and businesses. There is direct access to St. Andrews Church from the A47.

3.2.11 There are 5 lay-bys on the Section, laybys are situated both sides of the A47 to the west of Hall Drive, on the eastbound A47 west of Blind Lane and on the eastbound and the westbound carriageways to the west of the Easton Junction.

3.3 Traffic

3.3.1 This section discusses the traffic modelling which existed at the start of PCF Stage 1 and existing traffic conditions on the North Tuddenham to Easton section of the A47.

3.3.2 A review was undertaken of available strategic models which may inform the study. Strategic models covering the A47/A12 corridor are summarised in **Table 3-1** below.

Table 3-1 – Strategic Saturn Models covering the A47 Corridor

Model	Geographical Scope	Model Base Year	Status
East of England Regional Model (EERM)	A47 and A12 routes	2006	Strategic SATURN model Age of base year data exceeds desirable time limit. The 2006 re-validation was based on additional RSI surveys in parts of Norfolk and Suffolk.
Peterborough Transport Model (PTM)	A47 (A1 to Thorney)	2003/ 2006	Strategic SATURN model Age of base year data exceeds desirable time limit.
Wisbech Area Transport Study (WATS) model	A47 (A141 Guyhirn to B198 Lynn Road junction NE of Wisbech)	2008	Strategic SATURN model Base data is reaching time limit.
King's Lynn Transport Model (KLTM)	A47 (A17 to A149)	2007	Strategic SATURN model Base data is reaching time limit.
Norwich Area Transportation Strategy (NATS)	A47 from Dereham to Acle	2006/ 2012	Strategic SATURN model 2006 Base data is reaching time limit. Status of 2012 recalibration unclear.

Great Yarmouth Area Transport Strategy (GYATS)	Short section of A47 approaching Great Yarmouth A12 from A47 to Gorleston Golf Club on south edge of Great Yarmouth	2003	Strategic SATURN model Age of base year data exceeds desirable time limit.
Lowestoft	A12 – From B1375 north of Lowestoft to B1437 junction south of Lowestoft	2001	Strategic SATURN model Age of base year data exceeds desirable time limit.

3.3.3 At PCF Stage 1 suitable strategic modelling was not available for this study. Although some models existed the age of the base data was reaching or exceeded the desirable time set out in WebTAG guidance.

3.3.4 Following detailed discussion with Norfolk County Council with regard to the detail and status of the Norwich Area Transport Strategy (NATS) model and discussion with Highways England TAME with regards to transportation modelling an approach for updating and revalidating the NATS model for use as a transportation modelling tool to assess the Scheme was initially agreed.

3.3.5 The area covered by the NATS model also included the areas for the other two RIS schemes in the Norwich Area, A47/A11 Thickthorn Junction and the A47 Blofield to Burlingham schemes. Due to programme constraints and to enable traffic forecasting and economic assessments to be completed prior to the end of PCF Stage 1, the initial agreed approach was to independently update and validate a separate version of the model locally to the three individual schemes.

3.3.6 Following further programme review of the likely time scales to combine and revalidate the models which would be required for PCF Stage 2, it was agreed with Highways England and TAME that a single NATS model update and validation exercise which covered the necessary detail to analyse all three of the Schemes would be undertaken. Due to the timescales involved in updating and validating a combined model the transportation forecasting and economics following the combined approach would not be available until PCF Stage 2. Further details are included in Chapter 12.

3.3.7 The following sections give details of the existing information available at the time (PCF Stage1) with regard to traffic on the section of the A47 between North Tuddenham and Easton.

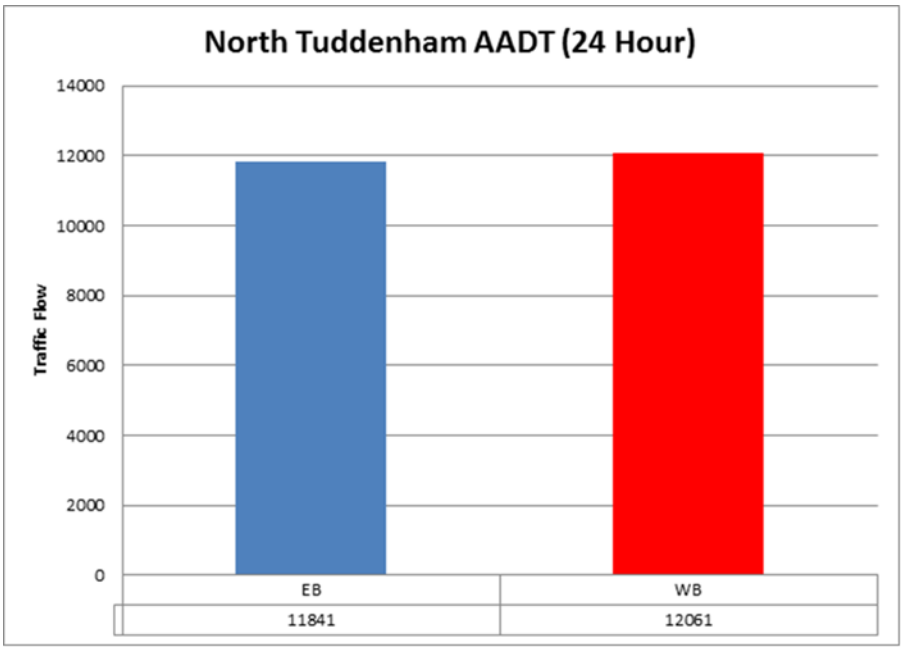
3.3.8 The approach adopted for the A47/A12 Feasibility Study (2014) made use of existing available traffic data and made general assumptions about traffic growth. Existing traffic levels were generally sourced from Highways England's Traffic Flow Data System (TRADS) or DfT counts. In some cases additional manual counts were undertaken.

3.3.9 Manual Classified Count (MCC) and queue length surveys were undertaken on Thursday 25th June 2015. Traffic flows for every hour of 2014 have been extracted from the TRADS database for the North Tuddenham to Easton section of the A47.

3.3.10 Average Annual Daily Traffic (AADT) flows (24 hour) were calculated based on this data.

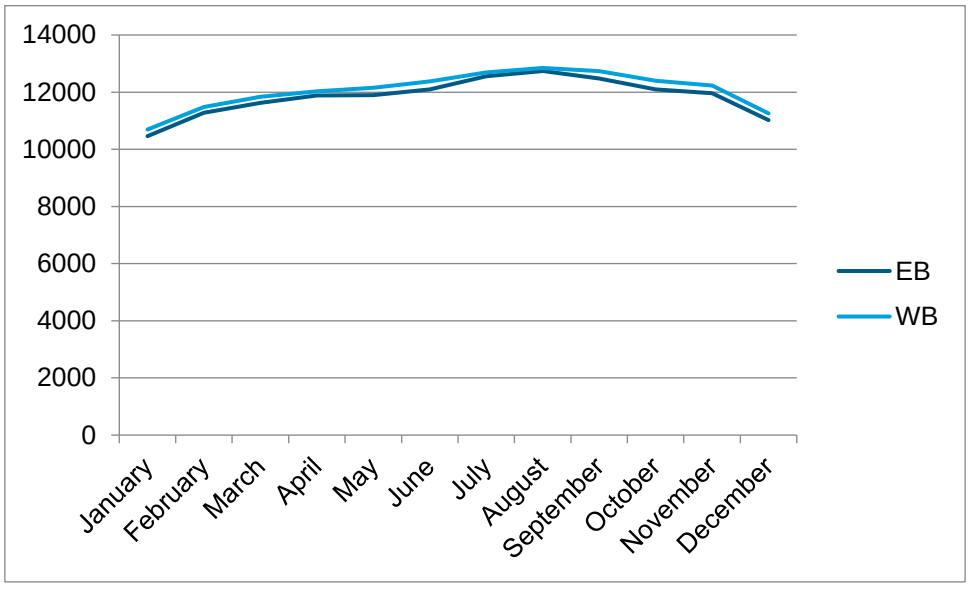
3.3.11 AADT flows on the A47 are shown in **Figure 3-4** below. The data shows slightly higher flow in the westbound direction compared to the eastbound.

Figure 3-4 - AADT Flows Diagram



3.3.12 The daily total flows by month extracted from 2014 TRADS data on the scheme is shown on **Figure 3-5**. It shows higher flows in the period July to October, however the variation in traffic flows over the year is not as pronounced as at other locations on the A47.

Figure 3-5 - 2014 Daily Flows by Month Diagram



3.3.13 The flow on this section of the A47 has 19.2% HGV's in the AM peak and 10.2% HGVs in the PM peak. HGVs have a greater impact on the operation of the highway than the same number of light vehicles, increasing the potential for delays and congestion.

3.3.14 The theoretical capacity of the existing single carriageway has been calculated as 1236 vehicles per hour per lane based on WebTAG Unit M3.1. The observed hourly flows

(extracted from TRADS) for 2014 were compared against this theoretical capacity for each hour of the year. The number of hours in which flow on the link reached or exceeded the theoretical capacity is shown in **Table 3-2** below. The number of hours in which flow on the link reached or exceeded 90% of the theoretical capacity is also shown in **Table 3-2** below.

Table 3-2- Number of hours near or above theoretical capacity in 2014

Hours – per year (2014)	Eastbound	Westbound
Number of hours at or above theoretical capacity	15	154
Number of hours at or above 90% theoretical capacity	382	481

3.3.15 To put the figures in the table into context, there were 253 business days in the year 2014. Therefore, on the assumption that times of highest flow occurred on business days, every working day has more than one hour in which the recorded flow is above or near the theoretical capacity of the road- see **Table 3-3.** The comparison of flows to theoretical capacity demonstrates that the single carriageway is currently reaching its capacity and therefore is highly susceptible to congestion.

Table-3-3 – Average Hours per day near or above theoretical capacity in 2014

Hours – per day average (2014)	Eastbound	Westbound
Hours at or above theoretical capacity	0.06	0.61
Hours at or above 90% theoretical capacity	1.51	1.90

3.3.16 Although the calculation of theoretical capacity, took into account the percentage of HGVs, it does not take into account the effect of slower moving vehicles such as agricultural vehicles. The presence of these vehicles would negatively affect vehicle speeds and potentially the capacity of the road. On a single carriageway where there is limited opportunity to pass slower vehicles their presence will clearly impede the flow by reducing potential vehicle speeds on the road and hence reducing the number of vehicles which can use the route per hour.

3.3.17 The feasibility report (Feb 2014) indicates that the average AM peak hour speed on the North Tuddenham to Easton section of the A47 is 63 km/h. It also indicates that the daily average speed on the section of road is 83 km /h.

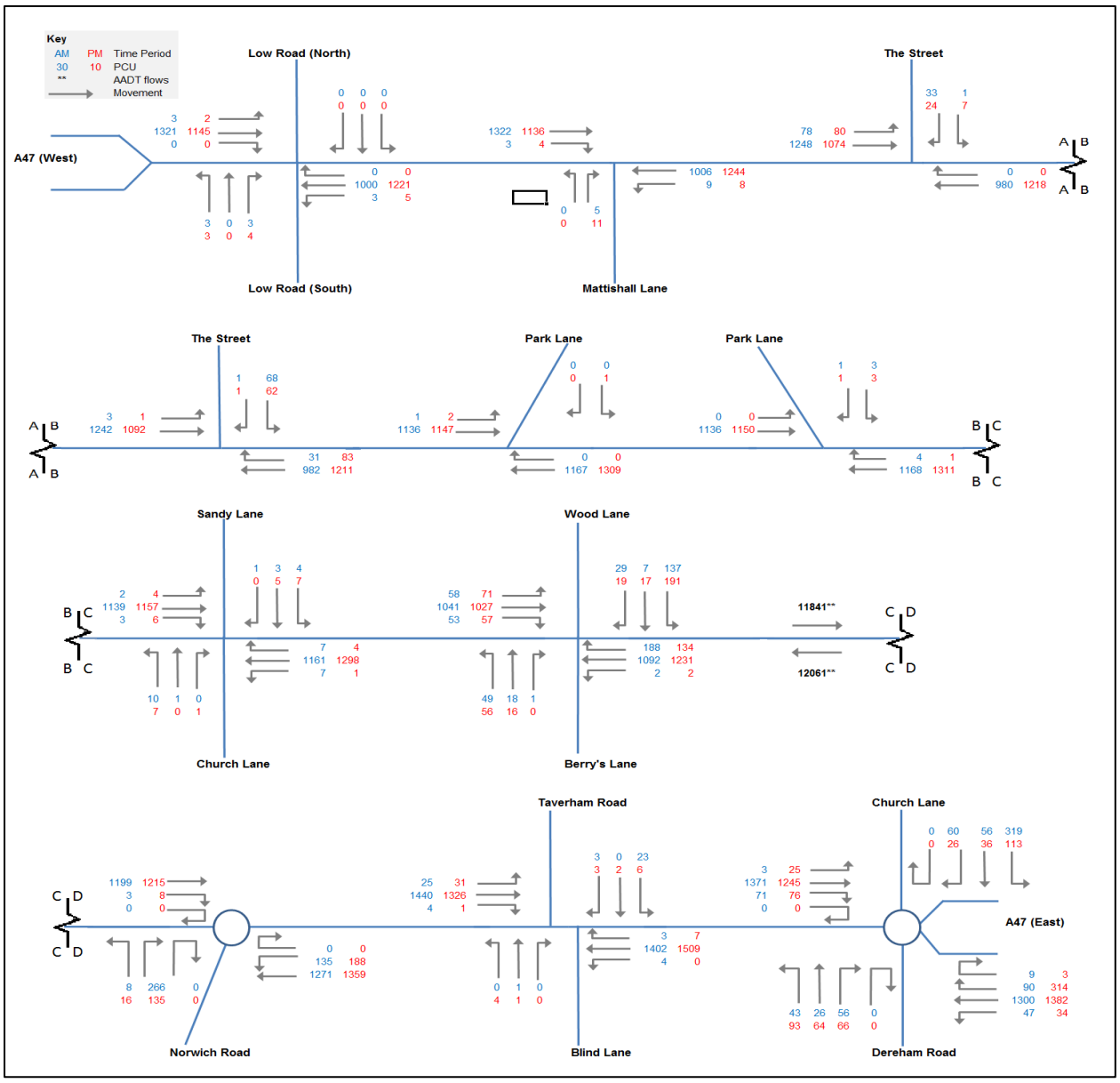
3.3.18 The hourly variation in average speeds on the road can be an indicator of the congestion on the road. Generally, where average speeds are significantly lower than the posted speed limit or drop for certain periods during the day the road is more likely to be congested. The particularly low figure in the AM peak against the daily average is a measure of the congestion on the link in the morning peak as vehicle speeds are limited due to numbers of vehicles and the lack of capacity provided by the single carriageway.

3.3.19 Junction turning count survey data was collected for junctions along the link late in June 2015. The turning count totals for the AM and PM peaks for significant junctions along the route show a slightly higher total flow in the PM peak than the AM peak.

3.3.20 The turning count figures are shown graphically in **Figure 3-6.** The numbers illustrated in the figure are passenger car units (PCU's).

3.3.21 The figures show that for the existing scenario (2015), with the exception of Wood Lane and Church Lane, the turning flows from the local access roads and side roads are minor when compared to the main line A47 flows.

Figure 3-6 – Flow Diagram Schematic for Existing Traffic data



3.3.22 In addition to the turning count data collected in June 2015 and presented above, a series of traffic counts were undertaken in May 2016. These traffic counts were undertaken on the road network surrounding the Scheme. A location plan for count locations is included for reference in **Appendix B**. The counts have been used in updating and validating the transportation model. Details of these counts including location and count data are included in a separate Traffic Data Collection Report which was signed off November 2016.

3.4 Collision Data

3.4.1 Records of collisions for the 5 year period between 1 July 2011 and 30 June 2016 were extracted along the North Tuddenham to Easton scheme. The location and severity of collisions are shown in the diagram in **Appendix C.**

3.4.2 A total of 56 collisions were recorded in the study area during this period. This included 43 slight, 10 serious and 3 fatal collisions. The 56 collisions resulted in 91 causalities: 73 slight, 14 serious and 4 fatal.

3.4.3 Groupings of collisions can be seen along the route but in particular, there are clusters where existing side roads join the A47 around the junction of Sandy Lane and the A47 and the junction of Wood Lane and the A47.

3.4.4 For the 5 year period, there was an average of 11.2 collisions per year. This number peaked in 2013 when 19 collisions occurred.

3.5 Topography, Land Use, Property and Industry

3.5.1 The A47 from North Tuddenham to Easton runs generally through an arable agricultural landscape and as described in Chapter 4. The single carriageway section provides local access to the 3 villages that lie immediately adjacent, Hockering, Honingham and Easton.

3.5.2 The village of Hockering is located 16km to the west of Norwich and has direct links to the A47 east and west of the village. Heath Road runs from the village in a north east direction and provides a link to the local road network. The village has approximately 250 homes with a population of 700. Within the village there is primary school, a garage, a public house and a small number of commercial / retail businesses.

3.5.3 Honingham is 2.8km southeast of Hockering, located south of the A47 to which it is has direct links east and west of the village. The population is approximately 350 with 150 homes, a church, a public house and a small industrial estate of six units. Two roads run southwards from the village area and connect into the local highway network.

3.5.4 Easton is 6.3km southeast of Hockering, located south of the A47 to which it has direct links east and west of the village. The village has approximately 450 homes with a population of 1300. Within the village there is a school, two churches, a public house, garage, restaurant and a small number of retail / commercial businesses. Located on the eastern outskirts of the village are the Norfolk Centre of Agriculture & Horticulture; Easton & Otley College Campus; Norfolk Family Golf Centre; and the Royal Norfolk Agricultural Association.

3.5.5 The River Tud is located approximately 400m to the south of the A47 at Hockering running parallel to it for 3km until it turns towards the A47 crossing under it at Honingham. East of Honingham, the river runs east towards Easton.

3.5.6 The landscape adjacent to the A47 and between the three villages is predominantly agricultural. There are, a number of farms, residential properties and businesses between the villages being accessed from a combination of local roads, farm access tracks and direct access junctions onto the A47. There are some areas of grassland, uncultivated woodland and cultivated woodland adjacent to the River Tud. Hockering Wood is located some 600 metres north of the A47 to the north of Hockering.

3.5.7 There are a variety of property uses along the route, predominantly agricultural and residential but also including; vehicle specialists, equestrian centre, cattery / kennels, timber yard, plant nursery, produce suppliers, scrap yard and reclamation yard, and a sewage works. In addition to the Churches in the villages there is also St Andrews Church to the east of the Norwich Road Roundabout.

3.5.8 The local roads joining the A47 in this section also give access routes serving further outlying surrounding villages, properties and businesses.

3.5.9 To the west of Hockering the landscape is generally flat. To the east, between Hockering and Honingham the land falls gently from the north down to the River Tud. The landscape between Honingham and Easton remains generally flat to the south of the A47, while north of the A47 the ground falls gently down towards the River Tud from both directions

3.5.10 There are no areas of heavy industry within the study area.

3.6 Climate

3.6.1 All information in this section is sourced from the Met Office Website:

http://www.metoffice.gov.uk/climate/uk/regional-climates/ee

3.6.2 The mean annual temperature over the region varies from around 9.5 °C to just over 10.5 °C. Temperature shows both seasonal and diurnal variations. January and February are the coldest months with mean daily minimum temperatures across the region close to 1 °C. Mean daily maximum temperatures range from just over 6 °C to 8 °C during the winter months and from 20 °C to 23 °C in the summer.

3.6.3 Across most of the region there are, on average, about 30 rain days (rainfall greater than 1 mm) in winter (December to February) and less than 25 days in summer (June to August). Much of eastern England receives less than 700 mm per year and includes some of the driest areas in the country.

3.6.4 Eastern England is one of the more sheltered parts of the UK. As Atlantic depressions pass by the UK the wind typically starts to blow from the south or south-west, but later comes from the west or north-west as the depression moves away. Directions between south and north-west account for the majority of occasions and the strongest winds nearly always blow from this range of directions. Eastern England has the greatest frequency of tornadoes in the UK.

3.7 Highway Drainage & Flooding

3.7.1 No formal drainage surveys have been carried out during the options selection stage. Drainage surveys are planned to be carried out during the preliminary design phase. Information on the existing drainage system has been derived from a combination of:

- The Highways Agency Drainage Data Management System (HADDMS),
- Highways Asset Data from Integrated Asset Management Information System (IAMIS)
- Observations from Google Maps images

3.7.2 The carriageway is drained through a highway drainage network utilising a variety of drainage systems including:

- Over edge flows into filter drains or ditches
- Channels formed through the verge (grips) leading to verge ditches
- Dropped kerbs along sections to direct flows (via grips) towards the bottom of embankment drainage
- Kerb and gullies and kerb drainage units discharging into ditches within verges or the bottom of embankments
- HADDMS indicates that there are soakaways in the westbound verge around the junction of Berrys Lane, and approximately 350m to the east of Fox Lane junction.

3.7.3 The local highway drainage networks collect the highway runoff and discharges it to local outfalls including watercourses and ditches which are likely to convey flows ultimately to the River Tud or possibly to soakaways in the ground.

3.7.4 HADDMS has a facility to show information on the service and structural condition of the drainage assets including pipework and chambers (but not for water course culverts crossing under the carriageway). However, for this section of the A47, the service and structural condition of the drainage assets are classified as having 'Not Grades', i.e. no such assessments have been carried out.

3.7.5 The existing drainage system will need to be investigated and verified on site to confirm the condition of the system and outfalls particularly in any areas where the system will remain in use or be adapted for future proposals.

3.7.6 HADDMS indicates that a culvert crossing around 30m to the west of The Street on/off slip appears to convey flows from a 'tertiary river' across the A47. It also shows 'tertiary river' crossings under the A47 around 600m to the west of Low Road, and 300m to the west of Norwich Road roundabout. It is therefore likely that at each of these two locations a pipe or culvert exists to convey flows under the A47.

3.7.7 For information on water courses, flood zones/plains, groundwater source protection zones, ponds and aquifers, see Chapter 4 (Environment including Environmental Status) and Section 16 (Environmental Assessment).

3.7.8 The scheme corridor is dominated by large agricultural fields. At this stage no information is available on field drainage systems adjacent to the highway.

3.7.9 For this section of the A47 HADDMS shows 14 Historic or No Status Flooding Hot Spots over the scheme length. However, it does show one On Going Flooding Hot Spot at the junction of Wood Lane (Score of 0-2). Also, HADDMS does not show any records of spillages in this area. See also section 3.8.23 and Chapter 4 for information regarding flood zones and aquifers.

3.8 Geology

3.8.1 From BGS (BGS: http://www.bgs.ac.uk/geoindex/) records viewed on the Highways England Geotechnical Data Management System (HAGDMS: http://www.hagdms.com/) it is noted that the site is underlain by superficial and bedrock geological sequences. Geological maps can be found in **Appendix D.**

Artificial Geology

3.8.2 No artificial ground is recorded on HAGDMS; however, the historic infrastructure development on site is indicative of the potential presence of Made Ground beneath the A47 carriageway.

Superficial Geology

3.8.3 The anticipated Superficial Geology underlying the site is presented in **Appendix D (Figure D1).**

3.8.4 The study area is underlain by Superficial deposits comprising Lowestoft Formation (Diamicton), Alluvium (Clay, silt, sand and gravel), Sheringham Cliffs Formation (Sand and Gravel), Lowestoft Formation (Sand and Gravel), Happisburgh Glacigenic Formation and Alluvial Fan Deposits (Clay and Silt). Areas of River Terrace Deposits are also present.

3.8.5 In the western area of the study area, Superficial deposits forming part of the Sheringham Cliffs Formation are recorded. Furthermore, thin bands of Alluvium are recorded as crossing the study area at a number of locations. Towards the eastern end of the study area, Alluvial deposits or deposits belonging to the Sheringham Cliffs Formation (Sand and Gravel), Happisburgh Glacigenic Formation and Lowestoft Formation (undifferentiated) have been recorded.

Bedrock Geology

3.8.6 The anticipated Bedrock Geology underlying the site is that of the Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation and Culver Chalk Formation, as illustrated in **Appendix D (Figure 2)** and **Table 3-4** below.

Table 3-4: Bedrock Geology

Age	Strata	Rock Type
Cretaceous	Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Forma.	Chalk

3.8.7 There are no potential geological faults noted from the geological maps.

Historic Ground Investigation

3.8.8 Borehole data provided on HAGDMS identifies 95 No. historic borehole records within 250m of the scheme. These holes have served to confirm the general geological model described by the geological mapping as presented above.

3.8.9 A review of the existing HAGDMS reports associated with A47 within the boundaries of the proposed development has been undertaken. One Historical Geotechnical Report is available on HAGDMS (Report no. 8288); however, this desk study is not within the immediate vicinity of the study area. The area is covered by multiple historic BGS borehole records with the exception of a section between Hockering and Honingham, approximately 2km long, which is covered by limited GI data. The boreholes indicate the variability of the geology along the length but have all encountered the same basic strata sequences as detailed above.

Sensitive Geological Sites

3.8.10 A review of data available on HAGDMS does not identify any Sites of Special Scientific Interest (SSSI) relating to geologically sensitive sites. Data provided by the Geological Conservation Review (GCR; http://jncc.defra.gov.uk/page-1) does not identify any GCR sites within the project area.

3.8.11 The Environment Agency website records one historic landfill approximately 695m south of the A47 known as the Mattishall landfill. Records indicate the landfill took inert material with the first waste received on 31st December 1968. A historic landfilling activity map is presented in **Appendix D**.

Geosure Datasets

3.8.12 GeoSure national datasets provide geological information about potential ground movement or subsidence that can help planning decisions (http://www.bgs.ac.uk/ products /geosure/home.html). Geosure deposits are rated from A to E, with A indicating negligible risk, and E indicating deposits where potential for movement has been

identified. A basic review of Geosure data for the site available on HAGDMS has been conducted; a detailed review of the data will be provided in the PSSR.

3.8.13 The entire project site is underlain by materials which are considered to have potential for collapse (Class B) when loaded or saturated. Alluvium deposits are considered to present a high risk of compressibility (Class D) as well as a possibility of running sand problems (Class C) after major changes in ground conditions. River Terrace Deposits have been identified as having slight potential to be running sands hazard.

3.8.14 Superficial deposits underlying the site are considered to have a potential risk of shrinking swellling. Lowesoft Formation Deposits are designated as medium plasticity soils (Class C), while Alluvium deposits are designated as low plasticity soils (Class B).

3.8.15 Slope instability problems are unlikely to be present on site (Class B).

3.8.16 The Lewes Nodular Chalk Formation is considered to present a risk of significant soluble rocks from solution features associated with soluble rocks (Class B), however these are unlikely to cause problems except where significant surface or sub surface waterflow occurs. However, specific sections, within close proximity to the existing carriageway (to the south east of Honingham) are identified as having a significant content of soluble rocks, with low possibility of localised subsidence or dissolution related to degradation of the bedrock identified (Class D).

Hydrogeology

3.8.17 The Environment Agency (EA) and data available on HAGDMS provides the following information on the hydrogeological regime of the project area.

3.8.18 The Environment Agency website and HAGDMS indicates deposits belonging to Alluvium, River Terrace Deposits, Sheringham Cliffs Formation, Lowestoft Formation-Sand and Gravel are classified as Secondary A Aquifers, while deposits belonging to Lowestoft Formation-Diamicton are classified as Secondary (undifferentiated) Aquifers. Solid geology comprising Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (undifferentiated) is classified as a Principal Aquifer.

3.8.19 The superficial deposits are recorded to have intermediate vulnerability to the west of Honingham and high vulnerability from Honingham to the east. The solid geology is designated as a major aquifer with low vulnerability to the west of Honingham and high vulnerability from Honingham to the east.

3.8.20 The western extent of the site as well as specific sections within the central part of the site falls within Zone 3 of a source protection zone for groundwater abstraction located in Taverham to the north east of the A47.

Hydrology

3.8.21 Environment Agency data available on HAGDMS indicates that the site has no main river recorded flood events. The PSSR will fully investigate the hydrological regime of the site.

3.8.22 Three primary rivers, namely River Tud, Wensum and Yare are in proximity to the site, with the closest one to the existing carriageway being the River Tud. The three rivers are recorded to flow from west to east towards Norwich where the Rivers Tud and Wensum merge with the River Yare.

3.8.23 The Environment Agency's rivers and sea flood map indicates a high flooding risk of the area surrounding all primary rivers being present on site. These areas have been classified under Flood Zone 3 (a 1 in 100 or greater annual probability of river flooding

(>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year).

Geomorphological Review

3.8.24 Based on available topographic survey information provided by HAGDMS displayed in **Appendix D Figure 3**, the landscape is recorded to be a sloping terrain comprising numerous hills and ranging in elevation between 22m AOD between Honingham and Easton where the existing road approaches a river channel and 52m AOD adjacent to North Tuddenham as well as between North Tuddenham and Hockering. Three primary rivers are recorded within close proximity of the scheme; River Tud, River Wensum and River Yare which are recorded to merge to the south east of Norwich.

3.8.25 A series of earthworks of variable height, length and slope profile are recorded on HAGDMS to accommodate the existing A47 carriageway. Earthworks data is listed in **Table 3-5**. The cutting earthworks identified along the scheme length are generally in the region of 2.5m to 3.5m in height although a maximum cutting height of 5.3m has been recorded.

3.8.26 No significant geotechnical defects, associated with these current earthworks, have been identified on HAGDMS.

Table 3-5: A47 Existing Earthworks

Earthwork	Type	Length	Max Height	Max Slope	Comment
Eastbound Carriageway					
6_A47_28134	Cutting	628.7m	5.1m	20°	-
6_A47_29577	At-Grade	880.8m	0m	0°	-
6_A47_28133	At-Grade	443.8m	0m	0°	-
6_A47_28131	At-Grade	517.9m	2m	18°	-
6_A47_28130	Embankment	168.7m	3.3m	24°	-
6_A47_28084	At-grade	136.5	0m	0°	-
6_A47_28189	Cutting	294.4m	2.8m	40°	-
6_A47_28188	At-Grade	443.8m	1m	20°	-
6_A47_28187	At-Grade	128.9	0m	0°	-
6_A47_28185	Cutting	109.7	2.7m	20°	-
6_A47_28184	Embankment	149.7	7.5m	22°	-
6_A47_28183	Cutting	415	3.8m	20°	-
6_A47_29604	At-Grade	209	1.7m	20°	-
6_A47_29603	At-Grade	450.3	2.3	20°	-
6_A47_28181	At-Grade	192.6	2.3	16°	-
6_A47_28179	At-Grade	172.6	1.9	16°	-
6_A47_28178	At-Grade	88.9m	1.4	18°	-
6_A47_62562	At-Grade	368.4m	0.5	9°	-
6_A47_14185	Embankment	54.5m	2.9m	17°	-
6_A47_14174	Cutting	499.8m	3m	22°	-
6_A47_39053	At-Grade	331.4m	0m	0°	-
6_A47_14170	At-Grade	159.4m	0m	0°	-
6_A47_14169	At-Grade	54.1m	0m	0°	-
6_A47_14162	At-Grade	238.6m	2.1m	20°	-
6_A47_14160	At-Grade	1024.5 m	0m	0°	-
Westbound Carriageway					
6_A47_27995	Cutting	66m	5.3m	18°	-
6_A47_28071	Cutting	257.2m	2.6m	20°	-
6_A47_28073	At-Grade	193m	0	0°	-

6_A47_30494	At-Grade	333.8m	1m	16°	-
6_A47_28075	At-Grade	531.5m	0m	0°	-
6_A47_30495	At-Grade	16.4	0m	0°	-
6_A47_39809	At-Grade	382.6m	0m	0°	-
6_A47_30496	At-Grade	244.5m	0m	0°	-
6_A47_38901	At-Grade	156.1m	0m	0°	-
6_A47_30497	At-Grade	426.9m	2m	26°	-
6_A47_30498	At-Grade	909.5m	0m	0°	-
6_A47_30499	At-Grade	106.4m	1.2m	18°	-
6_A47_28141	At-Grade	117.2m	0m	0°	-
6_A47_28143	At-Grade	407.6m	0m	0°	-
6_A47_39797	At-Grade	148.1m	0m	0°	-
6_A47_39798	At-Grade	200.9m	0m	0°	-
6_A47_28145	Cutting	492.6m	3.2m	22°	-
6_A47_28147	Embankment	175.9m	4.9m	24°	-
6_A47_62564	At-Grade	127.3m	0.3m	10°	-
6_A47_62563	At-Grade	124.3m	0.3m	10°	-
6_A47_17479	At-Grade	309.5m	0	0°	-
6_A47_17483	Embankment	129.9m	2.8m	16°	-
6_A47_58286	Cutting	227.4m	3.5m	22°	-
6_A47_58287	Cutting	134.4m	2.9m	35°	-
6_A47_17495	Cutting	209.9m	2.9m	35°	-
6_A47_17496	At-Grade	456.6m	0m	0°	-
6_A47_17498	Cutting	271.4m	2.6m	26°	-
6_A47_17499	At-Grade	811.3m	0m	0°	-
6_A47_17502	At-Grade	166.3m	2.7m	27°	-

3.9 Unexploded Ordnance

3.9.1 Published Unexploded Ordnance risk (UXO) maps have been reviewed. Although the majority of the site is defined as having a remote risk of UXO presence there is a High risk recorded around Norwich; therefore, there is potential for the eastern extent of the project to fall within the high risk zone.

3.9.2 A review of historic maps indicate that Hockering Wood was used to store bombs and other materials for the nearby USAAF / RAF Atterbridge air base.

3.9.3 All potential sources of ordnance need to be further reviewed and considered in the Preliminary Sources Study Report (PSSR) produced in PCF Stage 2. Specialist Consultation is required to assess the actual risk. Further assessment is undertaken as part of the PSSR.

3.10 Mining

3.10.1 Coal Authority data held by HAGDMS indicates there are no coal mining related features, hazards or deposits within or in proximity of the site. Similarly, brine features are not identified in or around the site.

3.10.2 HAGDMS records seven ceased opencast pits in proximity to the A47. Sand and gravel mineral sites as well as 30 No. ceased opencast common clay and shale or sand and gravel mineral sites are recorded within the vicinity of the site. **Table 3-6** provides details of these features.

Table 3-6: A47 Ceased Opencast Pits

Name	Commodity	Geological Unit	X (NGR)	Y (NGR)
Low Strict Brick Yard	Common Clay and Shale	Lowesoft Formation	605392	313727
Low Street Gravel Pit	Sand and Gravel	Sheringham Cliffs Formation	605549	313599
Low Street Marl Pit	Chalk	White Chalk Subgroup	605716	313706
Low Street Clay Pit	Common Clay and Shale	Lowesoft Formation	605791	313261
Low Street Marl Pit	Common Clay and Shale	Lowesoft Formation	605842	313100
Hockering Pit	Sand and Gravel	Lowesoft Formation	606943	313092
Hockering Gravel Pit	Sand and Gravel	Lowesoft Formation	606723	312855
Hockering Gravel Pit	Sand and Gravel	Lowesoft Formation	606837	312838
Hall Lane Pit	Common Clay and Shale	Lowesoft Formation	607125	312584
Hockering Marl Pit	Common Clay and Shale	Lowesoft Formation	607976	312893
Hockering Pit	Common Clay and Shale	Lowesoft Formation	608262	313111
Honingham Pit	Common Clay and Shale	Lowesoft Formation	609539	312603
Honingham Pit	Common Clay and Shale	Lowesoft Formation	609596	312425
Honingham Pit	Common Clay and Shale	Lowesoft Formation	609875	312533
Honingham Pit	Common Clay and Shale	Lowesoft Formation	609831	312202
Honingham Pit	Common Clay and Shale	Lowesoft Formation	609818	312101
Honingham Pit	Common Clay and Shale	Lowesoft Formation	610148	311758
Honingham Pit	Common Clay and Shale	Lowesoft Formation	610567	312114
Britton's Grove Gravel Pit	Sand and Gravel	Lowesoft Formation	610520	311409
Alder Carr Pit	Common Clay and Shale	Lowesoft Formation	611149	311593
Alder Carr Gravel Pit	Sand and Gravel	Lowesoft Formation	611225	311631
Alder Carr Pit	Common Clay and Shale	Lowesoft Formation	611365	311587
Church Farm Pit	Common Clay and Shale	Lowesoft Formation	611339	310882
Church Farm Pit	Common Clay and Shale	Lowesoft Formation	611377	310939
Church Farm Sand Pit	Sand	Lowesoft Formation	611650	311663
Church Farm Sand Pit	Sand	Lowesoft Formation	611777	311542
Church Farm Pit	Common Clay and Shale	Lowesoft Formation	612019	311149
Blind Lane Pit	Common Clay and Shale	Lowesoft Formation	611911	310907

Name	Commodity	Geological Unit	X (NGR)	Y (NGR)
Easton Pit	Common Clay and Shale	Lowesoft Formation	612730	310964
Hill Farm Sand Pit	Sand and Gravel	Leet Hill Sand and Gravel Member	613092	311530

3.11 Public Utilities

3.11.1 Utilities records in the area were requested in PCF Stage 1 and where these have been provided, are referred to below and also shown on the plans contained in **Appendix E**

3.11.2 There appears to be little existing Statutory Undertaker's equipment in the vicinity of the existing A47 to the west of Mattishall Lane apart from some overhead BT cables to the north of the A47 with a BT cable overhead crossing of the A47 to Oak Farm.

3.11.3 There is a water main in the A47 westbound verge running from Hockering to Easton. Water mains are also present in the verges of Mattishall Lane, The Street, and Church Lane.

3.11.4 High voltage underground electrical cables are located in both verges of the existing A47 at Hockering.

3.11.5 BT supplies alternate between the eastbound and westbound verges at various locations between Hockering and Easton and are also located in the verges of The Street, Sandy Lane, Wood Lane, Berry's Lane and Mattishall Road.

3.11.6 There are two decommissioned sewer crossings and a foul water crossing the A47 to the east of Hockering. These services/mains enter Hockering via the northern verge of The Street.

3.11.7 A foul water sewer is located in the A47 westbound verge in the vicinity of Norwich Road and runs eastwards to Easton.

3.11.8 Street lighting is provided on the roundabouts and their approaches at Easton and on all approaches and exits to Norwich Road roundabout to the east of Honingham.

3.11.9 Records show statutory undertakers crossings of the A47 as follows:

- High Pressure gas main crosses the A47 approximately 150m west of Wood Lane;
- Electricity: overhead cables cross the A47 at Hockering, to the west of Hall Drive at Honingham and at Blind Lane/ Taverham Road. High voltage 132kV overhead cables cross the A47 approximately 400m west of Church Lane. High voltage overhead cables also cross the A47 at a point approximately 40m west of Easton roundabout;
- BT underground crossings of the A47 occur at Hall Drive to the north of Honingham and at a point approximately 400m west of Church Lane. BT overhead cables cross the A47 at Blind Lane/ Taverham Road.

3.12 Technology

3.12.1 From the Highways England asset data records available, the following existing technology is recorded as present:

- Seven isolated communications cabinets along the route.

- Two sets of road traffic count loops are located in the A47 eastbound and westbound carriageways at either end of the westbound layby at Honingham. The loops to the east of the layby are powered by means of a pole mounted solar panel which is located in the westbound verge adjacent to the loops. The loops to the west of the layby are connected to a mini feeder pillar also located in the westbound verge.
- Emergency telephones are installed in the A47 eastbound layby at Honingham and in the A47 westbound layby 400m to the west of Church Lane roundabout at Easton.

3.12.2 The current section of the A47 between North Tuddenham and Easton is predominantly unlit with lighting provided at localised junction locations along the route.

3.13 Maintenance Access

3.13.1 As described in section 3.2.12 there are existing laybys on the section of the A47 but there are no specific laybys provided for maintenance access.

3.13.2 There is currently no specific provision for access for maintenance to the culvert which carries the River Tud under the A47 at Honingham.

4 Environment including Environmental Status

4.1 Introduction

4.1.1 The purpose of this chapter is to provide an overview of the existing environment where the proposed scheme will take place. It is based on Chapter 2 of the PCF Stage 1 Environmental Assessment Report (EAR) and its associated drawings, and provides a summary of the key environmental receptors within the study area defined for the scheme, see Appendix F. Chapter 2 of the PCF Stage 1 EAR provides details of the methodology used to characterise the environmental baseline and describe its sensitivity to change.

4.2 Air Quality

Introduction

4.2.1 This section provides a summary of the air quality and greenhouse gas baseline within the study area, at the time of PCF Stage 1, along with the key constraints which could result from changes in air and greenhouse gases.

Baseline Conditions

4.2.2 No air quality monitoring is undertaken within the study area by any of the district councils. There are also no declared Air Quality Management Areas (AQMAs) within the study area, or any likely to be impacted by the scheme outside of it.

4.2.3 Background air quality concentration data for 2016 from Defra, based on the 2013 background mapping, show that there are no exceedances of the Air Quality Strategy objectives in the study area. Background air quality concentrations at the 1km grid squares in the study area show:

- a higher concentration of nitrogen based air pollutants following the course of the A47. There are higher concentrations shown at the far eastern edge of the map, which is likely a result of the presence of the Cemex industrial recycling and waste reclamation facility. This would see high quantities of diesel vehicle movements, and may also involve the use of diesel powered plant or equipment on site.
- the distribution of PM_{10} as having more of a relationship to the presence of worked arable agricultural fields and specific industrial facilities. The highest concentrations are located in grid squares where the following industrial facilities are present:
    - Banham Poultry Farm south of Kimblewick Farm Equestrian Centre. This is also a potential source of ammonia within the study area;
    - A timber yard at the end of Mill Lane, south of Hockering;
    - Thomson's Scrap Yard on Sandy Lane, identified from OS mapping and aerial imagery. This may also be a source of VOCs; and
    - Mooney Demolition, south of Hockering.
- the highest concentrations of $PM_{2.5}$ are located in areas where there are no obvious single sources of this pollutant. It is likely the higher concentrations are caused by a combination of sources such as road transport and agriculture.

4.2.4 There are other facilities within the study area which will produce a variety of emissions to air:

- The Cemex gravel quarries at Longdell Hills and recycling facility immediately east of the site;
- A local heating oil scheme run in Honingham village; and
- The water treatment works at Hockering.

Receptors

Human Exposure

4.2.5 An approximate count of human receptors within the study area is shown in **Table 4-1** and shown in PCF Stage 1 EAR **Figure 2.4.1**.

Table 4-1 Approximate Counts of Human Receptors within the Study Area

Receptor Type	Quantity
Residential	971
Community	16
Commercial	21

Designated Sites

4.2.6 Hockering Wood SSSI is located partially within the study area. It is an area of natural and semi-natural ancient woodland. The main stand type is acid oak-lime woodland. As a deciduous woodland in a temperate region, Hockering Wood is a habitat vulnerable to the effects of excess nitrogen deposition as noted in the PCF Stage 1 EAR.

Key Constraints

Temporary (Construction)

4.2.7 All human receptors within the study area are exposed to the risk of health impacts from the inhalation of construction dust and exhaust gas pollutants and there are therefore potential constraints to the scheme. Risks during construction are primarily from construction dust. This can occur through particles suspended in the air, and through deposition of particles on receptor surfaces. Construction dust can include particles that contribute to ambient PM_{10} concentrations, and also far coarser particles. There are no limit values for deposition, however dust from wet or dry deposition on receptor surfaces can result in a loss of amenity, and as such is considered a statutory nuisance under the Environmental Protection Act 1990. Construction dust can also affect ecosystems through deposition that acts as a physical barrier to photosynthesising plants, and through the effects of its chemical constituents on sensitive ecological receptors.

4.2.8 Receptor sensitivity from the risk of amenity impacts from construction dust is considered to be medium. With proper mitigation, the risks of construction dust can be significantly reduced. Receptor sensitivity is considered very high from the risk of emissions of construction vehicle and plant exhaust gas emissions.

Permanent (Local Air Quality)

4.2.9 Permanent risks to local air quality can result from changes in the alignment of road centrelines and road edges to a position closer to sensitive human and ecological receptors, and through changes to traffic, such as volume, composition, speed and flow. Whilst realignment of the road may reduce the distance between pollutant source and receptors, this may be countered by improvements in flow that reduce stationary or low-speed traffic and the

amount of time that engines are operating at sub-optimal levels. Changes in composition can affect ambient air quality such as an increase in diesel powered HGV and LGV traffic that could result in an increase to PM and NO_2 levels.

4.2.10 All receptors within the study area are considered to be exposed to this risk and their sensitivity is considered very high because emissions from road traffic have the potential to cause mortality. Pollutant concentrations will not be impacted in any AQMAs because there are no AQMAs in the study area.

Risk to Ecosystems

4.2.11 All ecological receptors within the study area are exposed to the risk of increased concentrations of ambient NO_X and nitrogen deposition of vehicle exhaust gas pollutants and therefore there could be constraints put in place for the scheme.

4.2.12 Ecosystems are generally affected by the deposition of nitrogen, affecting the balance of nutrients available. Changes in the levels of nutrient nitrogen can favour those plants that will thrive in a high nutrient environment, and thus out-compete those that favour low nutrient environments. Dust deposition can also act as a physical light barrier and block plant stomata. However, the risk to the health of ecological receptors from temporary construction dust deposition is considered to be low because the impacts are likely to be temporary and transient. Hockering Wood SSSI is considered to be exposed to these risks and can be considered to have very high sensitivity because of the very limited potential for substitution.

4.2.13 Deposition of sulphurous compounds and their acidic effects is no longer considered a risk due to the removal of sulphur from road fuels.

Compliance Risk (EU Directive on Ambient Air Quality 2008/50/EC)

4.2.14 The Compliance Risk is the likelihood that the scheme may cause the EU air quality limit values to be exceeded either at the scheme location or at locations on the local Compliance Risk Road Network as affected by the scheme. The latest UK air quality compliance report available described in the PCF STAGE 1 EAR states that the Eastern non-agglomeration area in which the scheme is located, did not meet the EU mean annual average limit values for NO_2, but did comply with other thresholds. Accordingly, there is the risk that the scheme may contribute negatively to compliance risk in the wider Eastern non-agglomeration area.

4.3 Cultural Heritage

Introduction

4.3.1 This section provides a summary of the cultural heritage assets within the study area, and the key constraints on any potential scheme resulting from impacts on such assets are described.

Baseline Conditions

Scheduled Ancient Monuments

4.3.2 There are no Scheduled Ancient Monuments within the study area.

Recorded Archaeological Remains

4.3.3 There are no World Heritage Sites recorded within the study area. There are 113 archaeological records within the study area in the Norfolk County Council (NCC) Historic Environment Records (HER), which include prehistoric artefacts and finds from the Bronze Age, Iron Age and Roman period through to the post-medieval periods. The range and extent of the archaeological record within the study area indicate the area has

been attractive for settlement for millennia. The multi-period prehistoric ritual landscape at Longdells Hills gravel quarry near Easton, the Bronze Age ritual landscape featuring round barrows and ring ditches, and the probable Roman building with a hypocaust are important records of archaeological activity, which is otherwise dominated by artefacts discovered via metal detecting or other chance methods. These are shown on PCF STAGE 1 EAR **Figure 2.5.1.**

Unrecorded Archaeological Remains

4.3.4 The known archaeological sites recorded within the study area suggests that there is high potential for further buried archaeological remains to survive.

Listed Buildings

4.3.5 There are 21 Listed Buildings in the study area, as shown in **Table 4-2** with the features identified by their map reference numbers in **Figure 2.5.1** of the PCF Stage 1 EAR.

Table 4-2 Listed Buildings within the Study Area

Map Ref.	NHLE No.	UID No.	Grade	Description
6.	1077359	220743	II	Old Lane House, Low Road, North Tuddenham
25.	1077354	220730	I	Church of St Michael, Hockering
27.	1306686	220733	II	Manor Farmhouse, The Street, Hockering
29.	1342550	220732	II	Manor House, The Street, Hockering
34.	1077355	220734	II	Yew Tree Farmhouse, The Street, Hockering
41.	1306718	220731	II	Overgate House, Heath Road, Hockering
44.	1068814	359835	II	Milestone 2 miles from Mattishall, Norwich Road, East Tuddenham
49.	1077352	220723	I	Church of All Saints, Norwich Road, East Tuddenham
60.	1077351	220721	II*	Old Hall, Norwich Road, East Tuddenham
61.	1306736	220722	II	Barn at Old Hall, Norwich Road, East Tuddenham
70.	1306730	220716	II	Berry Hall, Berrys Lane, East Tuddenham
74.	1077350	220717	II	Icehouse, Berrys Lane, East Tuddenham
87.	1170745	228415	II	39, 40 and 41, The Street, Honingham
88.	1051541	228412	II	Greenacres Farm House, Colton Road, Honingham
99.	1372666	228414	II	Stables and coach house to Honingham Hall, Honingham Hall Estate, Honingham
103.	1170701	228413	II*	Church of St Andrew, Dereham Road, Honingham
108.	1051542	228416	II	Church Farm House, Taverham Road, Honingham,
109.	1170764	228417	II	Barn at Church Farm, Taverham Road, Honingham
129.	1305921	226459	I	Church of St. Peter, Dereham Road, Easton
136.	1373015	226462	II	Hill Farmhouse, Ringland Lane, Lower Easton, Easton
142.	1170875	226463	II	Bellevue, Ringland Lane, Lower Easton, Easton

Undesignated Historic Buildings and Structures

4.3.6 The NCC HER includes eighteen undesignated historic buildings and structures including milestone markings, a Gothic cottage, a post medieval mill house and World War Two artefacts as shown in **Figure 2.5.1** of the PCF Stage 1 EAR.

Registered Parks and Gardens and Registered Battlefields

4.3.7 There are no Registered Historic Parks and Gardens or Registered Battlefields within the study area.

Conservation Areas

4.3.8 There are no conservation areas within the study area.

Historic Landscape Character Areas

4.3.9 The historic character of the area is one of small villages and small farms in low, rolling fields linked by a network of small lanes. Any new dual carriageway road or widening of existing roads will have an impact on this historic character.

Key Constraints

4.3.10 There are 21 listed buildings within the study area, including three Grade I and two Grade II* listed buildings that are assigned a high value due to their designated status and their national importance. The remaining sixteen Grade II listed buildings are assigned a medium value due to their designated status and their regional importance. The scheme has the potential to have an adverse impact directly or indirectly upon all of the listed buildings and their settings within the study area.

4.3.11 There are a further 131 archaeological and historical structures recorded in the study area. They vary considerably in size and complexity, from prehistoric to 20th century activity. These have been assigned a medium value because together they indicate that the area has been utilised for millennia, and much of the remains are of well-defined extent, date and significance to the local area and region.

4.3.12 There is the potential for encountering known features and artefacts during construction, particularly as previous investigations in the area have revealed recorded archaeological sites from the prehistoric to the post-medieval periods. This potential increases with greater land take.

4.4 Landscape and Visual

Introduction

4.4.1 This chapter outlines the various landscape and visual constraints within the study area, at the time of PCF Stage 1, and identifies their sensitivities to change.

4.4.2 Landscape and visual characterisations are undertaken as separate procedures. Landscape impacts are the changes to the physical landscape which change landscape character, while visual impacts are the modifications to existing views and how the landscape is experienced by people (visual receptors).

Baseline Conditions

Landscape Designations

4.4.3 There are no designated landscapes or registered parks or gardens within the study area.

National Character Areas

4.4.4 As noted in the PCF STAGE 1 EAR and shown in PCF Stage 1 EAR **Figure 2.6.1**, the study area covers two National Character Areas (NCA). These are NCA 78 Central South Norfolk, and NCA 84 Mid Norfolk. There is little difference in the landform of the two NCA as there are no hills, mountains, rocky surface features or deep valleys present. NCA 78 incorporates some low, undulating landforms with elevations ranging from 0.3m to 101m above sea level, and NCA 84 is largely flat with a mean elevation of 51m above sea level. Shallow, wide river valleys are present in both NCA, consistent with the low lying nature of much of East Anglia, and the history of the land use.

Local Landscape Character Areas

4.4.5 The local landscape character is described below for each of the districts covered by the A47. PCF STAGE 1 EAR **Figure 2.6.2** shows the main landscape features within the study area:

- South Norfolk District - the River Tud valley is described as being flat with steeply wooded sides. Woodland at Longdell Hill divides the River Tud catchment from the River Wensum catchment. Arable agricultural land is present, however pig farming is also prevalent. Settlements are sparse and described as being mainly agricultural with white painted buildings with red roofs. Transport in the area is via narrow lanes and footpaths. Woodlands, willow pollards, watercourses and the valley landform are important features.
- Broadland District - the Weston Green area of Broadland that is within the study area is isolated from the rest of the Broadland district by the River Wensum and consists of low rolling, often wooded, hills. There are some arable agricultural areas, along with pig farming.
- Breckland District - the Upper Tud Valley landscape area of Breckland District is defined by the shallow River Tud valley bordered by the Wensum and Yare river catchments. The landscape in this area is largely made up of small to medium fields on broad, flat land. There are areas of woodland, including wet woodland, along the course of the river, and some areas of wet meadow. Settlements are small, though Hockering is identified as having expanded rapidly in recent years. East Tuddenham is identified for its church, which sits distinctly outside of the village in flat fields.

Landcover, pattern and texture

4.4.6 The landform is defined by a broad, low rolling fluvial valley. Arable farmland is the predominant land cover, divided into relatively small and linear agricultural enclosures interconnected by narrow rural lanes, as shown in **Photograph 4-1.** Hedgerows are frequent land and field boundaries, with a predominance of hawthorn. Lines of mature trees are also found in the edges of some fields, while low embankments divide other fields with most of the rural lanes running amongst them**.**

Photograph 4-1 Lane to Lodge Farm in Hockering

4.4.7 The River Tud is the main water feature of the area, with many tributaries that create a rich wetland mosaic along the river. Riverside woodland grows along the course of the river as a linear feature, but it is not always conspicuous from the A47 due to topography. Small copses are scattered over the area, and there are some areas of woodland in the north side of the road where topography is higher. Most of this woodland is of recent origin, which is evidenced through map searches and the propensity of linear planting in aerial imagery. However, there are woodland areas of ancient origin located to the north of Hockering, and there are several veteran trees scattered through the area.

4.4.8 Within the existing pattern, the texture of the overall landscape is defined by the cropping fields and the vegetation in hedgerows and woodland patches. This produces a contrast between the fine grain, smooth and uniform texture of the fields, and the coarse and more irregular texture of the deciduous hedges and trees.

Scale and appearance

4.4.9 There are many points within the study area that allow open views of the surroundings, including many views of the current A47 and of the potential scheme options (as illustrated in **Photograph 4-2**). Topography rises slightly northwards until it meets the ridge that separates the Tud valley from the Wensum valley, which is the main ridge line of the area.

Photograph 4-2 Views of open fields from Taverham Road

Tranquillity

4.4.10 The low-rolling topography, uniformly covered with a traditional agricultural pattern, and interspersed with historical landmarks such as church spires, define a place with a great sense of tranquillity. The A47, as shown in **Photograph 4-3** from the surroundings of Oak Farm, is the principal source of disturbance within the area, but its effects become less perceptible as the distance from the road increases.

4.4.11 Traffic in the rural lanes is generally low, increasing during peak hours. Traffic is more intense on Mattishall Road and Norwich Road, which are also the main links between the settlements to the south of the A47. Some roads on the north side of the A47, like Sandy Lane, Wood Lane and Taverham Road, have a high volume of traffic during peak hours, as they offer an alternative route from the congested main road, with great detriment to the tranquillity.

Photograph 4-3 Intermittent views of the HGV traffic on the A47 from Oak Farm

Cultural

4.4.12 The whole landscape shows a strong historical character from the agricultural pattern of medieval origin to the numerous medieval churches whose flint stone spires stand as historical milestones in the rural skyline, as depicted in **Photograph 4-4.** The built landscape has a great aesthetic consistence with the vernacular style of the area being characterised by two storey cottages made of a mixture of bricks and flint stone, with tiled roofs.

4.4.13 Most of the modern houses in the villages of Hockering and Honingham are built in a more modern style but keeping the main characteristics of the vernacular typology, with brick or whitewashed walls and tiled roofs. There are some utilitarian buildings, like storehouses in the farms or small industries, built with industrial materials of a different kind, but their presence is not disruptive to views as they appear screened by high trees, hedges and other buildings. The tower of Honingham Mill, built on black wood, is also a valuable landmark in the surroundings, especially when seen from Mattishall Road.

4.4.14 Approximately 2.5km north of the study area, at Weston Longville, is the former RAF Attlebridge airfield that was used by the American Air Force during World War Two, now a Bernard Matthews turkey farm. A decoy airfield was also constructed on fields immediately south of North Tuddenham of which only crop marks are now visible. Whilst these two areas fall outwith the study area, remnant buildings, shelters or other wartime infrastructure remain within the study area that are linked to these two landscape features, especially in and around Hockering Wood.

Photograph 4-4 View of St Andrew Honingham Church from Blind Lane

Human Interaction

4.4.15 The A47 is a key route for traffic in the area, but acts as a geographical barrier and poses some dangers due to heavy traffic and the problematic junctions from the side roads. A regular bus service runs along the A47 with stops in Hockering and Easton connecting with the train station in Norwich. The rural lanes either side of the A47 connect every settlement in the area, but many do not have footways and the visibility on the road is low. However, there are numerous PRoW (Public Rights of Way) and some bridleways that can be accessed by non-motorised users.

4.4.16 There are three main residential settlements within the study area – Hockering, Honingham and Easton with associated community facilities, including schools, leisure outdoor areas and other amenities.

4.4.17 A line of pylons crosses the A47 at Easton, entering the eastern end of the study area and are a conspicuous element on the horizon from many points of view.

Visual Receptors

4.4.18 Views within the study area are generally open as a result of the flat agricultural land and limited woodland cover. A zone of visual influence has not yet been defined for the project, however following a site walkover in June 2016 a number of sensitive visual receptors were identified as shown in **Table 4-3**.

Table 4-3 Visual Receptors

Visual Receptors	
Hall Farm	Stables and Coach House to Honingham Hall
Ailwyn Hall Care Home	Properties on Park Lane
20 and 57-81 Heath Road Hockering	Lily Avenue and Manor Close, Hockering
Lodge Farm	Rickwood Farm
Oak Farm	Kimblewick Farm
Summer Mills Traveller's Camp	Properties on Mattishall Road
Properties on Rotten Row	Properties on Church Lane;
Berry's Hall	Merrywood House
Grange Farm	Honingham Mill
Woodview, High Croft, 42, 43, 44 and 45 Sandy Lane	The EarthSea School on Berrys Lane with Mattishall Road
Properties on Fellowes Road and Colton Road, Honingham	Public Rights of Way and bridleways in the area
Church Farm in Taverham Road	

Key Constraints

4.4.19 There are no landscape designations within the study area, which predominantly contains flat agricultural land; the majority of which is grade 3 (good to moderate quality). Land take from such agricultural land is a constraint for the scheme.

4.4.20 There are several priority habitats identified within the study area, especially concentrated along the course of the River Tud and therefore in the south side of the A47: floodplain grazing marsh, good quality semi-improved grasslands, lowland fens and traditional orchards. These habitats are a valuable element within the local landscape. A number of woodland areas, including many currently benefitting from Forestry Commission grants, could be lost for any scheme to the north of the current A47 route. The ancient woodland of Hockering Wood SSSI creates a narrow corridor with the village of Hockering, which is a significant constraint. Any new dual carriageway will impact the current local character of the area which consists of small lanes joining small villages.

4.4.21 The historic nature of this agrarian landscape, with reminiscences of its medieval past in the pattern of the lands and in the churches with spires emerging over the fields, is a feature that defines the identity of the area. Any option interrupting the visual and historic relationship between buildings and landscape would have an adverse effect.

4.4.22 There are numerous visual receptors present within the study area. The existing A47 appears well hidden from the view of the villages and any new road will be a prominent feature in the landscape, particularly given the long open nature of views within the study area. Any new alignment that follows the rural fringe of the villages of Hockering and Honingham is likely to have significant impacts on visual receptors, particularly if any sections of the road are elevated.

4.5 Nature Conservation and Biodiversity

Introduction

4.5.1 This chapter outlines the various ecological constraints within the study area, known at the time of PCF Stage 1, and identifies their sensitivities to change. It is informed by baseline information gathered through desktop study and fieldwork carried out in summer 2016.

Baseline Conditions

Designated sites

4.5.2 As described in the PCF STAGE 1 EAR, online sources identified three statutory designated nature conservation sites within 2km of project extents (extended to 10km for sites designated for bats and birds). The sites are detailed in **Table 4-4**, with their distance from the existing A47 and the qualifying/notifying features. These areas are shown on PCF STAGE 1 EAR **Figure 2.7.1**.

Table 4-4 Designated sites

Designated Site	Distance from A47 (km)	Reason for Designation
Hockering Wood SSSI	0.55km N	Hockering Wood is notified as one of the largest areas of ancient, semi-natural woodland in Norfolk. Large areas of the woodland are undisturbed and contain rare and local species. The range of species identified is infrequent for Norfolk.
River Wensum SAC/SSSI	1.6km NE	Designated due to the Annex I habitat (water courses of plain to montane levels containing Ranunculion fluitantis and Callitricho-Batrachion vegetation) and presence of Annex II species: White-clawed crayfish Austropotamobius pallipes, Desmoulin's whorl snail Vertigo moulinsiana, Brook lamprey Lampetra planeri, Bullhead Cottus gobio.
Rosie Curston's Meadow SSSI	1.7km SW	This area is noted as a small unimproved calcareous clay pasture, with scattered scrub, mature hedgerows and grassland. There are over 60 grassland species identified.

4.5.3 No statutory sites designated for bats or birds were found within an extended 10km search area.

4.5.4 Online sources identified 21 non-statutory designated nature conservation sites within 2km of the project extents, the sites are shown in **Figure 2.7.1** of the PCF STAGE 1 EAR. In addition, online resources identified pockets of ancient woodland within the study area, which are all additionally County Wildlife Sites (CWS) (or SSSI).

Habitats

4.5.5 Priority Habitat Inventory Data indicate that seven Biodiversity Action Plan priority habitats are present within 2km; lowland fen habitat, traditional orchard habitat, coastal floodplain grazing marsh habitat, pond habitats, good quality semi-improved neutral

grassland habitat, lowland meadows habitat and lowland mixed deciduous woodland habitat. These are shown in PCF STAGE 1 EAR **Figure 2.7.3.**

4.5.6 **Table 4-5** shows the habitat types found within the Phase 1 survey area (as shown in PCF STAGE 1 EAR **Figure 2.7.2A**).

Table 4-5 Habitats

Habitats within Study Area	
Arable	Semi-improved neutral grassland
Marshy grassland	Dense and scattered scrub
Amenity grassland	Mixed semi-natural woodland
Unimproved neutral grassland	Recently felled woodland
Running water	Broadleaved semi-natural woodland
Standing water	Broadleaved plantation woodland
Hedgerows including: 'intact hedge – species rich', 'intact hedge – species poor', 'defunct hedge – species rich', 'defunct hedge – species poor', 'hedge with trees – species rich', 'hedge with trees – species poor'	Tall ruderal

Protected and Notable Species

4.5.7 Following the Phase 1 Habitat Survey and records search the study area was found to have the potential to support the following protected and notable species:

- Amphibians – eDNA surveys conclusively show the presence of Great Crested Newt (GCN) within the survey area with four ponds showing positive results
- Birds - observations during the Phase 1 survey and anecdotal evidence include:
    - Barn owl *Tyto alba* – the number of records and nest boxes may indicate a significant population in the area;
    - Kingfishers *Alcedo atthis* – there are a few records and anecdotal evidence of nest locations;
    - Red kites *Milvus milvus* – a pair of red kites were observed during the Phase 1 survey and are considered likely to be breeding in the survey area. As a 'near threatened' species this pair may be considered important to the species; and
    - Swifts *Apus apus* – by far the most numerous records received, as a BoCC – amber species, the study area may be an important area for this species.
- Fish – European eel *Anguilla Anguilla*, brown trout *Salmo trutta*, and bullhead *Cottus gobio*
- Invertebrates - 53 notable species of insects; three species of butterfly and 50 species of moth. The River Wensum SAC/SSSI is designated for the presence of the Annex II species; desmoulin's whorl snail *Vertigo moulinsiana* and white-clawed crayfish *Austropotamobius pallipes*. Any resident snails within the study area may represent a significant proportion of the UK population.
- Badger *Meles meles* – records indicate a stable badger population within the survey area, with 23 records of setts and various sightings scattered throughout the area.
- Bats – the landscape is well connected by hedgerows and pockets of woodland and scrub. The surrounding habitat provides high quality foraging habitats for various species. The

extended Phase 1 survey identified 241 trees/groups of trees for bat potential, 33 areas of woodland, nine buildings and four anecdotal bat roosts informed by local residents.

- Otter *Lutra lutra* – the River Tud provides suitable habitat for otter with high potential for foraging and commuting throughout the survey area. There was one spraint and one otter slide observed within the survey area on the River Tud.
- Water vole *Arvicola amphibius* – the River Tud and tributaries are assessed as having areas of suitable habitat for water vole
- Reptiles – the extended Phase 1 survey identified several areas of suitable habitat for all of the above reptile species including grassland, hedgerows, woodland and marshy grassland.
- Plants – there are a number of notable records of plant species including one record of Depford pink *Dianthus armeria*. As noted in the PCF STAGE 1 EAR this species is only found with 34 sites in the UK.
- Fungi – there was one record of a notable fungi species within the study area: sandy stilt puffball *Batterrea phalloides*, which is rare within the UK and has only been recorded in the south and east of England.

Invasive species

4.5.8 Invasive species within the area include American mink *Neovison vison*, Japanese knotweed *Fallopia japonica*, Himalayan balsam *Impatiens gladulifera,* Chinese water deer *Hydropotes inermis,* Muntjac deer *Muntiacus reevesi,* Canada goose *Branta leucopsis*, Egyptian goose *Alopochen aegyptiacus*, Night heron *Nycticorax nycticorax*, Ring-necked parakeet *Psittacula krameri*, Grey squirrel *Sciurus carolinensis,* Spanish bluebell *Hyacinthoides hispanica*, Rhododendron *Rhododendron ferrugineum* and Red-eared terrapin *Trachemys scripta.*

Key Constraints

4.5.9 **Table 4-6** identifies the ecological features within the study area and provides an indication of their value (as explained in detail in the PCF Stage 1 EAR). Key constraints are those of regional, national and international value.

Table 4-6 Ecological Features

Ecological Feature	Resource Valuation
Designated sites	
River Wensum SAC/SSSI	International
Hockering Wood SSSI	National
Rosie Curston's Meadow SSSI	National
Ancient Woodland	National
CWSs not identified as ancient woodland	County
Habitats	
Priority habitats	County
Important hedgerows	County
Other hedgerows	Local
Running water	County
Unimproved grassland	County
All other habitats	Local
Protected/ notable species	

Ecological Feature	Resource Valuation
Great crested newt	County
Breeding bird species	National
Wintering bird species	Not assigned
Brown trout	County
Bullhead	Regional
Other fish species	Local
Terrestrial invertebrates	Local
Desmoulin's whorl snail	National
White clawed crayfish	County
Other aquatic invertebrates	Local
Badger	Local
Bat	Regional
Otter	County
Water vole	County
Reptiles	local
Depford pink	National
Tower mustard	National
Veteran trees	Local
Sandy stilt puffball	National
Invasive species	Negative
Red Kite	Regional
Barn Owl	Local
Kingfisher	County
Swift	Local

4.6 Materials

4.6.1 Most construction, improvement and maintenance schemes on the road network will require the acquisition and use of primary raw materials and manufactured products, and this scheme will require large quantities of raw materials, the use of which has the potential to cause adverse impacts such as the depletion of natural resources and the generation of waste.

4.6.2 **Table 4-7** identifies the materials use and potential waste that are likely to arise from the scheme.

Table 4-7 Materials Use and Waste Production

Project Activity	Material use	Potential waste arisings
Site remediation / preparation / earthworks	Site clearance will involve the removal of street furniture (e.g. street lightening, cabinets, CCTV) and traffic signs as well as any affected boundary walls and fencing.	The scheme will involve considerable earthworks with all excavated earthwork material being re-used on site (where possible) rather than disposed of and importing virgin aggregates. Maximising the reuse of

Project Activity	Material use	Potential waste arisings
	These should be retained wherever possible for reuse after the scheme's completion.	materials won on site for example through the use of a Materials Management Plan (MMP) or Soils Resource Plan (SRP) will lead to a reduction in the volume of materials needing to be imported onto the site and reduce the number of haulage journeys. This practice will have its own cost benefits and will aid in the reduction of airborne pollutants and greenhouse gas emissions from transport. A reduction in waste leaving the site for landfill also has significant cost savings and long term environmental benefits
Demolition	Equipment and machinery will likely be mini-digger, large digger, planer, spreader, jack-hammer, tipper lorries and cranes.	The existing road and roundabouts may be taken up and removed. There may also be properties that may be demolished and removed if they lie beneath the scheme. Vegetation that is removed to allow construction of the earthworks and drainage structures should be chipped on site and used as a mulch to help establish new planting once construction is completed
Site construction	This scheme will require a large amount of materials in order to construct, most obvious of which is the materials required to construct the new widened carriageways, cycle ways and footpaths. Recycled aggregates can be sourced for road construction to reduce costs and improve sustainability of the scheme. Materials that are required should be sourced from local quarries and suppliers to reduce the length of the haulage route Kerbs and drains will all be precast concrete, with footways being finished with a mix of asphalt surfacing and paving. Tactile paving will be used along the route for pedestrian crossings which will be a mixture of a segregated cycle lane and shared cycleway / footway.	Materials should be ordered as and when required to minimise storage times on site. This will prevent deterioration of materials and reduce wastage. Any material excavated and not reused within the scheme boundaries will also likely be removed from site to a materials reclamation site. Any materials not suitable for reuse will likely be disposed of at a landfill site. This may include any excavated material from contaminated land. There is a potential for road planings to contain coal tar which would be classified as hazardous waste and would require disposal at a hazardous landfill site. If waste is disposed of at a landfill site, it would create a large impact, as landfill space within both inert and hazardous landfill sites is a finite resource, (medium sensitivity and major magnitude leading to a large impact). However, if suitable inert material can be reused either on site or from a materials reclamation centre it

Project Activity	Material use	Potential waste arisings
		would reduce the impact
Operational / maintenance	The material resources and waste post construction cannot be estimated at this stage. However assumptions can be made in that any road repairs will require granular sub base, asphalt binder and surface course and will have road planings as waste. There may also be material and waste issues from the upkeep of road furniture and lighting.	

4.6.3 As the design is ongoing, there is insufficient information at present to accurately forecast waste streams that will be produced on the site. Therefore, local landfill capacity as a whole has been reviewed. The EA has information on the nearest active landfill sites to the scheme, as summarised in **Table 4-8**.

Table 4-8 Nearest Waste Infrastructure

Name of site	License Number	Distance	Type of site
Attlebridge Landfill Site Reepham Road, Attlebridge, Norfolk, NR9 5TD	EAEPR\EA/EPR/VP3399NP/V002	5.1km	A01: Co-Disposal Landfill Site (Non-hazardous and hazardous waste in the same cells.) A06: Landfill taking other wastes (Non-hazardous and Hazardous)
Costessey Landfill Longwater Lane, Costessey, Norwich, Norfolk, NR5 0TL	EAEPR\EA/EPR/CP3796LU/T001 EAEPR\EA/EPR/CP3799LF/T001	11km	A04: Household, Commercial & Industrial Waste Landfill (Non-hazardous)
Easton Inert Landfill Site Easton Lodge Farm, Dereham Road, Costessey, Norwich, Norfolk, NR9 5EQ	EAEPR\EA/EPR/YP3598NU/V002	1.4km	A05: Landfill taking Non-Biodegradable Wastes (Non-hazardous)
Spixworth Quarry Grange Farm, Buxton Road, Spixworth, Norwich, NR10 3PR	EAEPR\EA/EPR/CB3401LP/A001	5.2km	L05: Inert waste

4.7 Geology and Soils

Introduction

4.7.1 This section describes the constraints from geology and soils within the study area.

Baseline Conditions

Designated Sites

4.7.2 There are no designated sites within the study area that are designated for their geological or geomorphological importance. The nearest designated site is the Catton Grove Chalk Pit, lying 9.2km east of the study area, designated for Upper Chalk

(Cretaceous) Catton Sponge Bed, which has a well preserved fauna including important ammonites and many undescribed sponges.

Geomorphology

4.7.3 The geomorphology of the study area has been formed by both geological and human activity. The Anglian glaciation, around 450,000 years ago, laid down an extensive and characteristically chalky till deposit – the Lowestoft Till – as well as sand and gravel outwash deposits. River gravels occurring underneath the Lowestoft Till provide important evidence of pre-glacial river channels which were disrupted by glacial action. During cold periods between glacial periods, periglacial 'freeze thaw' actions and meltwater rivers, deposited gravel and sand sequences in valleys such as the Wensum providing an important river terrace archive of glacial information. The geomorphological landscape within the study area is relatively stable and is highly modified by human interference.

Solid Geology

4.7.4 Bedrock deposits underlying the area comprise the Lewes Nodular Chalk Formation, the Seaford Chalk Formation, the Newhaven Chalk Formation and the Culver Chalk Formation as shown in **Appendix D Figure 2.11.1**. These sedimentary bedrocks formed approximately 71 to 94 million years ago in the Cretaceous Period in warm shallow 'Chalk' shelf seas with little sediment input from land. They often consist of a calcareous ooze of the microscopic remains of plankton.

Superficial Geology

4.7.5 Superficial or drift deposits underlying the area comprise the following (shown in **Appendix D Figure 2.11.2**):

- Lowestoft Formation (Diamicton till) and the Sheringham Cliffs Formation (sand and gravel) which were formed up to 3 million years ago in the Quaternary Period, under ice age conditions. They were formed in cold periods with ice age glaciers scouring the landscape and depositing moraines of till with outwash sand and gravel deposits from seasonal and post glacial meltwaters.
- Alluvium deposits (clay, silt, sand and gravel) are found along the courses of the River Tud and its tributaries. These superficial deposits formed up to 2 million years ago in the Quaternary Period from rivers depositing mainly sand and gravel detrital material in channels to form river terrace deposits, with fine silt and clay from overbank floods forming floodplain alluvium, and some bogs depositing peat; includes estuarine and coastal plain deposits mapped as alluvium.

Soils

4.7.6 The European Soil description describes the soils within the study area as being predominately glacial till (loam to clayey loam, locally chalky texture) with outcrops of glaciofluvial (silt to sand texture) deposits in the area which become dominant east of Easton as shown in **Appendix D Figure 2.11.3.** Riverine clay and floodplain sands and gravel (clay to sandy loam texture) are found along the course of the River Tud and its tributaries with river terrace sand and gravel (sand to sandy loam texture) found adjacent. North east of Honingham and north of Easton, outcrops of chalk (chalky, sandy loam texture) are found adjacent to the bands of riverine clay and flood plains.

4.7.7 According to the Cranfield Soil and Agrifood Institute, there are four soilscapes within the study area, soilscape 8 (slightly acid loamy and clayey soils with impeded drainage), soilscape 10 (freely draining slightly acid sandy soils), soilscape 18 (slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils) and soilscape 23 (loamy and sandy soils with naturally high groundwater and a peaty surface).

4.7.8 The Natural England agricultural land classifications (PCF STAGE 1 EAR **Figure 2.11.4**) show much of the land within the study area to be Grade 3 (good to moderate) with land surrounding the River Tud to be Grade 4 (poor) and land north east of Easton to be non-agricultural. Land north of Hockering and east of North Tuddenham is indicated to be Grade 2 (very good).

Mining Resources

4.7.9 The study area does not lie within an area requiring a Coal Authority Licence. There is one active quarry within the study area, Costessey Sand and Gravel Quarry, although recent aerial photographs show it to be in the process of reclamation. A review of historical maps shows numerous historical sand pits, gravel pits and marl pits with brick fields and lime kilns within the study area. The BGS Geoindex indicates economically workable chalk deposits north of the A47 at west of Hall Farm and north west of Church Farm. There are also economically workable deposits of glaciofluvial and river terrace sand and gravel deposits along the River Tud and from Honingham eastwards.

4.7.10 It is considered likely that there will be considerable extractable mineral resources within the study area.

Hydrogeology

Aquifers and groundwater vulnerability

4.7.11 The EA has indicated that the study area lies within the Anglian River Basin Management Plan district. The groundwater body underlying the study area comprises the Broadland Rivers Chalk and Crag groundwater body which has been classified by the EA in 2015 as having an overall status of poor, the current quantitative quality of poor and the current chemical quality of poor. Further information on the groundwater and surface water regimes and their interconnectivity can be found within Section 2.9 Road Drainage and Water Environment.

4.7.12 The BGS indicates that the bedrock aquifer underlying the study area is the White Chalk Subgroup, a highly productive principal aquifer up to 450 m thick and yielding 50 to 100l/s from large diameter boreholes and up to 300l/s from adited systems. Groundwater flow occurs mainly in fissures and bedding planes and is largely a confined under pressure aquifer with artesian often seasonal flow recorded in a number of locations, particularly the Wensum valley.

4.7.13 Superficial aquifers west and south of Honingham comprise chalky boulder clay aquifers, which limit rainwater infiltration to the underlying chalk. It does not yield much water but small local supplies may be obtained from interbedded sands. East and north of Honingham the superficial aquifer comprise course glacial sands and gravels. They yield supplies of up to 1.9l/s although higher yields have been noted. To the east and north, the superficial aquifers are categorised as Secondary A aquifers while to the south of the A47, they are categorised as Secondary A and Secondary undifferentiated aquifers. The EA has classified the groundwater west of Honingham as being of a major aquifer with intermediate vulnerability. East of Honingham, it is classified as being of high vulnerability.

Groundwater Wells

4.7.14 The PCF STAGE 1 EA has indicated that there is a groundwater source protection zone classified as a 'Total catchment (Zone 3)' crossing the study area, west of the start of the North Tuddenham section of the dual carriageway as shown in **Appendix D Figure 2.9.3**. It predominantly runs in a north south direction between Zone 1 and Zone 2 zones to the south at Mattishall and to the north, north east of Elsing. The Zone 3 protection

zone also runs along the River Tud, south of the A47, before crossing at Honingham, continuing eastwards before becoming a Zone 2 protection zone, north of Easton.

4.7.15 The BGS indicates 37 water wells within the study area. However, the PCF STAGE 1 EA indicates there are only 15 licensed within the River Tud catchment area, being 11 groundwater abstractions and four surface water abstractions. It should be noted that an abstraction licence is not required if the abstraction is of $20m^3$ or less a day, provided the abstraction is part of a single operation or where the abstraction is from the same source at multiple points and the combined total of all abstractions is $20m^3$ or less a day.

Groundwater Dependent Terrestrial Ecosystems

4.7.16 Groundwater dependent terrestrial ecosystems (GWDTE) are wetlands which critically depend on groundwater flows and / or chemistries. The Water Framework Directive (WFD) sets out objectives for the water environment. These include the protection, enhancement and restoration of surface water, groundwater and water dependent protected areas and prevention of deterioration.

4.7.17 As stated within Section 4.5 Nature Conservation and Biodiversity, there are coastal and floodplain grazing marsh, lowland meadows and lowland fens BAP Priority Habitats (England). Although these areas are likely to be dependent on the River Tud, they may also be dependant to an extent on groundwater, for example, bog woodland, mires, swamps, wet grassland.

Contaminated Land

Historical Map Review

4.7.18 A review of historical OS maps has been undertaken which indicates that, although the area has not had a heavily developed history, there are indications of industrial land use. These comprise old gravel and sand pits, marl pits, mills with mill ponds and lades, brick works, fields and kilns, lime kilns, corn windmills and smithies. There was no heavy industry in the area until the 20th century when large scale mineral extraction activities were noted north and south of Easton and Hockering Wood was used to store bombs and other materials for the nearby USAAF / RAF Atterbridge air base. Current potentially contaminative land uses include, a timber yard, garages, vehicle salvage, livestock farms and mineral extractions.

Landfill Sites

4.7.19 The PCF STAGE 1 EA indicates that there is one historic landfill site, Mattishall, believed closed in the early 1970's adjacent to Whitford Bridge containing 'waste which remains largely unaltered once buried such as glass, concrete, bricks, tiles, soil and stones'. There is one current landfill site, east of Easton, Easton Inert Landfill Site 0.8km east of the study area described as a 'Landfill taking Non-Biodegradable Wastes (Environmental Permit Reference number EAEPR/EA/EPR/ YP3598NU/A001).

Petroleum Sites

4.7.20 There is one garage, Hockering Garage Services, within Hockering which has petroleum storage tanks, although there are likely to be more in the area, for example at vehicle salvage yards, or agricultural farms.

Key Constraints

4.7.21 The geological and soil features and their sensitivities are summarised below in **Table 4-9**. Those features with a medium or higher sensitivity are considered to be key constraints.

Table 4-9 Key Constraints Geology and Soils

Feature	Sensitivity
Designated sites	Not defined
Geomorphology	Low
Drift and solid geology	Low
Soils	Low to medium
Mineral Resources	Low / High
Hydrogeology	High
Contaminated land	Not defined

4.8 Noise and Vibration

Introduction

4.8.1 This chapter describes the noise environment, highlights the sensitive receptors and reports any constraints within the study area, known at the time of PCF Stage 1. It is informed by desk study and preliminary baseline noise measurements undertaken by Amey surveyors in summer 2016.

4.8.2 The realignment or improvement of an existing road has the potential to change the existing noise and vibration levels at sensitive receptors and therefore has the potential to cause either beneficial or adverse effects. These potential effects may arise either during construction (which are typically temporary in nature) or during operation (which are typically permanent in nature).

Baseline Conditions

Desk Study

4.8.3 As noted in the PCF STAGE 1 EAR, traffic volumes have been recorded at two locations relevant to the study area. Count point 80760 records an Annual Average Daily Flow (AADF) of traffic for 2015 of 23,182 vehicles. Count point 8702 records an AADF for 2015 of 20,675 vehicles. From these figures, it is likely that the A47 is the dominant source of noise in the area.

4.8.4 Traffic noise along the A47 at Tuddenham was mapped by Defra and can be viewed on the England Noise Map Viewer website which also shows the locations of NIA as described in the PCF STAGE 1 EAR. Daytime noise levels along the A47, within the study area are between 55dB to 75dB LAeq,16h.

4.8.5 Defra identified four Noise Important Areas (NIA) within the study area (shown on PCF STAGE 1 EAR Figure 2.8.1) due to the high levels of traffic. NIA are defined by Defra as areas where the 1% of the population affected by the highest noise levels in England reside. The NIA are as follows:

- ID 5200, on the A47 Hockering Village;
- ID 5201, on the A47 between Park Lane and Sandy Lane;
- ID 6287, on the A47 at Church House Lodge; and
- ID 5202, on the A47, Easton.

4.8.6 Noise sensitive receptors (NSR) are receptors that are potentially sensitive to noise and vibration. They include dwellings, hospitals, community facilities and designated sites (including Special Areas of Conservation (SAC), Special Protection Areas (SPA), Sites of

Special Scientific Interest (SSSI), Areas of Outstanding Natural Beauty (AONB), World Heritage Sites, Wetlands of International Importance (Ramsar Sites) and Public Rights of Way (PRoW)).

4.8.7 Sensitive receptors within the study area include all properties in Hockering and Honingham, properties in the west of Easton, the north of East Tuddenham, and any of the surrounding farms or other isolated buildings. This includes residential, community and commercial properties. From a review of aerial imagery and OS Maps it can be concluded that there are approximately 971 residential properties, 16 community facilities and 21 commercial or industrial facilities located within the study area (shown on PCF STAGE 1 EAR Figure 2.8.1). Highlighted sensitive receptors include:

- St. Peters Church of England Primary School, Easton. OFSTED lists the school as having 210 pupils;
- Hockering Church of England Primary School. OFSTED lists the school as having 50 pupils;
- Earthsea School, Berry's Lane, Honingham; a specialist school for victims of severe childhood trauma. The school has not been inspected since opening with no publicly available information on pupil numbers; although likely to be a low number;
- Earthsea House, Berry's Lane, Honingham; a residential children's home offering therapeutic care, treatment and education for children with behavioural and emotional problems for up to 47 children; and
- Ailwyn Hall Care Home, Berry's Lane, Honingham; a residential care home with 39 residents.

4.8.8 There are a number of wetland and ancient woodland areas within the study area, including Hockering Wood Site of Special Scientific Interest (SSSI) and the River Tud valley that may accommodate sensitive ecological receptors. The River Tud is a tributary of the River Wensum which is designated as a SSSI and Special Area of Conservation (SAC).

Field Survey

4.8.9 During the site visit in June 2016 short term noise measurements were undertaken at sample locations throughout the study area (shown in **Figure 2.8.1)**. The survey locations were chosen based on their proximity to sensitive receptors as well as within NIA. It was observed that the predominant noise source within the study area is road traffic noise from the A47. Further away from the A47 carriageway, natural sounds become more dominant such as birdsong and the natural wind. Other noise sources within the area include:

- Agricultural activity in the surrounding arable fields;
- Industrial sites (the timber yard on Mill Lane Mooney Demolition, Thomson's Scrap Yard);
- Commercial properties such as Fresh Direct; and
- Livestock sites (Banham poultry farm).

4.8.10 The results of the noise survey described in the PCF STAGE 1 EAR show that noise levels are highest at the monitoring points close to the A47. Noise levels generally decrease with distance from the A47, however road traffic on local roads, particularly in the villages of Hockering, Honingham, Easton and Mattishall generates noise levels of up to 61 dB $L_{Aeq,\ 15\ min.}$ At several survey locations the A47 is not audible, for example in the village of Mattishall and areas surrounding Berry's Lane, Wood Lane and Mill Lane within Honingham village. The lowest noise levels measured were found in the arable farmland off Hall Lane.

Key Constraints and Their Sensitivities

4.8.11 Sensitive receptors within the study area include all properties in Hockering and Honningham, properties in the west of Easton, the north of East Tuddenham and any of the surrounding farms and isolated buildings. This includes residential, community and commercial properties, which are considered to be of high sensitivity to changes in noise levels.

4.8.12 The four Noise Action Planning Important Areas will require consideration. The presence of NIA within the study area is a constraint to all dualling options. Even if the dualling has no significant impacts on noise levels, the presence of NIA means that mitigation must be considered to reduce the noise levels at these areas. However, mitigation will only be included within any scheme design if it provides value for money.

4.8.13 The residential centres of Easton, Honingham and Hockering are currently affected by noise from the A47. Any change in the road alignment will change the groups and numbers of residents affected, with properties on the outer edges of the settlements more likely to be affected. Moving the road alignment can have beneficial effects as well as adverse effects with properties currently located close to the existing A47 experiencing a reduction in noise levels if the road were to move further away.

4.9 People and Communities

Introduction

4.9.1 The aim of this chapter is to identify the key features and constrains in the study area in relation to people and communities including vehicle travellers, non-motorised users (pedestrians, equestrians and cyclists) and land use (private property, community land, development land, agricultural land). It is informed by desk study and a site walkover undertaken by Amey surveyors in summer 2016.

Baseline Conditions

Pedestrians, Cyclists, Equestrians and Community Effects

Public Rights of Way

4.9.2 PRoW are common within the study area and form a network in the landscape surrounding the existing A47 (shown in PCF STAGE 1 EAR **Figure 2.10.1)**. They are generally well signposted and well-used, with noticeboards observed encouraging their use. The routes appear to perform an important recreational purpose for residents and provide an alternative to travelling along often busy roads, in close proximity to traffic.

Cycle Routes

4.9.3 The AADF indicate that only three cyclists per day use the A47 itself. No specifically designated cycle routes were identified within the study area, however during a site visit conducted in June 2016, a newly constructed cycle route was observed running east-west along the northern edge of the A47 from the western edge of the study area to the edge of Hockering. No users were observed during the site survey.

Equestrians

4.9.4 Although no bridleways were identified from local mapping data, on a site visit conducted in June 2016 bridleways were identified to the south and east of Easton, making use of Dereham Road south east of St Peter's Church, Marlingford Road and a number of small

farm tracks. Considering the rural aspect of the study area, it is considered likely that there will be equestrians in the area, utilising these paths.

Footpaths

4.9.5 A footway runs along almost the entire length of the northern carriageway of the A47 within the study area. Where a footway is in place, it is largely over-grown as a result of poor maintenance and likely low levels of use. Non-Motorised Users (NMU) using the route are very close to fast-moving traffic and subject to high noise levels. No formal crossing points have been identified on the A47 within the study area and waiting times are likely to be significant. There is very little provision of footways on side roads within the study area, which carry notable volumes of traffic, making vehicle and NMU interactions frequent.

4.9.6 Footways within the villages of Honingham, Hockering and Easton are generally of good quality and higher amenity. Community facilities are concentrated within these residential areas and footways are likely to be well used as a means of accessing them. Hockering and Easton both contain primary schools meaning that vulnerable NMU may be more prevalent within these villages (where the schools are comfortably within walking distance for many properties within their catchments).

4.9.7 Census data indicates that the proportion of retired people and people over the age of 45 are above average within the study area, increasing the potential for vulnerable users of local NMU infrastructure and local community facilities.

Community Facilities and Community Land

4.9.8 There are a significant number of community facilities within the study area, with most facilities concentrated within the most populated areas such as Honingham, Hockering and Easton as shown in PCF STAGE 1 EAR **2.10.1**. These include schools, care homes, community buildings, shops and services, places of worship and recreational facilities.

Land Use

4.9.9 The majority of land within the study area is used for commercial agriculture. There are also a large number of residential properties. Commercial businesses (outside of agriculture) are also common and areas of community land or open space are numerous. Notable additional features include the River Tud which meanders to the south of the A47. Woodland is also common and the area is highly biodiverse, featuring a large number of ponds.

Private Property

4.9.10 Private properties are concentrated within the villages of East Tuddenham, Hockering, Honingham and Easton, although individual properties are also scattered throughout the study area. There are approximately 971 residential properties within the study area.

Community Land

4.9.11 Areas of community land are common within the study area and include places of worship and associated grounds, schools and playing fields and areas which could be considered to be open space such as allotments or village greens, where exchange land may be required if land is lost.

Development Land

4.9.12 Developments of particular note include:

- Planning application for the construction of approximately 900 dwellings to the east south and west of Easton, incorporating plans for an extended primary school, a new community centre and children's play facilities. Work is due to begin towards the end of 2016, although planning permission has not yet been granted.
- An EIA screening request was submitted in 2009 for the construction of a 84,530m^2 commercial food production facility incorporating a livestock market and veterinary services, as well as space for educational facilities and distribution and marketing services.
- Small scale housing developments of up to 20 houses are relatively common, for example an area of land to the north of Hockering, previously an area of recreational space, is currently for sale with planning permission for 18 residential properties.

Agricultural Land

4.9.13 Agriculture dominates much of the landscape within the study area. Agricultural activities relate predominantly to the cultivation of a wide range of crops, including vegetables and cereals. However, during a site visit in June 2016 frequent observations were made of land being used for pastoral agriculture.

4.9.14 As shown in PCF STAGE 1 EAR **Figure 2.11.4** the quality of agricultural land varies between Natural England Land Classification Grade 4 (poor) to Grade 2 (very good) within the study area with two unclassified areas to the north of Easton and to the north of Honingham. Land close to the River Tud is largely categorised as Grade 4 while Grade 2 land is largely situated to the north and west of Hockering. Much of the remaining land is categorised as Grade 3 (good to moderate).

4.9.15 There are also a large number of Environmental Stewardship Agreements within the study area with the majority of the agricultural land within the study area covered by such an agreement. The majority of these are entry level plus a higher level of stewardship. A particular concentration of such agreements has been identified around Honingham.

4.9.16 The majority of fields are accessed via side roads and a network of tracks. Very few examples of access directly from the A47 were observed during a site visit.

Vehicle Travellers

Driver Stress

4.9.17 Within the study area the A47 is an extremely busy single carriageway road. The speed limit is 60mph and the AADF at the closest count point was measured in 2015 to be 20,675. Given the surrounding land use, and the fact that the road is a key link between major conurbations, heavy goods vehicles and large agricultural vehicles are common. The prevalence of these slow moving vehicles leads to driver frustration, in turn leading at times, to unsafe overtaking manoeuvres. This takes place in the context of a flat landscape which substantially reduces clear sight lines.

4.9.18 Fast-moving traffic, in significant volumes, makes emerging from junctions very difficult; leading to driver frustration. While conducting a site survey in June 2016, reverse priority was also observed with vehicles stopped within the central refuge allowing vehicles from side roads to pull out. As a result of the A47 acting as a key route for road users moving to and from Norwich, side roads are also very busy. Visibility is highly restricted on many of these as a result of high verges and roads often being in cutting. Relatively frequent interactions with NMU exacerbate the perceived danger on using such roads, adding to the potential for driver stress.

4.9.19 Within villages driver stress is likely to be much lower, as a result of lower speeds, limited interactions with NMU and lower levels of congestion.

View from the Road

4.9.20 Within the study area, the view from the A47 is mostly obscured, largely as a result of mature verge vegetation. Where gaps in this vegetation do allow drivers to see beyond the highway boundary (most noticeably to the east of Hockering and north of Easton), views extend further to the north than the south as a result of the gently sloping topography of the area. Such views are predominantly of the surrounding arable agricultural land, interspersed with frequent wooded areas. Individual features visible to road users include St Andrew's Church and the tower belonging to St Michael's Church.

Key Constraints

4.9.21 One of the key constraints within the study area is the movement of NMU. There are a large number of well-used PRoW, while side roads and footways within villages which provide an important means of access for the local population using community facilities. The nature of some of these facilities (such as the Earthsea School, Hockering Primary School and various areas of open space) and the make-up of the local population suggest that such routes may also be used by vulnerable groups. Therefore, the sensitivity of the local NMU network is considered to be high.

4.9.22 In terms of land use, the key constraints within the study area are represented in the need to conserve high quality farmland within the study area. Grade 2 land is considered to be of high sensitivity while areas of Grade 3 land are deemed to be of medium sensitivity.

4.9.23 An additional notable land use constraint is development land. There are numerous greenfield development sites designated for residential of commercial projects of various sizes. As a result of this variation in scale, they also vary from a regional to local importance and therefore medium to low sensitivity.

4.9.24 Key areas of community land are those likely to be used by vulnerable groups or frequently by a significant number of people. Such areas of land are common within the study area and include recreational areas listed in **Table 4.8.1**. Such spaces should be considered to have a high sensitivity.

4.9.25 Similarly, where an area of community space is lost, this will represent a notable constraint through the need to provide an area of exchange land; equally advantageous to its users. Also of note, is the potential for any improvement of the A47 within the study area to benefit road users, both in terms of driver stress and views from the road.

4.10 Road Drainage and Water Environment

Introduction

4.10.1 The purpose of this section is to describe the road drainage and water environment within the study area, known at the time of PCF Stage 1, to highlight the sensitive receptors and to identify any constraints associated with the scheme.

Baseline Conditions

Topography

4.10.2 The study area consists of extremely flat land with few elevations rising 100m above sea level. The area does not contain any major hills, mountains, rocky surface features or deep valleys.

Surface Water Features/Abstractions

4.10.3 The study area lies within the Anglian River Basin District, the Broadland Rivers Management Catchment and the Wensum operational catchment, as designated under the Anglian River Basin Management Plan (RBMP) and as shown in **Appendix D Figure 2.9.2**. A small section of the study area at Easton also lies within the boundary of the Yare operational catchment.

River Tud

4.10.4 The River Tud is the only major watercourse which flows within the study area as shown in **Appendix D Figure 2.9.1**. This watercourse flows to the south of the A47 in an easterly direction, before crossing the carriageway at Honingham. The watercourse then continues eastwards north of the A47 before joining the River Wensum. Along its course through the study area, the river passes a number of residential properties, particularly at Rotten Row, Berry Hall, Honingham and Church Farm. The most recent cycle of the 2015 Anglian River Basin Management Plan classified the river as having an overall status of moderate, ecological potential of moderate and a chemical status of good.

4.10.5 The RBMP data for the River Tud classifies the watercourse as heavily modified as it is managed for water supply, flood management and navigation. OS mapping and aerial imagery however, shows that the river flows within its floodplain throughout the study area and maintains its meanders for the majority of its course. A number of modified sections are however located within the study area; notably within the village of Honingham where a watermill was previously located and to the north east of Honingham where a former flood storage area exists adjacent to Hall Farm.

4.10.6 It should be noted that the A47 crosses the River Tud within the study area at Honingham.

River Wensum

4.10.7 The River Tud flows into the River Wensum at approximate NGR TG 19710 10828. This lies to the east of the study area and to the north west of Norwich. The Wensum is a classified as a heavily modified watercourse and flows eastwards through the centre of Norwich before flowing into the River Yare. The most recent cycle of the Anglian RBMP classified the river as having an overall status of moderate, ecological potential of moderate and a chemical status of good.

4.10.8 The River Wensum is designated as a SAC for its Habitats Directive Annex I habitats and Annex II species. It is also designated as a SSSI due to its condition as an enriched, calcareous lowland river which hosts a large number of plant and invertebrate species.

River Yare

4.10.9 A small section of the River Yare catchment falls within 600m of the A47 at Easton. The River Yare is classified as a heavily modified watercourse with an overall status of moderate, ecological potential of moderate and a chemical quality of good.

Aquatic Ecology

4.10.10 Aquatic ecology is considered under section 4.5 Nature Conservation and Biodiversity.

Groundwater Features/Abstractions

4.10.11 The study area lies within the White Chalk subgroup which is classified as a highly productive aquifer. The British Geological Survey describes it as a principal aquifer in the UK up to 450m thick and yielding 50 to 100 L/sec from large diameter boreholes and up

to 300 L/sec from adited systems. This is classified as hard to very hard, good quality water.

4.10.12 The Environment Agency groundwater map reveals that the study area lies within the Broadland Rivers Chalk and Crag groundwater body. This was classified in 2015 as having an overall status of poor, a quantitative quality of poor and a chemical status of poor.

4.10.13 The entire study area is covered by a Nitrate Vulnerable Zone (NVZ) for surface water, with an NVZ for groundwater covering an area north from Church Farm. NVZ are areas where land drains into rivers polluted by high nitrate levels, or there is a high risk of nitrate runoff into the hydrological system.

4.10.14 The PCF STAGE 1 EA has indicated that there is a groundwater source protection zone classified as a 'Total catchment' (Zone 3) crossing the study area, within the western extent of the study area. It predominantly runs in a north south direction outwith the study area, yet also runs along the River Tud, south of the A47 within the study area, before crossing the carriageway at Honingham, continuing eastwards and becoming a Zone 2 protection zone to the north of Easton.

4.10.15 A review of the PCF Stage 1 EA Groundwater Vulnerability Map indicates that:

- The study area contains two major aquifers within the following geological layers; Lewes Nodular Chalk Formation, Seaford Chalk Formation, Culver Chalk Formation. According to the EA map, the aquifer experiences high groundwater vulnerability and the soils overlying it are classified as H1- soils that readily transmit liquid discharges because they are either shallow or susceptible to rapid by pass flow directly to rock, gravel or groundwater; and
- The other aquifer experiences intermediate groundwater vulnerability and the soils overlying it are classified as l1; soils which have the potential to transmit a wide range of pollutants.

4.10.16 The British Geological Survey's Geoindex reveals that there are a number of water wells within the study area, the closest of which lies approximately 30m to the north of the A47 at Church Farm. In addition, there are 15 abstraction points within the Tud catchment, eleven of which are from groundwater sources.

Flooding

4.10.17 The land surrounding the River Tud is located within Flood Zone 2 and 3, as shown in **Appendix D Figure 2.9.1**. Flood Zone 2 consists of areas with up to a 0.1 per cent (1 in 1000) chance of occurring each year. Flood Zone 3 comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. There are a number of residential properties located within Flood Zones 2 and 3 including properties at Rotten Row, Berry Hall and Honingham.

4.10.18 A review of the EA Risk of Flooding from Surface Water Map indicates that there are areas of surface water flooding around Hall Farm, Church Farm, Rotten Row, east of Hockering where the Street joins the A47 and south of Kimblewick Farm.

4.10.19 The study area is included within a flood warning area and a flood alert area. Fluvial flood defences run along both banks of the River Tud. There are no flood storage areas within the study area.

4.10.20 The Highways Authority Drainage Data Management System shows historic flooding events see section 3.7.9.

Key Constraints

4.10.21 The sensitivity of the receiving surface water environment (Rivers Tud, Wensum and Yare) is high. While the River Tud is not designated and currently holds an overall WFD status of poor, surface water features within the area are interlinked and the River Tud later flows into the River Wensum which is designated as a SAC and SSSI. Any development which would entail work to the existing, or construction of a new, structure is likely to have some influence on surface water in either the long or short term, affecting flow patterns, transportation processes and aquatic and riparian ecology.

4.10.22 Groundwater for the area is classified as medium sensitivity and will likely present further constraints to development. The study area lies within the Broadland Chalk and Crag groundwater body which currently holds a WFD status of poor. There are however, eleven groundwater abstraction points throughout the Tud catchment, suggesting that groundwater is of some value to the area.

4.10.23 The River Tud is covered by Flood Zones 2 and 3 for planning purposes and a number of residential properties lie within these areas, particularly at Rotten Row, Berry Hall and Honningham. Regional flood protection/alleviation infrastructure represents a significant barrier to development. Flood risk for affected properties must be maintained or improved. Areas of surface water flooding are present at Hall Farm, Church Farm, Rotten Row, east of Hockering where the Street joins the A47 and south of Kimblewick Farm. As a result, sensitivity of flooding within the study area is considered to be medium, forming a potential constraint to the scheme.

5 Accessibility & Integration

5.1 Existing NMU Provision

5.1.1 As already noted in Section 4.9.2 and 4.9.7 above, Public Rights of Way (PRoW) are common within the study area and form a network in the landscape surrounding the existing A47 corridor. The routes appear to perform an important recreational purpose for residents and provide an alternative to travelling along often busy roads, in close proximity to traffic.

5.1.2 There is little provision for NMUs on the A47 itself. Existing cycle use is very low and there is no designated cycle route along the A47. There are bridleways in the surrounding countryside and it is likely that some local roads such as Dereham Road, Marlingford Road and smaller farm tracks are used by equestrians.

5.1.3 No formal crossing points have been identified on the A47 within the study area. However, at the western end of the study corridor there is an informal crossing with a central refuge, dropped kerbs and buff tactile paving where a footway adjacent to Mattishall Lane emerges to run east along the south side of the A47 before crossing into The Street and then into Hockering. The footway continues through Hockering and on to where The Street re-emerges onto the A47 eastbound. From this point eastwards, a footway runs along almost the entire length of the northern carriageway of the A47 within the study area, largely over-grown as a result of poor maintenance and likely low levels of use by pedestrians.

5.1.4 A PRoW (Hockering FP7) runs from Hall Lane south of the river Tud, crosses the river on a footbridge and then follows a rough track to the rear of the sewage works south of Hockering. It emerges onto the A47 opposite the A47 eastern junction with The Street. Although there is a finger post marking this path to the south of the A47 there is no sign indicating that it crosses the A47, nor is there any provision of a crossing facility. However, the Ordnance Survey map indicates that the PRoW does cross here and continues via The Street and Rectory Road up to the edge of Hockering Wood.

5.1.5 There is a second informal crossing of the A47 towards the eastern end of the study corridor near Honingham just to the west of the A47 roundabout junction with Norwich Road. A footway in the northern verge of Norwich Road crosses the A47 with dropped kerbs in the nearside kerbs and in the splitter island of the roundabout. It then continues in the northern verge of the A47. There is no tactile paving provided at this crossing. East of this crossing the footway is in better condition and allows pedestrian access to St Andrew's Church and other properties fronting the A47.

5.1.6 There is very little provision of footways on the side roads around the A47 corridor although side roads and footways within villages provide an important means of access for the local population.

5.2 Existing Access to Transport Provision

Rail & Bus Services

5.2.1 Rail into East Anglia operates through Cambridge and Ely where it then branches off westwards towards Peterborough, northwards towards Kings Lynn or eastwards towards Norwich, Great Yarmouth and Lowestoft. The services are currently operated by Abellio Greater Anglia, East Midlands and Thameslink Great Northern.

5.2.2 There are no direct train services parallel to the A47 between Peterborough and Norwich. Rail journeys between these two locations are made via Ely. Train services between Ely and King's Lynn are run by Abellio Greater Anglia and Thameslink Great Northern.

5.2.3 The closest stations to the section of the A47 are Wymondham approximately 8 miles south of Hockering and Dereham Station which is 2.5 miles to the west of Hockering.

5.2.4 Wymondham station is served by local services operated by East Midlands Trains and Abellio Greater Anglia on the Breckland Line (17.3 km) west of Norwich to Peterborough and Cambridge. Wymondham station is also the junction for the Mid-Norfolk Railway.

5.2.5 Dereham station was reopened in 1997 by the Mid-Norfolk Railway Preservation Trust who since then have gradually reopened the line to Wymondham. Work is in progress in reopening the line northwards from Dereham towards County School and Fakenham. National Rail passenger services do not operate from the station.

5.2.6 There are a number of bus services that operate end to end along the corridor. First Group operates the Excel X1 service along the A47/A12 corridor connecting Peterborough, King's Lynn, Norwich, Great Yarmouth and Lowestoft.

5.2.7 There are currently timetabled stops for the route in Hockering and Easton the service is approximately twice hourly through the day and takes around 38 minutes from Hockering to Norwich bus station.

5.3 Existing Severance

5.3.1 Community severance can be defined as the separation of residents from facilities and services they use within their community caused by substantial changes in transport infrastructure or by changes in traffic flows. Severance will only be an issue where either vehicle flows are significant enough to significantly impede pedestrian movement or where infrastructure presents a physical barrier to movement.

5.3.2 The existing route of the A47 between North Tuddenham and Easton and the traffic using it creates a line of severance for both local motorised and non-motorised users in the area.

5.3.3 In and around Hockering residents of properties located to the south of the A47 have to negotiate crossing the A47 to access the facilities within Hockering to the north of the A47.

5.3.4 In and around Honingham the residents living in properties to the north of the A47 have to negotiate crossing the A47 to access the facilities within Honingham and to the south.

5.3.5 There are vehicular routes across the A47 via existing side roads and cross roads. With current levels of traffic along the A47 in the area these vehicle manoeuvres can be difficult to make comfortably.

5.4 Integration

Transport Interchange

5.4.1 There are no passenger or freight interchanges located in the immediate vicinity of the North Tuddenham to Easton section of the A47.

Land-Use Policy

5.4.2 The North Tuddenham to Easton section of the A47 passes through Breckland, Broadland and South Norfolk District Councils. The land in and around the Scheme is predominantly rural in nature and is dominated by agricultural use. See section 2.3 for further detail on the District Councils' Local Plans.

6 Maintenance

6.1 Introduction

6.1.1 This chapter focusses on the existing approach to maintenance of the A47 trunk road and the highways within the scheme study area.

6.1.2 At the time of PCF Stage 1, the existing highway network along the A47/A12 corridor was maintained on behalf of Highways England as part of the Area 6 Asset Support Contract (ASC) delivered by Amey. The highway was maintained, at the time in accordance with the requirements of their contract as set out in the Asset Maintenance and Operational Requirements (AMOR) in the Maintenance Requirements Plan. This details Highways England's mandatory requirements for the delivery of routine maintenance and operational services.

6.1.3 The Highway Authority for the local side roads connecting with the Tuddenham to Easton section of the A47 trunk road is Norfolk County Council and the roads are currently maintained by Norfolk County Council's Highways Department.

6.1.4 Norfolk County Council's approach to their highway asset and management is documented in "Norfolk's Transport Asset Management Plan 2016/17 – 2020/21" (TAMP). The purpose of this document is to set out an approach for Norfolk County Council for the management of its transport and highway assets. The Transport Asset Management Plan (TAMP) pulls together all the relevant strategies, goals, objectives, plans and methods in use within the County Council and the Community Environment Services (CES) department for managing the transport and highway assets in the County. In April 2017, Kier took over the Area 6 maintenance contract from Amey.

6.1.5 Norfolk County Councils TAMP, contains details of Norfolk's routine highway maintenance regime and any targeted capital maintenance projects.

6.2 Asset Condition

6.2.1 The asset condition data was taken at PCF Stage 1 from the latest information available at the time, using Highways England databases (HAPMS) and information from the local ASC Area 6 Contractor.

CHART Referencing

6.2.2 The trunk road network is divided up for maintenance referencing into a series of lengths. These chart section lengths are identified on the carriageway by a series of physical markers known as CHART nodes, the position of the nodes and sections are then referenced on OS plans. This allows maintenance surveys to easily reference data to actual sections of the highway.

Available Data on Asset Condition

6.2.3 The Area 6 ASC have provided digital survey data which they held (at PCF Stage 1) for the section of the A47. Below are examples of some of the data held:

- Surface Skid Resistance
- Pavement road layer information
- Defelctograph survey information – for analysis of pavement residual life

- TRACS

6.2.4 In addition to digital copies of numerical data being available. At the time of PCF Stage 1, the Area 6 ASC team had developed an Asset Manager visualisation and analysis tool which allowed the digital data to be visualised and analysed as a series of visualised layers of asset information which could be viewed as overlays to Google mapping.

6.2.5 Over the years the road pavement over the Scheme length has been subject to numerous maintenance interventions to maintain the road in a safe and serviceable condition. The pavement over parts of the scheme length were resurfaced in 2006 with more recent construction of the roundabout at Honingham and resurfacing of the roundabout at Easton.

6.2.6 The Asset Manager analysis shows that the pavement is in a reasonable condition. There are areas of the pavement construction which require resurfacing and these areas correspond to the areas of road covered by the maintenance interventions detailed in section 6.3.3 below.

6.2.7 The drainage in the area is subject to ongoing routine maintenance to ensure ditches and over the edge drainage systems remain unblocked by vegetation and debris. Specific maintenance works to the highway drainage system at Honingham and Easton have been identified see section 6.3.3.

6.2.8 Fencing and lighting provisions need to be investigated further in future stages of the current programme.

6.3 Planned Maintenance

6.3.1 Planned maintenance is carried out by the local ASC6 Contractor for the main A47 trunk roads.

6.3.2 Generally the ASC6 Contractor on behalf of Highways England carries out the following annual maintenance activities on the A47 Trunk Road

- Cut back foliage to maintain visibilities
- Cut / spray around fixed furniture
- Clear gullies, piped grips, catchpits
- Clean signs
- Structures maintenance

6.3.3 At the time of PCF Stage 1, there were the following planned maintenance activities in the area of the Scheme which were identified in the Area 6 forward plan

- A47 Honingham and Easton (Drainage) Local Drainage renewals, planned 2017/18
- A47 Easton East Bound Resurfacing and Patching, planned 2016/17
- A47 Hockering East Bound and West Bound Resurfacing, planned 2016/17

6.3.4 NCC have a routine maintenance regime for the side roads in the area which is included in the NCC TAMP document.

6.3.5 There are currently no targeted capital maintenance works in the area of the Scheme, within NCC's TAMP.

6.3.6 The planned resurfacing works above in Easton and Honingham were undertaken in Spring 2017.

6.4 Strategic Diversion Routes

6.4.1 Strategic diversion routes for works requiring closures along the A47 trunk road were provided during PCF Stage 1 by the Area 6 ASC and are included in Appendix G.

7 Planning Factors

7.1 Introduction

7.1.1 There were a number of committed developments, planning applications and Local Plan allocations which were identified in PCF Stage 0, which were likely to have an impact on the traffic in the area of the scheme these were reviewed for inclusion in the NATS modelling (see Chapter 28 for details). Following detailed discussions with the planning authorities in the area, relevant applications were taken into consideration in the transportation modelling and a detailed uncertainty log was produced. Details can be found in the Local Model Validation Report and the Traffic Forecasting Report.

7.1.2 A number of specific key development proposals which could impact the scheme development were identified during PCF Stage 1, these are outlined in the sections below

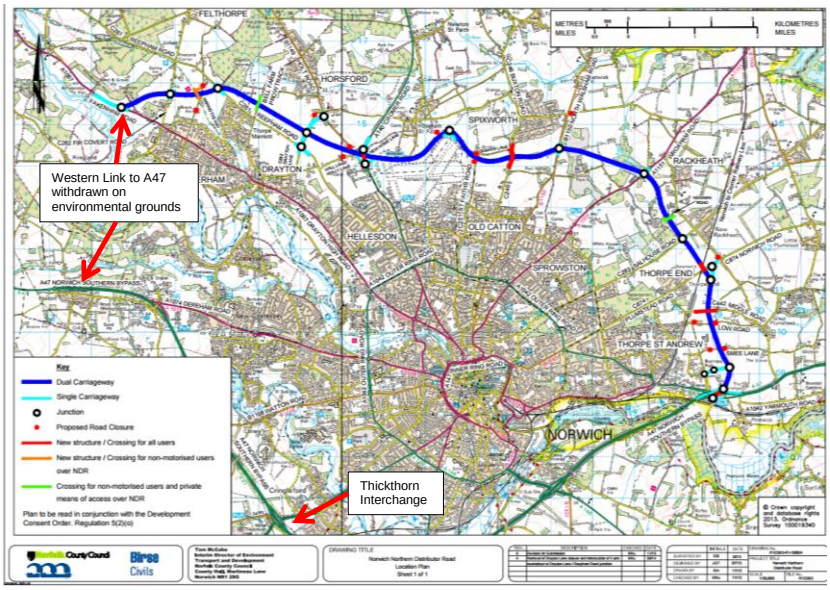
7.2 Norwich Northern Distributor Road

7.2.1 The land surrounding the section of the A47 North Tuddenham to Easton is predominantly agricultural and residential, there are developer led plans to develop areas around the Easton end of the scheme: Section 3.6 describes a detailed account of the land use of the area within the section of existing A47 single carriageway between Tuddenham and Easton.

7.2.2 In June 2015, Norfolk County Council obtained approval through the DCO process for the Norwich Northern Distributor Road (NDR). The NDR is a 20km dual carriageway road planned to run from the A47 at Postwick, east of Norwich, to the A1067 north of Taverham, as shown in **Figure 7-1**. This provides a link road around the north and east sides of Norwich linking to the A47 at the east of Norwich. Construction on various sections of the NDR is currently ongoing with construction due to be completed in 2018.

7.2.3 Connecting the NDR between the A47 and A1067 Fakenham Road was considered to potentially complete the north western section of the distributor road. However, it was decided not to promote a link across the Wensum Valley on environmental grounds due to its status as a Special Area of Conservation and because it is protected due to its international importance for biodiversity conservation. Therefore, the main purpose of the NDR is to distribute traffic around the north side of Norwich and it is not intended to act as a bypass.

Figure 7-1 – Norwich Northern Distributor Road

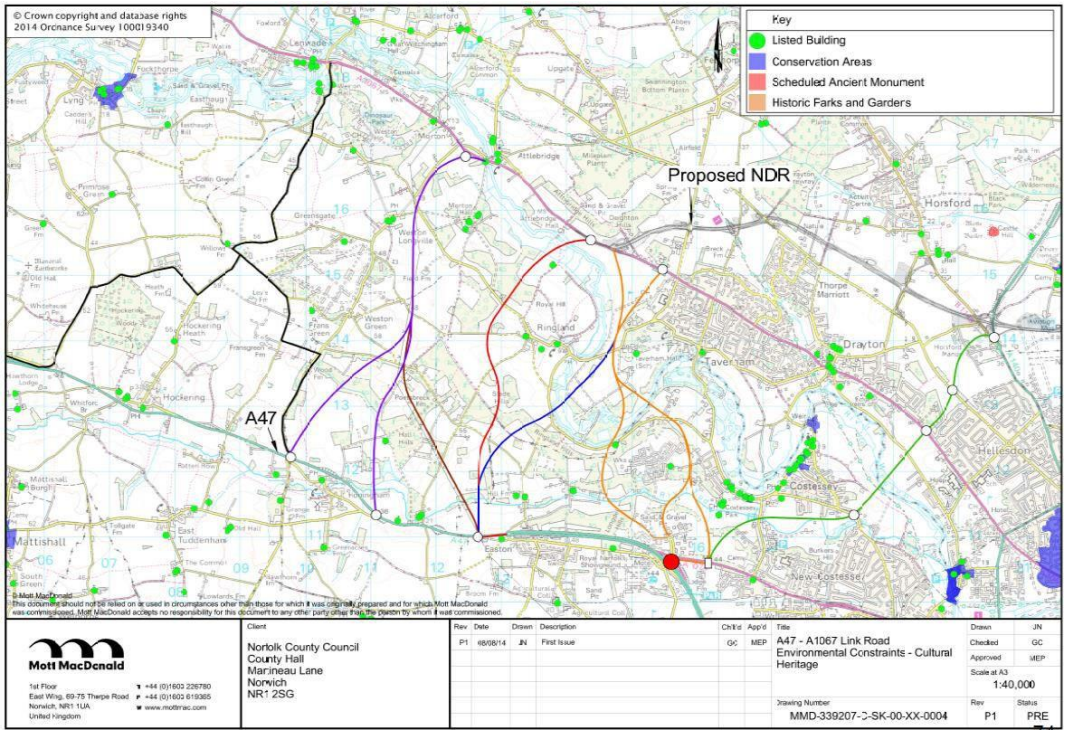


7.3 A47-A1067 Western Link Road (WLR)

7.3.1 As described above in section 7.1.3 and 7.1.4 Norfolk County Council obtained approval through the DCO process for the Norwich Northern Distributor Road (NDR). The road when completed will provide a link road around the north and east sides of Norwich linking to the A47 to the east of Norwich.

7.3.2 There is also a scheme being developed by NCC, which is currently in options feasibility stage, to provide a link to potentially complete the north western section of the distributor road. The western link would potentially join to the A47 within the Tuddenham to Easton scheme or close to the limits of the scheme, see **Figure 7-2.**

Figure 7-2 – Location Plan A1067 to A47 Route Options (source: 2014 Scoping Study)



7.3.3 The Norwich Western Link Project was taken to the Environment Development and Transport Committee of Norfolk County Council on the 8th of July 2016 following a report undertaken by Mouchel to appraise the potential solutions to the transport issues in the western quadrant of Norwich.

> *"A tentative programme envisages some preliminary work prior to the opening of the NDR and work required after the NDR is opened and following a period of monitoring. This would also need to take regard of A47 improvements being progressed by Highways England (with construction currently suggested to start in 2020), the Food Hub proposal, and the update of the Greater Norwich Local Plan (GNLP). This report therefore recommends options to be progressed in the short-term over the next 18 months, in 6 month phases, with appropriate "review gateways" before further work is progressed."*

7.3.4 The report details that for a scheme to be delivered, a major scheme business case would need to be prepared for submission to either the New Anglia Local Transport Body or to the DfT. It would need to set out a compelling case for the scheme and must provide evidence that:

- There is a real problem to be solved.
- The scheme is part of a coherent wider strategy.
- A full range of options has been considered, and the best scheme has been selected.
- The scheme represents high or very high value for money.
- The scheme is feasible and affordable, and can be delivered within the planned timescale.

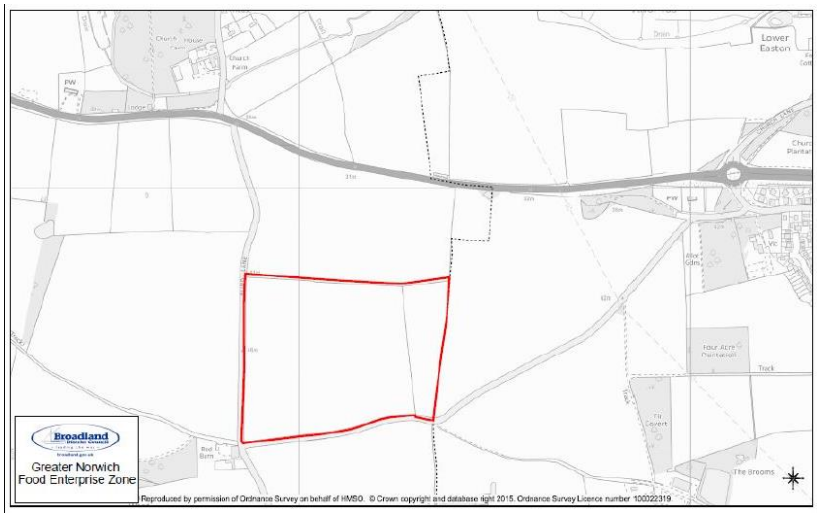
7.3.5 The project team maintained a close liaison with NCC Technical Officers throughout PCF Stage 1 (see section 19), this will continue through the PCF Stages to ensure that progress on the WLR and any implications and effects on the A47 North Tuddenham to Easton Scheme can be assessed as development of the scheme progresses.

7.4 Greater Norwich Food Enterprise Zone (GNFEZ) Local Development Order (LDO)

7.4.1 South Norfolk and Broadland District Councils have adopted a “Supplementary Planning Document: Guidance for the delivery of a Food and Agriculture Hub for Broadland and South Norfolk – July 2014” (SPD). The SPD sets out the main considerations that will apply to any proposal for a food and agricultural sector "hub" in the Broadland district and South Norfolk local planning authority areas.

7.4.2 Broadland District Council have received an application for a Local Development Order (LDO) for a plot of land to the north west of Honingham to the south of the existing A47 see GNFEZ LDO application location plan in **Figure 7-3** below.

Figure 7-3 – Location Plan GNFEZ LDO



7.4.3 At PCF Stage 1 the application was being considered by Broadland District Council.

8 Other Relevant Factors

8.1 Previous relevant studies and reports

8.1.1 During PCF Stage 0 and 1, a number of previous studies and strategy reports were identified as potentially relevant to the scheme, some of which have been used to inform the national and local policy covered in Chapter 2. Those with particular relevance to the scheme are listed below.

Central Government DfT and Highways England

- East of England Route Strategy Evidence Report (Highways Agency, April 2014)
- East of England Route Strategy Evidence Report Technical Annex (Highways Agency, April 2014)
- A47/A12 Study (Leaflet Highways Agency / DfT March 2015)
- A47 – A12 CORRIDOR Feasibility Study Summary (DfT March 2015)
- A47/A12 Corridor Feasibility Study (February 2015, published by DfT March 2015)
- Norwich to Great Yarmouth Roads based Study (2001)
- Highways Agency Area 6 Quarterly Safety Report (Q4 2014), Skanska, January 2014

Local Authority

- A47 Dualling: Economic Assessment Methodology (July 2014 Report by Mouchel for Norfolk County Council)
- A47 Wider Economic Benefits Executive Summary (August 2012, Norfolk County Council)
- Norwich Area Transport Strategy (2006, implementation plan updated 2013)
- Norfolk Infrastructure Plan (version 1, 2012, Norfolk County Council)
- Norfolk Rural Development Strategy 2013-2020
- Delivering Economic Growth in Norfolk', The strategic role for Norfolk County Council 2012 – 2017
- Breckland District-Wide Infrastructure Needs, Funding and Delivery Study Final Report, 2009
- A47 –A1067 Western Link Road Scoping Study (September 2014 Norfolk County Council)

Local Enterprise Partnership

- New Anglia Strategic Economic Plan (2014, NEWANGLIA Local Enterprise Partnership for Norfolk and Suffolk)
- A47 Strategic Route Gateway to Growth (2014 published by A47 Alliance by NEWANGLIA Local Enterprise Partnership for Norfolk and Suffolk)

9 Description of Route Options

9.1 Route Option Development

9.1.1 The feasibility work undertaken in PCF Stage 0 identified that dualling the section of the A47 between North Tuddenham and Easton represented a feasible potential solution to solve the identified transportation problem. As part of the PCF Stage 0 work, 3 broad solutions were reviewed to ensure that dualling of the route represented a suitable and economically cost effective solution. The broad solutions considered were

- Dualling the A47 online
- Dualling the A47 offline to the north and
- Dualling the A47 offline to the south

9.1.2 During PCF Stage1 these broad solutions were used as a basis to develop a number of more defined potential route options. At the start of the PCF Stage 1 Option identification stage an optioneering exercise was undertaken to identify potential route options for the dualling.

9.1.3 The desk study work in PCF Stage 0 identified a number of potential key constraints and features within the study area, these were used as the starting point for a route identification optioneering workshop held on the 1st February 2016. The workshop was attended by a number of engineering, environmental and transportation technical staff.

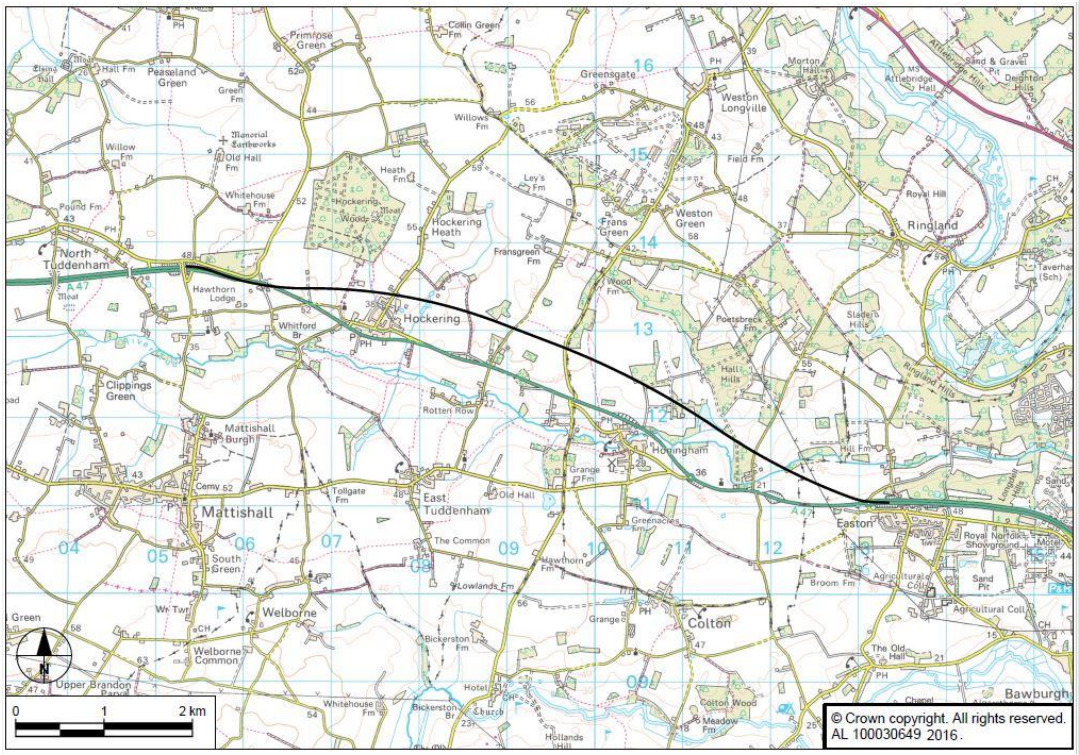
9.1.4 Using large scale printed plans of the study area the team hand drew potential routes for the dualling. Following the workshop the hand drawn sketches were developed into a number of initial route options. These route options were drawn out as high level engineering layouts which would potentially meet highway alignment layout standards, these layouts are included in Appendix H along with constraints plans.

9.1.5 The route options identified were numbered 1-14 for reference purposes and these options are described in turn in the following sections.

9.2 Option 1 (PCF Stage 1)

9.2.1 Option 1 is an offline dualling to the north of the existing A47, as shown in **Figure 9-1** below.

Figure 9-1 – Option 1 (PCF Stage 1).



9.2.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of offline dual carriageway with appropriate junction improvements.

9.2.3 The proposed new dual carriageway for this option follows an alignment running to the north of the existing A47 highway corridor.

9.2.4 At the western end of the scheme, the proposed alignment passes to the south of Hockering Wood (SSSI) and to the north of the village of Hockering, the remainder of the route passing predominantly through open farm land and some woodland habitat before crossing the River Tud close to Easton.

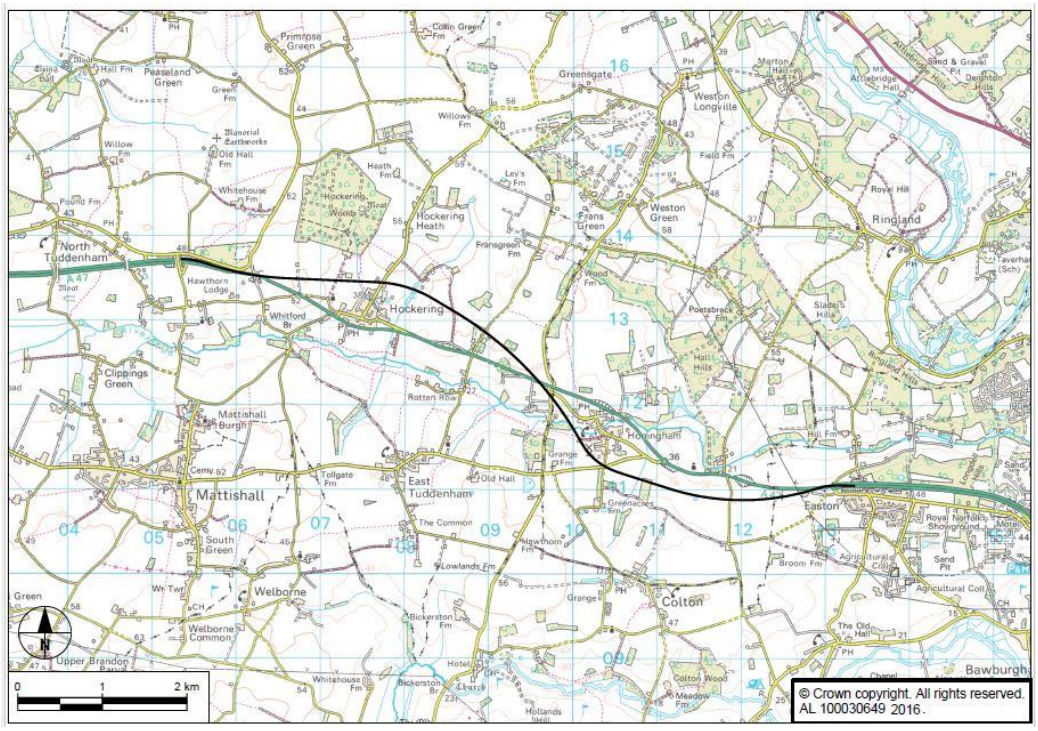
9.2.5 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.2.6 The existing A47 would, where unaffected by the new dual carriageway remain as part of the local road network.

9.3 Option 2 (PCF Stage 1)

9.3.1 Option 2 is an offline dualling to the north of the existing A47, for the western part of the route and to the south of the existing A47, for the eastern part of the route, as shown in **Figure 9-2** below.

Figure 9-2 – Option (PCF Stage 1).



9.3.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of offline dual carriageway with appropriate junction improvements.

9.3.3 The proposed new dual carriageway for this option follows an alignment running to the south of Hockering Wood (SSSI) and to the north of the village of Hockering and to the south of the existing A47 as the route passes the village of Honingham, crossing the existing A47 between the villages.

9.3.4 The route passes predominantly through open farm land and some woodland habitat and crosses the River Tud to the west of the village of Honingham.

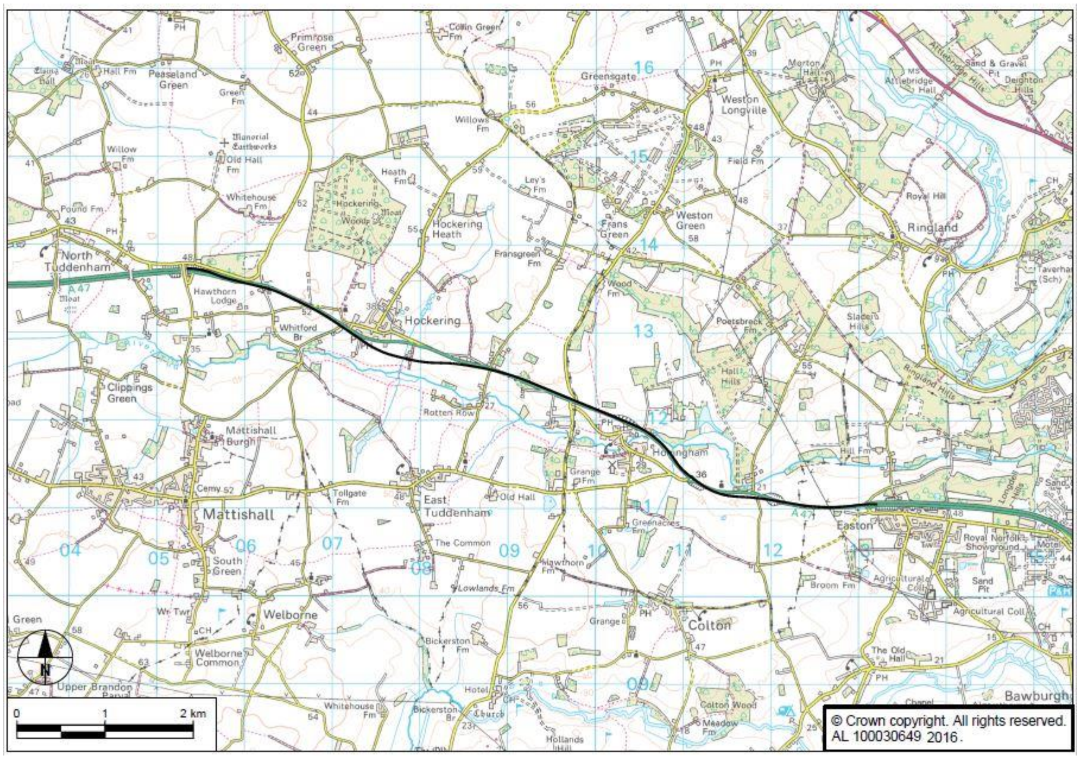
9.3.5 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.3.6 The existing A47 would, where unaffected by the new dual carriageway remain as part of the local road network.

9.4 Option 3 (PCF Stage 1)

9.4.1 Option 3 is an online dualling following the existing A47 route, as shown in **Figure 9-3** below.

Figure 9-3 - Option 3 (PCF Stage 1).



9.4.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of online dual carriageway with appropriate junction improvements.

9.4.3 The proposed new dual carriageway for this option follows an alignment running as close as practical to the existing A47 highway corridor.

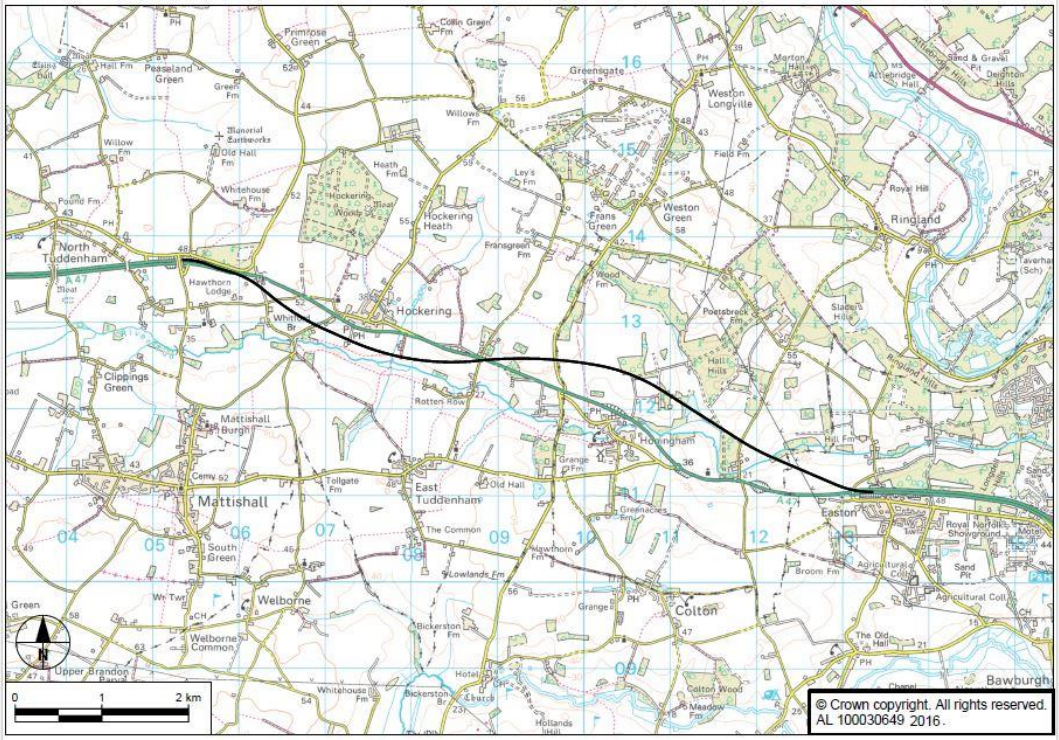
9.4.4 Improvement to the existing alignment to bring the route up to dual carriageway standards and the practicalities and safety of construction will make it necessary for the alignment in some sections to move away from the existing highway corridor particularly as the route passes to the south of the village of Hockering.

9.4.5 Due to the corridor width required to accommodate the additional carriageway width and the new alignment it would be necessary to acquire additional land along the route to accommodate the improvement.

9.5 Option 4 (PCF Stage 1)

9.5.1 Option 4 is an offline dualling to the south of the existing A47, for the western part of the route and to the north of the existing A47 for the eastern part of the route, as shown in **Figure 9-4** below.

Figure 9-4 – Option 4 (PCF Stage 1).



9.5.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of offline dual carriageway with appropriate junction improvements.

9.5.3 The proposed new dual carriageway for this option follows an alignment running to the south of the A47 but to the north of the River Tud as the route passes the village of Hockering and to the north of the existing A47 as the route passes the village of Honingham, crossing the existing A47 between the villages.

9.5.4 The route passes predominantly through open farm land and some woodland habitat and crosses the River Tud at the Easton end.

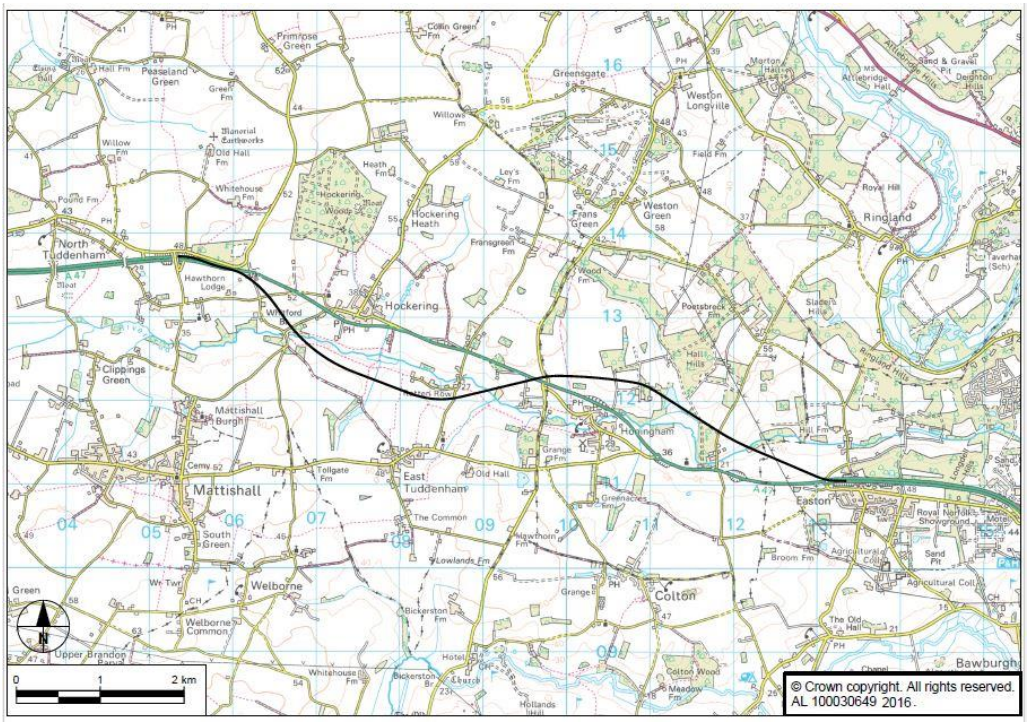
9.5.5 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.5.6 The existing A47 would, where unaffected by the new dual carriageway remain as part of the local road network.

9.6 Option 5 (PCF Stage 1)

9.6.1 Option 5 is an offline dualling to the south of the existing A47, for the western part of the route and to the north of the existing A47, for the eastern part of the route, as shown in **Figure 9-5** below.

Figure 9-5 – Option 5 (PCF Stage 1).



9.6.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of offline dual carriageway with appropriate junction improvements.

9.6.3 The proposed new dual carriageway for this option follows an alignment running to the south of the A47 and south of the River Tud as the route passes the village of Hockering and to the north of the existing A47 as the route passes the village of Honingham, crossing the existing A47 between the villages.

9.6.4 The route passes through open farm land and some woodland habitat. The route crosses the River Tud twice in the western section and again in the eastern section to the west of Easton,

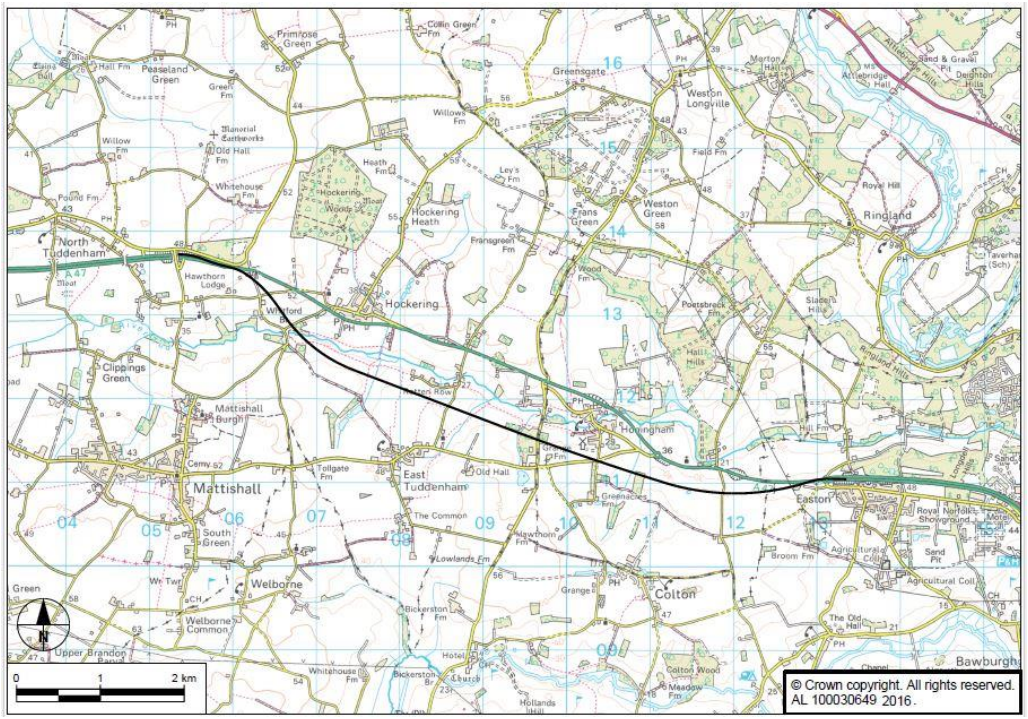
9.6.5 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.6.6 The existing A47 would, where unaffected by the new dual carriageway remain as part of the local road network.

9.7 Option 6 (PCF Stage 1)

9.7.1 Option 6 is an offline dualling to the south of the existing A47 route, as shown in **Figure 9-6** below.

Figure 9-6 – Option 6 (PCF Stage 1).



9.7.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of offline dual carriageway with appropriate junction improvements.

9.7.3 The proposed new dual carriageway for this option follows an alignment running to the south of the existing A47 and to the south of the River Tud. At the western end of the scheme, the proposed alignment crosses the River Tud before passing to the south of the village of Honingham and returning to the A47 at Easton

9.7.4 The route runs predominantly through arable farmland and semi-improved grassland.

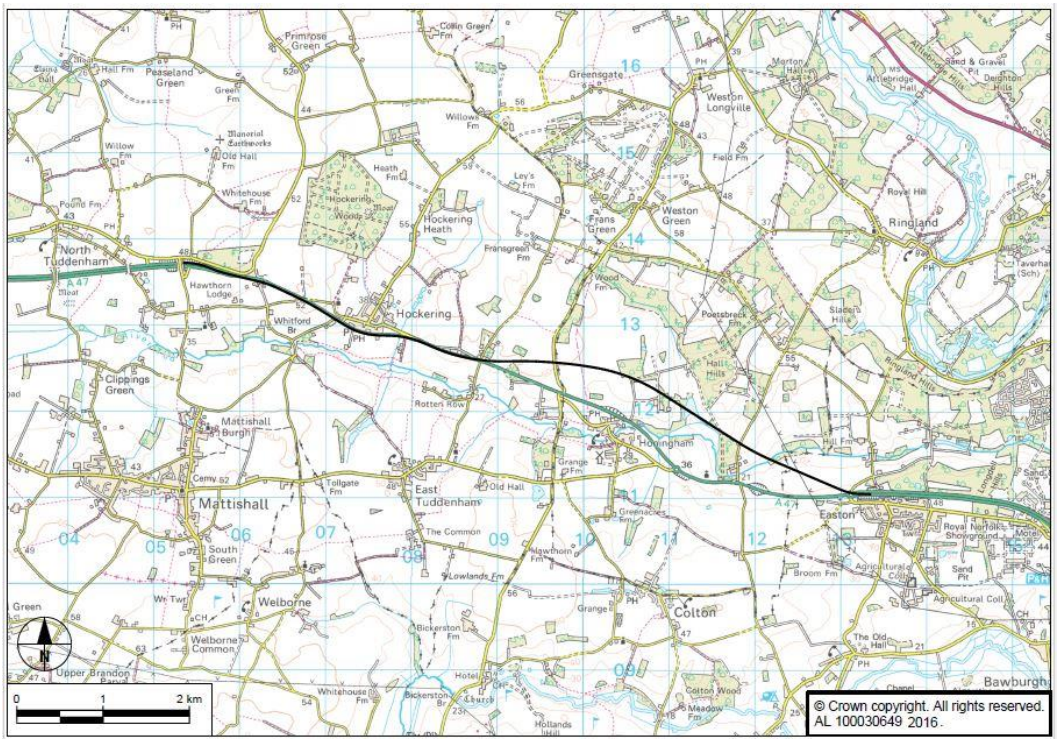
9.7.5 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.7.6 The existing A47 would, where unaffected by the new dual carriageway remain as part of the local road network.

9.8 Option 7 (PCF Stage 1)

9.8.1 Option 7 is an online dualling for the western part of the route and an offline dualling to the north of the existing A47 for the eastern part of the route, as shown in **Figure 9.7** below.

Figure 9-7 – Option 7 (PCF Stage 1).



9.8.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of dual carriageway with appropriate junction improvements.

9.8.3 The alignment of the new dual carriageway follows as closely as practical to the existing A47 highway corridor in the western section to the south of the village of Hockering, the eastern section is offline to the north of the existing A47.

9.8.4 The route alignment seeks to retain a similar alignment to the existing A47 as the route passes the village of Hockering.

9.8.5 The offline section runs predominantly through open farm land and some woodland habitat. The route crosses the River Tud in the eastern section.

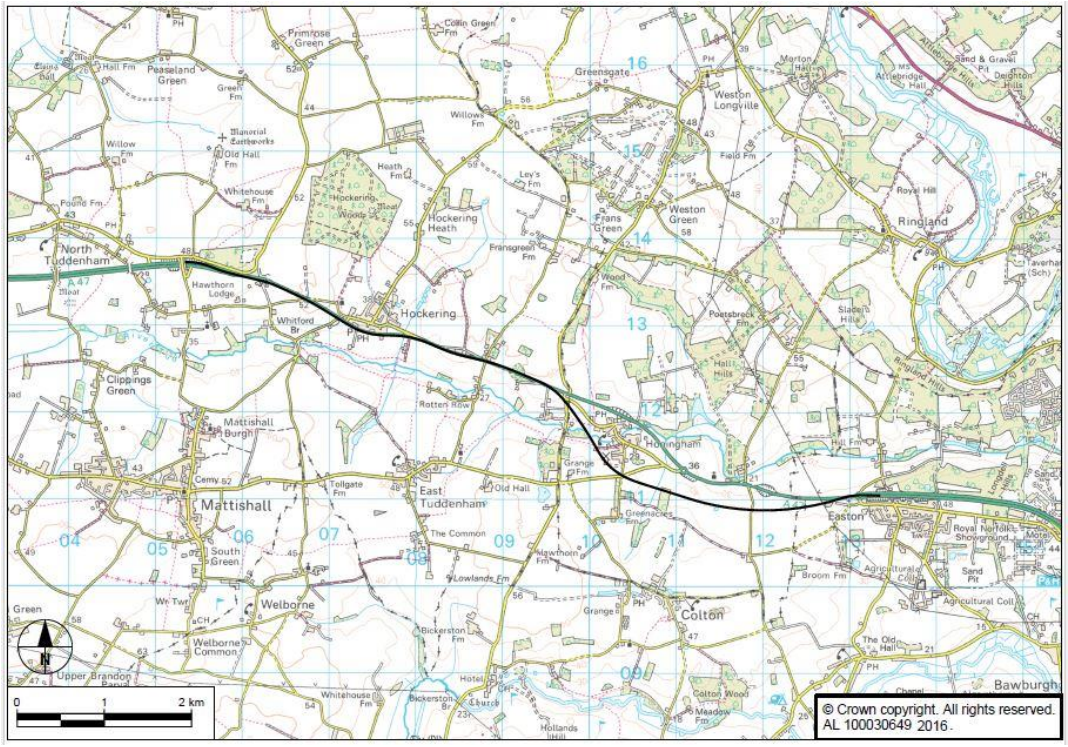
9.8.6 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.8.7 The existing A47 would, where unaffected by the new dual carriageway remain as part of the local road network.

9.9 Option 8 (PCF Stage 1)

9.9.1 Option 8 is an online dualling for the western part of the route and an offline dualling to the south of the existing A47 for the eastern part of the route, as shown in **Figure 9-8** below.

Figure 9-8 – Option 8 (PCF Stage 1).



9.9.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of dual carriageway with appropriate junction improvements.

9.9.3 The alignment of the new dual carriageway follows as closely as practical to the existing A47 highway corridor in the western section to the south of the village of Hockering, the eastern section is offline to the south of the existing A47.

9.9.4 The route alignment seeks to retain a similar alignment to the existing A47 as the route passes the village of Hockering.

9.9.5 The offline section of the route runs predominantly through arable farmland crossing the River Tud to the west of the village of Honingham.

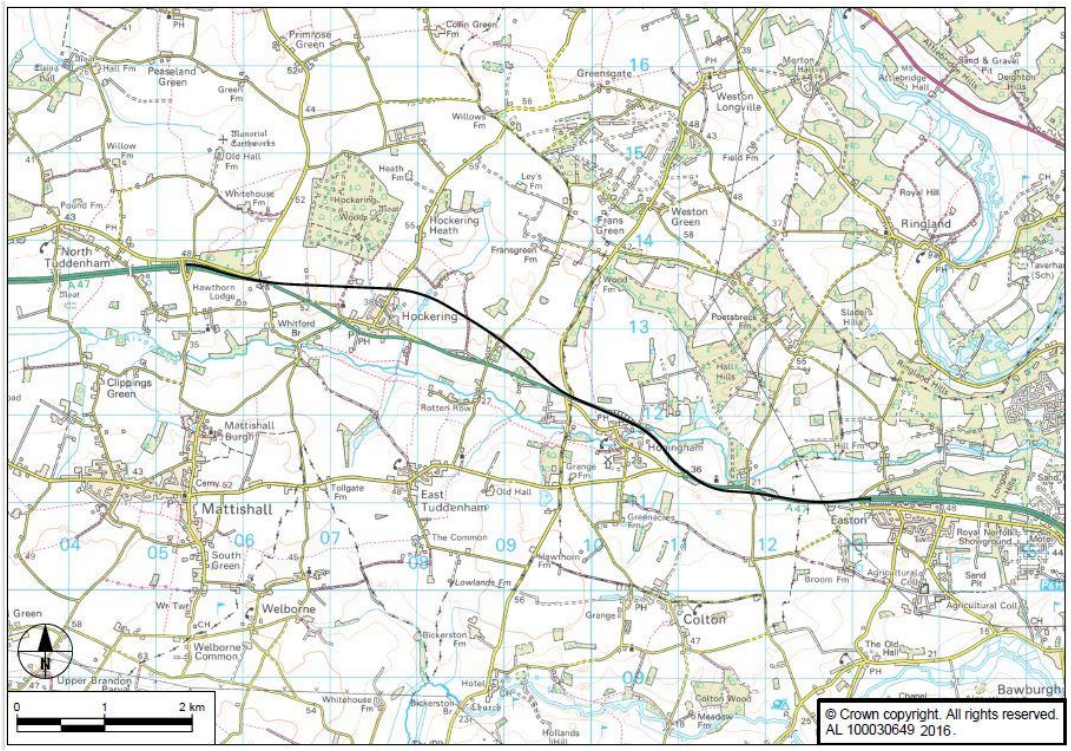
9.9.6 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.9.7 The existing A47 would, where unaffected by the new dual carriageway remain as part of the local road network.

9.10 Option 9 (PCF Stage 1)

9.10.1 Option 9 is an offline dualling to the north of the existing A47, for the western part of the route and an online dualling for the eastern part of the route, as shown in **Figure 9-9** below.

Figure 9-9 – Option 9 (PCF Stage 1).



9.10.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of dual carriageway with appropriate junction improvements.

9.10.3 The alignment of the new dual carriageway is offline in the western section to the south of Hockering Wood (SSSI) and to the north of the village of Hockering. In the eastern section the alignment follows as closely as practical to the existing A47 highway corridor.

9.10.4 The route alignment seeks to retain a similar alignment to the existing A47 as the route passes the village of Honingham.

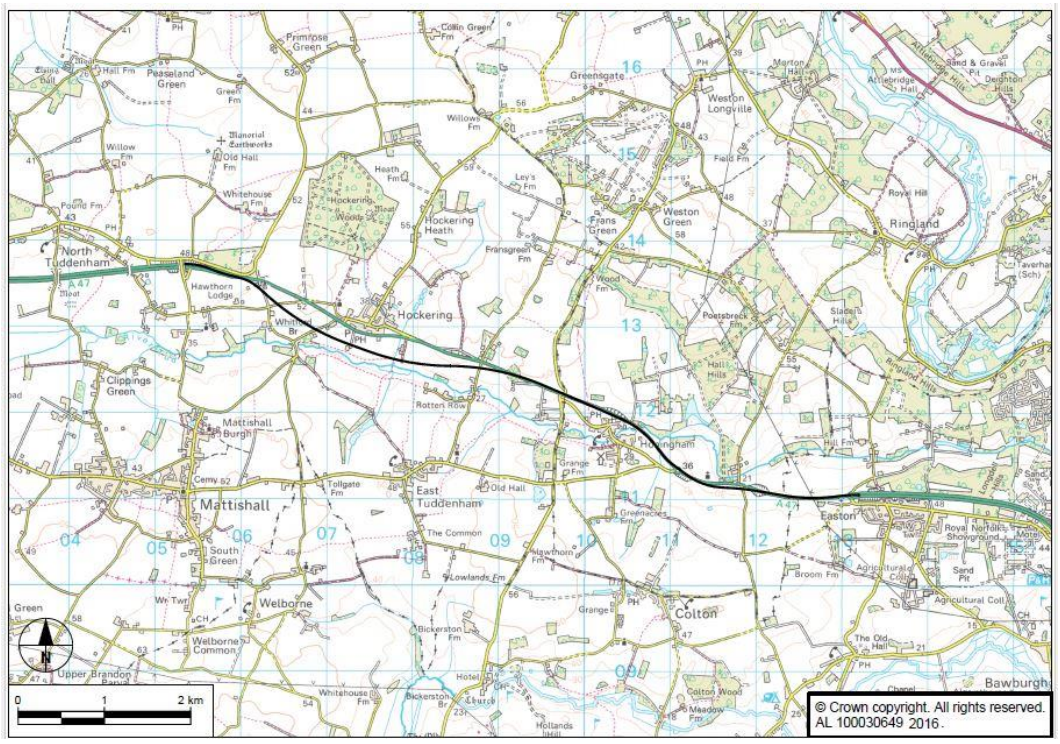
9.10.5 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.10.6 The existing A47 would, where unaffected by the new dual carriageway remain as part of the local road network.

9.11 Option 10 (PCF Stage 1)

9.11.1 Option 10 is an offline dualling to the south of the existing A47, in the western part of the route and an online dualling for the western part of the route, as shown in **Figure 9-10** below.

Figure 9-10 – Option 10 (PCF Stage 1).



9.11.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of dual carriageway with appropriate junction improvements.

9.11.3 The alignment of the new dual carriageway is offline in the western section to the south of the existing A47 and to the north of the River Tud as it passes the village of Hockering. In the eastern section the alignment follows as closely as practical to the existing A47 highway corridor.

9.11.4 The route alignment seeks to retain a similar alignment to the existing A47 as the route passes the village of Honingham.

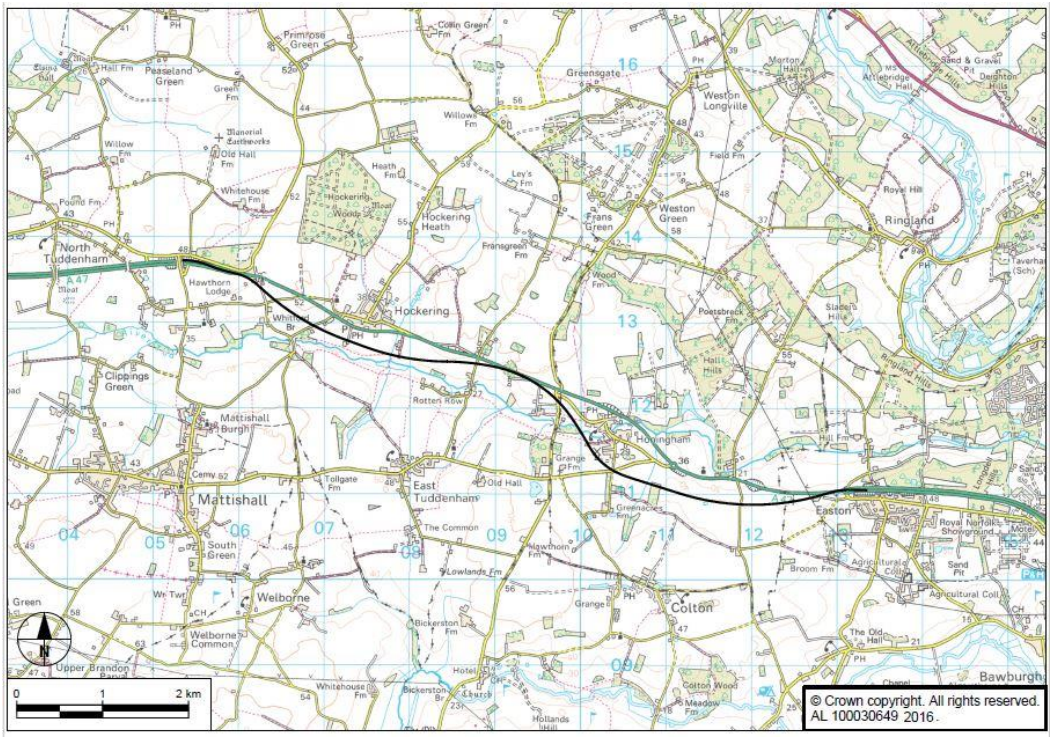
9.11.5 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.11.6 The existing A47 would, where unaffected by the new dual carriageway remain as part of the local road network.

9.12 Option 11 (PCF Stage 1)

9.12.1 Option 11 is an offline dualling to the south of the existing A47 route, as shown in **Figure 9-11** below.

Figure 9-11 – Option 11 (PCF Stage 1).



9.12.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of offline dual carriageway with appropriate junction improvements.

9.12.3 The western section of the proposed alignment runs to the south of the existing A47 and north of the River Tud as it passes the village of Hockering, and returns to meet the existing alignment around Woods Lane. The alignment then crosses the River Tud to the south west of the village of Honingham, before passing to the south of the village of Honingham and returning to the A47 at Easton.

9.12.4 The route runs predominantly through arable farmland and areas of semi-improved grassland.

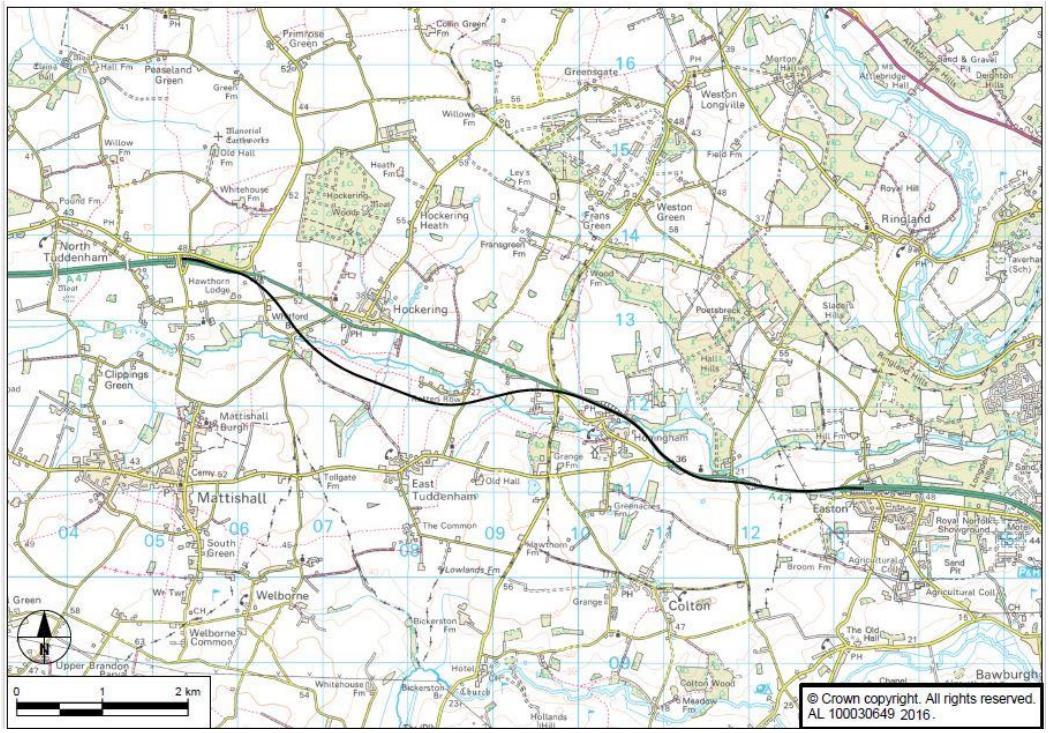
9.12.5 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.12.6 The existing A47 would, where unaffected by the new dual carriageway remain as part of the local road network.

9.13 Option 12 (PCF Stage 1)

9.13.1 Option 12 is an offline dualling to the south of the existing A47, for the western part of the route and an online dualling for the eastern part of the route, as shown in **Figure 9-12** below.

Figure 9 -12 – Option 12 (PCF Stage 1).



9.13.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of dual carriageway with appropriate junction improvements.

9.13.3 The western section of the proposed alignment runs to the south of the existing A47 and south of the River Tud as it passes the village of Hockering. The route returns to meet the existing alignment around Woods Lane. The alignment then follows as closely as practical to the existing alignment, as an online alignment for the eastern section.

9.13.4 The route crosses the River Tud twice in the western offline section and again to the west of the village of Honingham. The western part of the route runs predominantly through semi-improved grassland and areas of arable farmland.

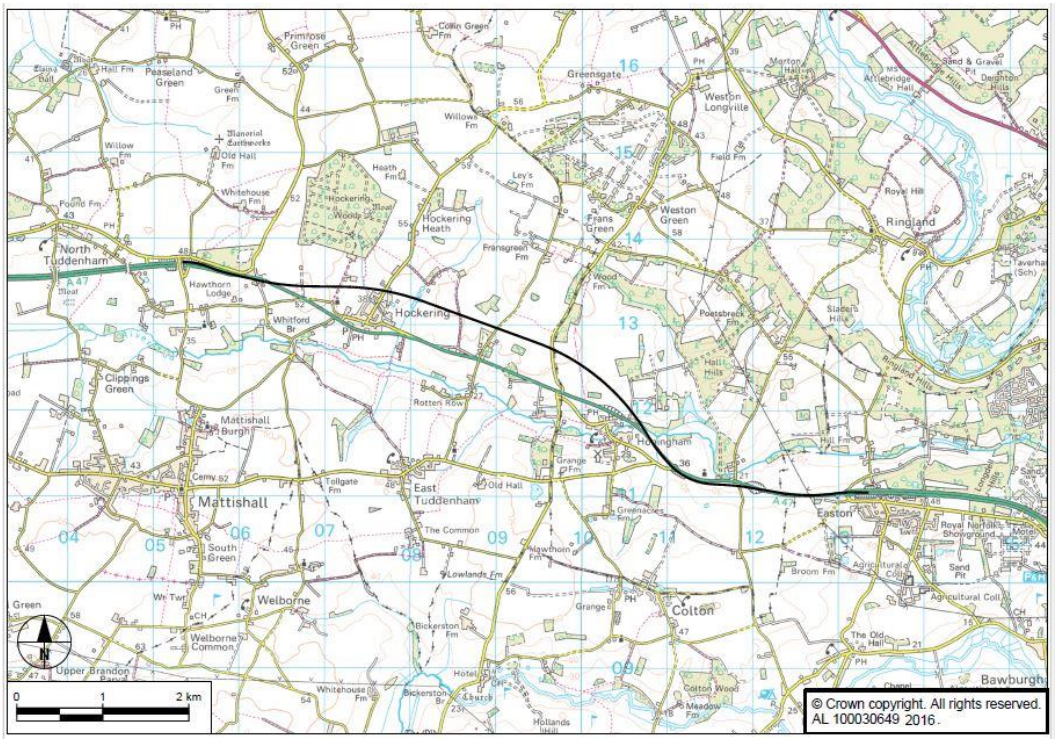
9.13.5 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.13.6 The existing A47 would, where unaffected by the new dual carriageway remain as part of the local road network.

9.14 Option 13 (PCF Stage 1)

9.14.1 Option 13 is an offline dualling to the north of the existing A47, for the western part of the route and an online dualling for the eastern part of the route, as shown in **Figure 9-13** below.

Figure 9-13 – Option 13 (PCF Stage 1).



9.14.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of dual carriageway with appropriate junction improvements.

9.14.3 The alignment of the new dual carriageway is offline in the western section to the south of Hockering Wood (SSSI) and to the north of the village of Hockering. In the eastern section the alignment follows as closely as practical to the existing A47 highway corridor.

9.14.4 The route alignment seeks to retain a similar alignment to the existing A47 as the route passes the village of Honingham.

9.14.5 The offline section runs predominantly through open farm land and some woodland habitat. The route crosses the River Tud in the eastern section.

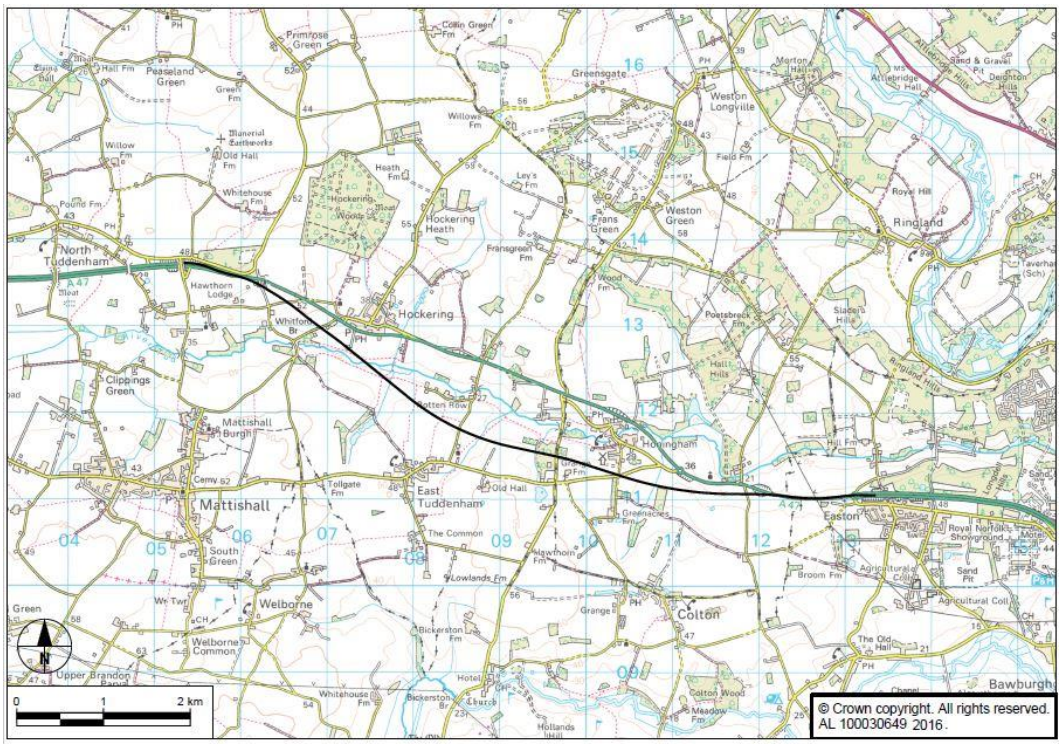
9.14.6 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.14.7 The existing A47 would, where unaffected by the new dual carriageway remain as part of the local road network.

9.15 Option 14 (PCF Stage 1)

9.15.1 Option 14 is an offline dualling to the south of the existing A47 route, as shown in **Figure 9-14** below.

Figure 9-14 – Option 14 (PCF Stage 1).



9.15.2 The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of offline dual carriageway with appropriate junction improvements.

9.15.3 The proposed new dual carriageway for this option follows an alignment running to the south of the existing A47 highway corridor to the south of the River Tud. At the western end of the scheme, the proposed alignment crosses the River Tud before passing to the south of the village of Honingham and returning to the A47 at Easton.

9.15.4 The route runs predominantly through arable farmland and areas of semi-improved grassland.

9.15.5 To accommodate the proposed dualling, it would be necessary to acquire land along the route of the improvement.

9.15.6 The existing A47 would remain where unaffected by the new dual carriageway and become part of the local road network.

10 Initial Assessment of Options

10.1 Introduction

10.1.1 In order to reduce the number of options to be taken forward to more detailed assessment and to public consultation at PCF Stage 2 initial comparative assessments of the 14 options were undertaken.

10.1.2 Initial assessments were made of the options using the Department for Transport's Early Assessment and Sifting Tool (EAST) and an assessment of the options against Highways England's KPIs. These assessments are described in sections 10.2 and 10.3 below.

10.1.3 The EAST and KPI assessments used the desk top data, available from PCF Stage 0 and the knowledge of the project team who had undertaken the PCF Stage 0 work to assess the 14 options.

10.2 EAST (Early Assessment and Sifting Tool)

10.2.1 EAST is a Department for Transport (DfT) decision support tool that forms the initial part of the DfT's Transport Business Case. It is a high level assessment of the different options for a scheme to discard any options that will not meet the transport objectives nor fit with local, regional, national strategies, or would be highly unlikely to pass key viability and acceptability criteria.

10.2.2 The EAST assessment rates the impact of the scheme against the following headline criteria

- Overall Impacts
- Strategic Impacts
- Economic Impacts
- Managerial Impacts
- Financial Impacts
- Commercial Impacts

10.2.3 Further detail with regard to the EAST assessment methodology and the results of the assessment undertaken can be found in **Appendix I**.

10.2.4 Due to the high level strategic nature of the EAST assessment the results and ratings for each of the route options considered showed no discernible difference between the 14 options identified.

10.2.5 The conclusion of the EAST assessment being that all of the options would meet the transport objective in a similar manner and that a more detailed assessment of the options would be necessary to identify the differentiators between the 14 route options.

10.3 Highways England KPI Assessment

10.3.1 As presented in Chapter 2, as part of the Highways England Delivery Plan a series of KPI's have been developed to ensure that schemes that Highways England deliver, achieve their strategic outcomes.

10.3.2 Each Option was appraised and scored from 1 to 5 where 1 is poor and 5 is good. The scores have been RAG (red –amber – green) rated and presented in **Table 10-1** below

Table 10-1 KPI Assessment

Option	Fit with wider transport and government objectives							
	Managing the network safer	Improving user satisfaction	Supporting the Smooth Flow of Traffic	Encouraging Economic Growth	Delivering better environmental outcomes	Helping cyclists, walkers and other vulnerable users	Achieving real efficiency	Keeping the Network in Good Condition
1	4	4	5	3	3	3	3	4
2	4	4	5	3	3	3	3	4
3	4	4	5	3	4	3	3	4
4	4	4	5	3	3	3	3	4
5	4	4	5	3	3	3	3	4
6	4	4	5	3	3	3	3	4
7	4	4	5	3	3	3	3	4
8	4	4	5	3	3	3	3	4
9	4	4	5	3	4	3	3	4
10	4	4	5	3	4	3	3	4
11	4	4	5	3	3	3	3	4
12	4	4	5	3	3	3	3	4
13	4	4	5	3	3	3	3	4
14	4	4	5	3	3	3	3	4

10.3.3 The table shows that other than for the environmental scoring each of the options was considered to score against the KPI headings in a similar manner. The environmental scoring differentiator being that the online solutions were judged, on the available information, to generally be likely to have less environmental impact and therefore would deliver a better environmental impact.

10.3.4 The conclusion of the assessment against the Highways England KPIs was, as the KPIs are reasonably high level, that each of the route options is likely to meet the KPIs and score against the KPIs in a very similar way.

10.3.5 As with the EAST assessment the conclusion of the KPI assessment was that in order to differentiate and compare options a more detailed assessment would be necessary. The more detailed assessment would need to be made based on criteria which would more readily differentiate between the options.

10.4 Further Sifting Assessment

10.4.1 As described in sections 10.2 and 10.3 above the EAST and KPI assessment methods were too high level to effectively differentiate between the 14 options sufficiently to allow the options to be reduced to a practical number of options to be taken forward.

10.4.2 It was agreed with Highways England that further initial assessment of the 14 options should be undertaken. Using the desktop information available from PCF Stage 0 as a base further assessment work was undertaken on the 14 options. Initially for each option a qualitative appraisal summary table was completed based on the available information.

The assessment work was then further developed to allow assessment and ranking of the 14 options against the following headings

- Environment
- Engineering
- Transportation
- Economics

10.4.3 The assessment methodology and the results from each are presented in the following sections.

10.4.4 The result of each of the assessments prepared gave a ranking of the options from 1 to 14. The best performing option of the assessment being ranked highest as 1 to the worst performing option of the assessment being ranked lowest as 14.

10.5 Environmental Assessment for initial options review

10.5.1 For each of the 14 options a qualitative assessment was made of the likely environmental impact against the following environmental topic areas, the environmental topic areas were selected based on the headings within a typical scheme appraisal summary table

- Noise
- Air Quality
- Greenhouse gases
- Landscape
- Townscape
- Historic Environment
- Biodiversity
- Water Environment

10.5.2 Experienced technical environmental specialists made the qualitative assessments from the baseline environmental data readily available from the desk studies and previous work undertaken.

10.5.3 Based on the known environmental information and constraints from desk study the likely impact of each option was estimated for each of the topic areas. Each of the environmental topic areas was given an estimated impact based on a 7 point scale as follows

- Large adverse (-3)
- Moderate adverse (-2)
- Slightly adverse (-1)
- Neutral (0)
- Slightly beneficial (1)
- Moderate Beneficial (2)
- Large Beneficial (3)

10.5.4 The 8 topic areas and the estimated impacts were compiled for each option and this was used as a basis to determine an environmental ranking of the 14 options. The

environmental ranking assessment is included in **Appendix J**. **Table 10-2** below shows the ranking result of the initial environmental assessment. The numbered rankings 1 best performing with regard to initial environmental assessment through to 14 worst performing with regard to initial environmental assessment. The rankings have also been RAG (red –amber – green) rated to give an easy visual comparison based on the following banding of ranks; 1 to 4 green, 5 to 8 amber and 9 to 14 red.

Table 10-2: Ranking of Options from Environmental Assessment

Environmental Ranking of Options Options ranked 1 best to 14 worst and RAG rated (1-4 red, 5-8 amber, 9-14 red)		
Option	**Option Rank**	**Comment**
Option 1	8	Option offline, likely to have a larger environmental impact than online options. Impact on landscape, biodiversity and water environment all assessed as moderate adverse impacts for this option. Noise impact assessed as slight adverse for proximity of route to Hockering.
Option 2	10	Option offline, likely to have a larger environmental impact than online options. Impact on landscape, biodiversity and water environment all assessed as moderate adverse impacts for this option. Noise impact and air quality assessed as slight adverse for proximity of route to Hockering and Honingham.
Option 3	1	This option is predominantly online so has less impact than offline solutions particularly with regard to impact on landscape, biodiversity and water environment – impacts are all assessed as either slight adverse or neutral.
Option 4	3	Option offline likely to have a larger environmental impact than online options. Impact on landscape, biodiversity and water environment all assessed as moderate adverse impacts. Neutral impacts for noise and air quality as the route is further from Hockering and Honingham than the existing route.
Option 5	10	Option offline, likely to have a larger environmental impact than online options. Impact on landscape assessed as moderate adverse, biodiversity and water environment both assessed as large adverse impacts due to the proximity and crossing of the River Tud. Neutral impacts for noise and air quality as the route is further from Hockering and Honingham than the existing route.
Option 6	10	Option offline, likely to have a larger environmental impact than online options. Impact on landscape, biodiversity and water environment all assessed as moderate adverse impacts for this option. Noise impact assessed as slight adverse for proximity of route to Honingham.
Option 7	8	Option part online part offline, so likely to have lesser environmental impact than some all offline options. Impact on biodiversity and water environment all assessed as moderate adverse due to the proximity and crossing of the River Tud. Slight adverse impacts for noise and air quality as the online part of the route remains close to Hockering.
Option 8	5	Option part online part offline, so likely to have lesser environmental impact than some all offline options. Impact on landscape, biodiversity and water environment all assessed as moderate adverse due to the crossing of the River Tud. Slight adverse impacts for noise and air quality as the online part of the route remains close to Hockering.
Option 9	3	Option part online part offline, so likely to have lesser environmental impact than some all offline options. Impact on landscape, biodiversity and water environment all assessed as moderate adverse due to the crossing of the River Tud. Slight adverse impacts for noise and air quality as the offline part of the route remains close to Hockering and the online part remains

Environmental Ranking of Options Options ranked 1 best to 14 worst and RAG rated (1-4 red, 5-8 amber, 9-14 red)		
Option	**Option Rank**	**Comment**
		close to Honingham.
Option 10	1	This option is similar to option 1 predominantly close to the existing route and online so has less impact than offline solutions particularly with regard to impact on landscape, biodiversity and water environment – impacts are all assessed as either slight adverse or neutral.
Option 11	5	Option offline, likely to have a larger environmental impact than more online options. Impact on biodiversity and water environment all assessed as moderate adverse impacts for this option. Noise impact assessed as slight adverse for proximity of route to Honingham.
Option 12	5	Option part online part offline, so likely to have lesser environmental impact than some all offline options. Impact on landscape, biodiversity and water environment all assessed as moderate adverse due to the crossing and proximity of the River Tud.
Option 13	10	Option predominantly offline, likely to have a larger environmental impact than more online options. Impact on landscape, biodiversity and water environment all assessed as moderate adverse impacts for this option. Noise impact assessed as slight adverse for proximity of offline section to Hockering.
Option 14	10	Option offline, likely to have a larger environmental impact than online options. Impact on landscape, biodiversity and water environment all assessed as moderate adverse impacts for this option. Noise impact assessed as slight adverse for proximity of route to Honingham.

10.6 Transportation Assessment for Initial Options Review

10.6.1 The 14 options all provide a dual carriageway replacing the length of single carriageway between North Tuddenham and Easton. From a transportation assessment perspective all routes will predominantly perform in a similar way, the only real differentiating factor in terms of preliminary initial transportation assessment, prior to the detailed transportation modelling being available, was the difference between the options based on proposed route length.

10.6.2 In terms of an initial transportation ranking to inform the option assessment this was based on route length. The longer the proposed route length the lower the scheme ranked in the assessment, as the longer the journey time.

10.6.3 **Table 10-3** below shows the ranking result of the initial transportation assessment and ranking. The numbered rankings 1 best performing with regard to initial transportation assessment through to 14 worst performing with regard to initial transportation assessment. The rankings have also been RAG (red –amber – green) rated to give an easy visual comparison based on the following banding of ranks; 1 to 4 green, 5 to 8 amber and 9 to 14 red.

Table 10-3: Transportation Assessment and Ranking

Transportation Ranking of Options Options ranked 1 best to 14 worst and RAG rated (1-4 red, 5-8 amber, 9-14 red)			
Option	**Length of Option (km)**	**Option Rank**	**Comment**

Transportation Ranking of Options Options ranked 1 best to 14 worst and RAG rated (1-4 red, 5-8 amber, 9-14 red)			
Option	**Length of Option (km)**	**Option Rank**	**Comment**
Option 1	7.76	1	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher. Option 1 is the shortest route and ranks the highest.
Option 2	8.18	14	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher. Option 2 is the longest route and ranks the lowest.
Option 3	7.86	4	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher.
Option 4	7.83	3	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher.
Option 5	8.07	11	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher.
Option 6	7.97	8	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher.
Option 7	7.78	2	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher.
Option 8	8.05	10	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher.
Option 9	7.96	7	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher.
Option 10	7.88	5	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher.
Option 11	8.08	12	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher.
Option 12	8.11	13	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher.
Option 13	8.00	9	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher.
Option 14	7.89	6	Ranking based on the option length. Shorter routes will offer quicker journey times and are ranked higher.

10.7 Engineering Assessment for Initial Options Review

10.7.1 An engineering assessment was undertaken of the 14 route options. Each of the options was assessed and ranked comparatively based on the following seven criteria

- Buildability
- Land take
- General Alignment
- Accommodation works

- Geotechnical
- Structures
- Impact on Statutory Undertakers

Buildability

10.7.2 The buildability of the route was reviewed based on a qualitative assessment of the likely ease of construction of the option, predominantly assessing the level of offline and online construction which would be required. Online construction being more difficult disruptive and requiring more complex phasing and traffic management arrangements than building offline. This assessment was then used to rank the 14 options 1 to 14. The least challenging from a buildability being ranked highest through to the most challenging being ranked lower.

Land take

10.7.3 The land take requirements of each of the route options was determined from the engineering layouts. The options were then ranked from 1 to 14 according to the area of land take required by the option. The route option with the smallest area of land take being given the highest ranking through to the route with the largest area of land take being given the lowest ranking.

General Alignment

10.7.4 The general alignment of each route option was reviewed based on an analysis of the geometric alignment in particular the radii and curvature of the alignment to give a measure of overall route alignment which could be used to compare the options. The assessment was then used to rank the 14 options 1 to 14. Those with the worst alignment being ranked lowest through to the options with the better alignment scores being ranked higher.

Accommodation Works

10.7.5 The potential amount of accommodation access works, based on approximate length of tracks to maintain property and field access was reviewed and assessed for each of the route options. This assessment was then used to rank the 14 options 1 to 14. Those estimated to require comparably less accommodation works being ranked highest through to the route options estimated to require more accommodation works being ranked lower.

Geotechnical

10.7.6 Each route option was qualitatively assessed based on an engineering professional judgement of the likely geotechnical risks identified within the desktop information. The assessment was then used to rank the 14 options 1 to 14. Those options considered to have more risk and complexity due to identified geotechnical constraints ranked lowest through to the options with less complexity and risk being ranked higher.

Structures

10.7.7 The structural complexity of each route option was reviewed based on the number, size and complexity of potential structures (bridges and culverts) required for the option. This assessment was then used to rank the 14 options 1 to 14. Those scoring lowest and offering comparably more complexity with regards to structural input ranked lowest through to the options with less complexity and higher scores being ranked higher.

Impact on Statutory Undertakers

10.7.8 The potential amount of works required to divert or protect statutory undertakers plant in order to accommodate each route option was reviewed and assessed. These assessments were then used to rank the 14 options 1 to 14. Those scoring lower and estimated to require comparably less statutory undertakers' works being ranked highest through to the route options estimated to require more statutory undertakers' works being ranked lower.

Engineering Assessment Overall Ranking

10.7.9 The rankings for the seven individual engineering criteria assessed are contained in **Appendix J**. The individual ranks were combined to give an overall initial engineering assessment ranking of the 14 options.

10.7.10 **Table 10-4** below shows the ranking result of the initial engineering assessment and ranking. The numbered rankings 1 best performing with regards to initial engineering assessment through to 14 worst performing with regards to initial engineering assessment. The rankings have also been RAG (red –amber – green) rated to give an easy visual comparison based on the following banding of ranks; 1 to 4 green, 5 to 8 amber and 9 to 14 red.

Table 10-4: Ranking of Options from Engineering Assessment

Engineering Ranking of Options Options ranked 1 best to 14 worst and RAG rated (1-4 red, 5-8 amber, 9-14 red)		
Option	**Option Rank**	**Key Engineering issues**
Option 1	1	This option is offline and is considered easier to construct than online solutions. Land take area will be more than for online or part online solutions, accommodation works are anticipated to be less extensive.
Option 2	9	This option is offline and is considered easier to construct than online solutions. Land take area will be more than for online or part online solutions, accommodation works are anticipated to be less extensive.
Option 3	5	This option is online and is considered more difficult to construct due to increase in phasing and traffic management. There is likely to be an increased effect on statutory undertakers. Land take area will be less for online solution, accommodation works are anticipated to be more extensive.
Option 4	3	This option is offline and is considered easier to construct than online solutions. Land take area will be more than for online or part online solutions, accommodation works are anticipated to be less extensive.
Option 5	5	This option is offline and is considered easier to construct than online solutions. Land take area will be more than for online or part online solutions, accommodation works are anticipated to be less extensive.
Option 6	2	This option is offline and is considered easier to construct than online solutions. Land take area will be more than for online or part online solutions, accommodation works are anticipated to be less extensive.
Option 7	12	This option is part online part offline, online section is considered more difficult to construct due to increase in phasing and traffic management. There is likely to be increased effect on statutory undertakers. Land take area will be less than for totally offline solutions, accommodation works are anticipated to be more extensive than for totally offline solution.
Option 8	14	This option is part online part offline, online section is

Engineering Ranking of Options Options ranked 1 best to 14 worst and RAG rated (1-4 red, 5-8 amber, 9-14 red)		
Option	**Option Rank**	**Key Engineering issues**
		considered more difficult to construct due to increase in phasing and traffic management. There is likely to be increased effect on statutory undertakers. Land take area will be less than for totally offline solutions, accommodation works are anticipated to be more extensive than for totally offline solution.
Option 9	11	This option is part online part offline, online section is considered more difficult to construct due to increase in phasing and traffic management. There is likely to be increased effect on statutory undertakers. Land take area will be less than for totally offline solutions, accommodation works are anticipated to be more extensive than for totally offline solution.
Option 10	8	This option is part online part offline, online section is considered more difficult to construct due to increase in phasing and traffic management. There is likely to be increased effect on statutory undertakers. Land take area will be less than for totally offline solutions, accommodation works are anticipated to be more extensive than for totally offline solution.
Option 11	7	This option is offline and is considered easier to construct than online solutions. Land take area will be more than for online or part online solutions, accommodation works are anticipated to be less extensive.
Option 12	13	This option is part online part offline, online section is considered more difficult to construct due to increase in phasing and traffic management. There is likely to be increased effect on statutory undertakers. Land take area will be less than for totally offline solutions, accommodation works are anticipated to be more extensive than for totally offline solution.
Option 13	9	This option is part online part offline, online section is considered more difficult to construct due to increase in phasing and traffic management. There is likely to be increased effect on statutory undertakers. Land take area will be less than for totally offline solutions, accommodation works are anticipated to be more extensive than for totally offline solution.
Option 14	3	This option is offline and is considered easier to construct than online solutions. Land take area will be more than for online or part online solutions, accommodation works are anticipated to be less extensive.

10.8 Comparative Economic Assessment for Initial Options Review

10.8.1 The cost and economic benefit provided by a highway scheme are important assessment criteria, however at the initial assessment stage detailed information on the estimated costs and potential benefit to cost ratio for each option were not available. During PCF Stage 0 potential economic benefits for the schemes and order of magnitude estimates had been estimated based on a typical widening solution for the North Tuddenham to Easton dualling scheme. These were used as a starting point for a comparative economic assessment to be made.

10.8.2 Benefit Cost Ratio (BCR) information for each option did not exist for the route options at the time of optioneering, so an exercise was undertaken to estimate the benefits and cost of each of the proposed 14 options based on the previous PCF Stage 0 Order of Magnitude Estimate and Benefits.

10.8.3 A rough order of cost estimate of the likely construction cost of each of the options was estimated based on the typical solution order of magnitude estimate from previous stages with an adjustment made to account for the split of the option length between online and offline construction. Offline construction is anticipated to be cheaper than online construction due to less traffic management and temporary construction being required whilst constructing offline.

10.8.4 Scheme benefits from the typical solution analysed at PCF Stage 0 were used as a base and a comparative prorata based on option length applied to give an estimate of benefits for each option.

10.8.5 The benefits and the estimated costs were combined for each option to give a numerical figure representing an indicative BCR for comparative assessment.

10.8.6 The indicative BCRs were used to rank the 14 options. The higher the figure the higher the scheme ranked in terms of the economic assessment, as shown in Table 4.1.1.

10.8.7 The economic assessment ranking of the route options is presented in Table 10-5 below along with the indicative BCR for comparative purposes and high level comment. It should be noted that the BCR figures were produced as comparators to facilitate sifting and do not represent the scheme BCR which is used to measure the economic viability of the scheme (see Chapter 18).

Table 10-5: Economics Assessment and Ranking

Economic Ranking of Options –using indicative BCR for comparative assessment Options ranked 1 best to 14 worst and RAG rated (1-4 red, 5-8 amber, 9-14 red)			
Option	**Indicative BCR**	**Option Rank**	**Comments**
Option 1	1.70	1	Offline (costs for construction offline per m length likely to be cheaper due to decreased traffic management cost) shorter routes give potentially more benefits by reduced journey time. This option is the shortest of offline solutions.
Option 2	1.53	8	Offline (costs for construction offline per m length likely to be cheaper due to decreased traffic management cost) shorter routes give potentially more benefits by reduced journey time. This route offline but longest of the offline solutions.
Option 3	1.50	12	Online and part online options have ranked worse due to the increased cost of construction and traffic management delays caused by construction online.
Option 4	1.68	2	Offline (costs for construction offline per m length likely to be cheaper due to decreased traffic management cost) shorter routes give potentially more benefits by reduced journey time.
Option 5	1.58	6	Offline (costs for construction offline per m length likely to be cheaper due to decreased traffic management cost) shorter routes give potentially more benefits by reduced journey time. This route offline but longer than some of other offline solutions.
Option 6	1.62	3	Offline (costs for construction offline per m length likely to be cheaper due to decreased traffic management cost) shorter routes give potentially more benefits by reduced journey time.
Option 7	1.58	5	Offline (costs for construction offline per m length likely to be cheaper due to decreased traffic management cost) shorter routes give potentially more benefits by reduced journey time. This route offline but longer than some of other offline solutions.
Option 8	1.45	14	Online and part online options have ranked worse due to the increased cost of construction and traffic management delays caused by construction online.
Option 9	1.51	11	Online and part online options have ranked worse due to the increased cost of construction and traffic management delays caused by construction online.
Option 10	1.52	9	Online and part online options have ranked worse due to the increased cost of construction and traffic management delays caused by construction online.
Option 11	1.57	7	Offline (costs for construction offline per m length likely to be cheaper due to decreased traffic management cost) shorter routes give potentially more benefits by reduced journey time. This route offline but longer than some of other offline solutions.
Option 12	1.47	13	Online and part online options have ranked worse due to the increased cost of construction and traffic management delays caused by construction online.
Option 13	1.51	10	Online and part online options have ranked worse due to the increased cost of construction and traffic management delays caused by construction online.
Option 14	1.62	4	Predominantly offline (costs for construction offline per m length likely to be cheaper due to decreased traffic management cost) shorter routes give potentially more benefits by reduced journey time.

Economic Ranking of Options –using indicative BCR for comparative assessment Options ranked 1 best to 14 worst and RAG rated (1-4 red, 5-8 amber, 9-14 red)			
Option	**Indicative BCR**	**Option Rank**	**Comments**
			The route is similar to option 6 however has a longer online tie in at the eastern end.

11 Options Ranking Sifting and Review

11.1 Options Review Meeting

11.1.1 An Options review meeting was held on the 16th June 2016. The options development process and the assessment process and results described in sections 9 and 10 were presented and discussed.

11.1.2 The EAST assessment and the Highways England KPI assessments did not differentiate between the developed options or provide a suitable ranking which could be used to rank the schemes.

11.1.3 The 14 route options were presented to the options review meeting along with the environmental, transportation, engineering and economic assessments and rankings detailed in section 10.5 to 10.8. The assessment methodology and the assessment rankings were discussed and agreed as being appropriate.

11.1.4 It was agreed in the meeting that each of the assessments as presented in **Tables 10-2 to 10-5** in Chapter 10 were combined to give an overall ranking for each option. These rankings along with the overall ranking are presented below in **Table 11-1**. The table has been RAG (red – amber – green) rated with the top performing, (ranking 1-4) coloured green, middle performing (ranking 5-8) amber and worst performing, (lower ranking 9-14) red

Table 11-1 Overall Ranking from Initial Assessments

Overall Ranking of Options Options ranked 1 best to 14 worst and RAG rated (1-4 red, 5-8 amber, 9-14 red)					
Option	Option rankings from individual assessments				Overall Rank
	Environment Assessment	Engineering Assessment	Traffic Assessment	Economic Assessment	
Option 1	8	1	1	1	1
Option 2	10	9	14	8	11
Option 3	1	5	4	12	3
Option 4	3	3	3	2	1
Option 5	10	5	11	6	10
Option 6	10	2	8	3	4
Option 7	8	12	2	5	7
Option 8	5	14	10	14	13
Option 9	3	11	7	11	9
Option 10	1	8	5	9	4
Option 11	5	7	12	7	8
Option 12	5	13	13	13	14
Option 13	10	9	9	10	12
Option 14	10	3	6	4	4

11.1.5 The overall rankings presented to the review meeting and included in the table above were reviewed at the meeting alongside the assessments to determine which of the developed options represented the most appropriate options to take forward for further

more detailed assessment and to non-statutory public consultation. The results from the review and the rationale behind the review decisions are described in the following section.

11.2 Initial Options Review Conclusions and Recommendations

11.2.1 The overall rankings from **Table 11-1** above have been presented below in **Table 11-2** with the conclusions of the options review meeting and the conclusions as to whether the option is to be taken forward for further assessment.

Table 11-2: Summary of route options to be taken forward for further assessment

Route options to be taken forward for further assessment Options ranked 1 best to 14 worst and RAG rated (1-4 green, 5-8 amber, 9-14 red)			
Option	**Overall Rank**	**Take forward for further assessment?**	**Overview of Key reasons**
Option 1	1	Yes	Option ranks joint 1st with option 4. As the routes are significantly different to each other both are chosen to be taken forward for further assessment.
Option 2	11	No	Option ranks poorly overall and red (bottom 5) on three out of the four assessments, so not taken forward for further assessment.
Option 3	3	Yes	Following review option 3 and option 10 are considered at this stage of the scheme development similar route alternatives within scope of design development. Option 3 best represents as close to an online dualling improvement that modern standards allow, option 3 has been taken forward to best represent the online option.
Option 4	1	Yes	Option ranks joint 1st with option 1. As the routes are significantly different to each other both are chosen to be taken forward for further assessment.
Option 5	10	No	Option ranks poorly overall and red (bottom 5) on two out of the four assessments, so not taken forward for further assessment.
Option 6	4	Yes	Following review option 6 and option 14 are considered at this stage of the scheme development similar route alternatives within scope of design development. This is shown by their similar ranking, option 6 has been taken forward to best represent the offline option to the south.
Option 7	7	No	Option ranks reasonably well but not as well as others, the route is similar to option 4 but with the western part being online.
Option 8	13	No	Option ranks poorly overall and red (bottom 5) on three out of the four assessments, so not taken forward for further assessment.
Option 9	9	No	Option ranks poorly overall and red (bottom 5) on two out of the four assessments, so not taken forward for further assessment.
Option 10	4	No	Following review option 3 and option 10 are considered at this stage in scheme development similar route alternatives within scope of design development. Option 3 best represents as close to an online dualling improvement that modern standards allow, option 3 has been taken forward to best represent the online option.
Option 11	8	No	Option ranks poorly overall and red (bottom 5) on two out of the four assessments, so not taken

Route options to be taken forward for further assessment Options ranked 1 best to 14 worst and RAG rated (1-4 green, 5-8 amber, 9-14 red)			
Option	**Overall Rank**	**Take forward for further assessment?**	**Overview of Key reasons**
			forward for further assessment.
Option 12	14	No	Option ranks poorly overall and red (bottom 5) on three out of the four assessments, so not taken forward for further assessment.
Option 13	12	No	Option ranks poorly overall and red (bottom 5) on three out of the four assessments, so not taken forward for further assessment.
Option 14	4	No	Option ranks well, following review option 6 and option 14 are considered at this stage of the scheme development similar route alternatives within scope of design development. This is shown by their similar ranking. Option 6 has been taken forward to best represent the offline option to the south.

11.2.2 Options 2, 8, 12 and 13 clearly rank badly and all have 3 red rankings and 1 amber, it was therefore decided not to pursue these options further. The top 6 ranked options 1, 4, 3, 6, 10 and 14 were then reviewed against each other and the other options.

11.2.3 Option 6 and option 14 are similar offline to the south routes, from the two option 6 was considered a preferable alignment and it was decided it would be taken forward to represent the best offline to the south route.

11.2.4 Option 3 and option 10 are similar predominantly online routes, option 3 being closest to the existing alignment was taken forward to represent the best online route.

11.2.5 Option 1 as one of the other two options ranking in the top 6, was chosen to best represent the offline to the north routes (performing better than the other closest off line to the north route, option 9).

11.2.6 Option 4 which ranked joint first with option 1 was taken forward to represent a hybrid between north and south offline options (performing better than the other two similar route options, option 7 and option 5).

11.2.7 Option 11 the other option ranked in the top 10 is also an offline to the south solution but due to its alignment and lower ranking than option 6 it was decided that Option 6 should be taken forward.

11.2.8 As part of the initial options review undertaken it was noted that some design development of option 6 should be considered with regard to a specific area of the alignment around Earthsea House school and there was potentially an option which should be developed from Option 6 to give an option 15 which moved the alignment further to the north specifically in this area. Following the meeting potential changes to option 6 alignment were reviewed in this area and an option 15 was developed and drawn up. On reviewing the option 15 and option 6 together it was considered at this stage of the scheme development that option 15 was within the range of design development of option 6 and that option 6 as shown should be taken forward for assessment. The route for option 6 and option 15 together are shown in **Appendix K** so the difference between the options can be seen.

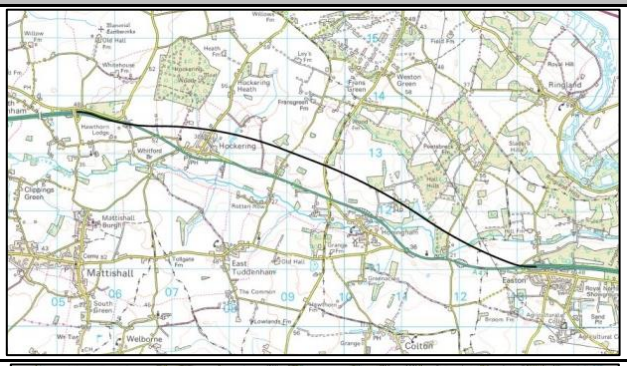
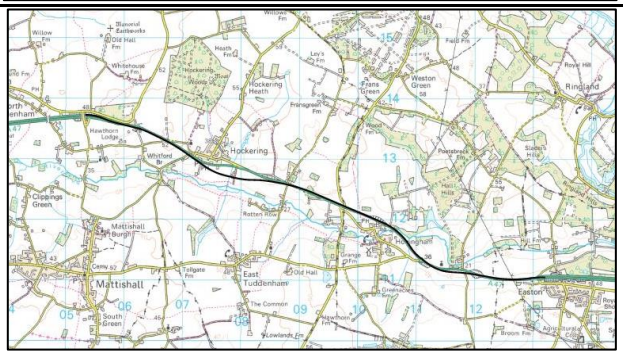
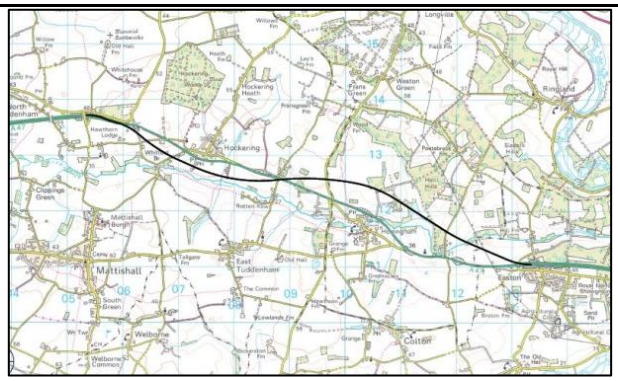
11.3 Options for Further Assessment

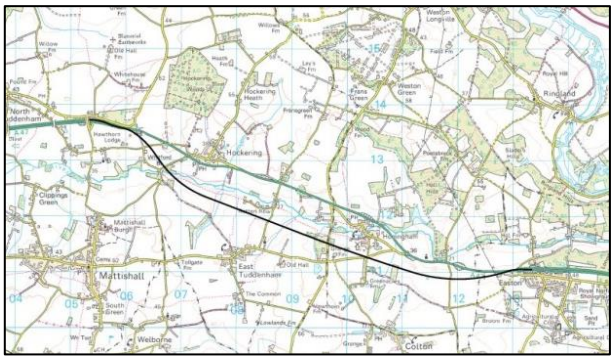
11.3.1 The four options to be taken forward for further assessment are

- Option 1 an offline dualling to the north of the existing
- Option 3 an online dualling following the existing A47 route
- Option 4 an offline dualling to the south of the existing A47 for the western part of the route and to the north of the existing for the eastern part of the route
- Option 6 an offline dualling to the south of the existing A47 route

11.3.2 The four options to be taken forward are shown below on **Figure 11-1**

Figure 11-1 The 4 options taken forward for further assessment

Option Number at PCF Stage 1	Route Plan (see section 9)
Option 1	
Option 3	
Option 4	

Option 6	

12 Traffic Analysis of Sifted Options

12.1 Introduction

12.1.1 The NATS model had been developed by Norfolk County Council specifically for assessment of traffic in and around Norwich. The model covered the area of central Norwich in detail and the surrounding areas in varying levels of detail. The detail around the Tuddenham scheme was not sufficient for the model to simply be used without additional detail being added and the model revalidated.

12.1.2 At the start of PCF Stage 1 it was initially planned to utilise the NATS model with suitable updates and revalidation specifically for and local to the A47 North Tuddenham to Easton Scheme, so that the modelling would be available to inform the economics at the end of PCF Stage 1.

12.1.3 Taking this approach would have led to three separate local model updates being undertaken for the three schemes (North Tuddenham, Thickthorn and Blofield) with a further exercise in PCF Stage 2 to combine the three model updates and revalidate the joined up model.

12.1.4 A detailed review of the timescales and programme for PCF Stage 1 and 2 was undertaken to review timescales to construction. It became clear that the time scales and work involved to combine and revalidate the 3 models proposed to be built in PCF Stage 1 into one model in PCF Stage 2 was likely to delay the end of PCF Stage 2 due to the rework and revalidation.

12.1.5 It was therefore agreed with Highways England and TAME that a single NATS model update and validation exercise which covered the necessary detail to analyse all three of the Schemes would be undertaken from the start.

12.1.6 Due to the timescales involved in updating and validating a combined transportation model the forecasting and economics based on the model outputs would not be available until PCF Stage 2. As the model build work would not be sufficiently advanced by the end of PCF Stage 1 the following products would not be able to be produced in time for SGAR 1

- The Local Model Validation Report
- The Traffic Forecasting Report
- The Economic Assessment Report and
- The Appraisal Summary Table (AST)

12.1.7 With the above in mind a technical note was produced in the Stage 1 TAR, Chapter 12, to summarise and describe the available transportation and economic appraisal information at the time of the Scheme reaching SGAR1 in November 2016.

12.1.8 The technical note was prepared in lieu of the full set of Stage 1 PCF products. With each of the sections of this note corresponding to a PCF product. The products covered in this note were:

- Appraisal Specification Report
- Traffic Data Collection Report
- Local Model Validation Report

- Traffic Forecasting Report
- Economic Assessment Report
- Appraisal Summary Tables

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12.1.9 Sections 12.2 have been taken from this technical note to describe the traffic modelling and forecasting which was undertaken at the end of PCF Stage 1, to enable the scheme to be assessed at the SGAR.

12.2 Traffic Modelling Approach

12.2.1 No strategic model is currently available to assess future year demand. In the absence of a calibrated strategic model and taking into account the timescales, the transport modelling was undertaken at a scheme level.

12.2.2 The assessment methodology is based on the assessment undertaken in Stage 0, with the figures updated to reflect updated scheme details and costs. Forecast traffic numbers have been re-forecast using TEMPRO 7.0. The latest version of TUBA (version 1.9.7) has been used in the economic assessment.

12.2.3 The traffic modelling has been undertaken using a spreadsheet-based tool to assess the link schemes. This considers the impact of the scheme on capacity/flow/speed characteristics and resulting vehicle travel times and distances. Capacity and speed flow characteristics have been derived from WebTAG Unit M3.1. The model assumes fixed demand and is highway only.

12.2.4 Journey times along the link have been calculated using speed-flow curves; do minimum journey times have been calculated using the speed/flow curve for a single carriageway and do something journey times have been calculated using the speed/flow curve for a dual carriageway.

12.2.5 No allowance was made for re-routing or induced traffic as a result of the scheme. Similarly no assessment has been made of the impacts of construction or maintenance due to a lack of data. The methodology was acceptable and proportionate for the detail of assessment required for stage 0.

12.3 Forecasting Methodology

12.3.1 Growth factors used to calculate future year demands have been derived from a combination of NTM and NTEM outputs as described in WebTAG Unit M4 Section 9.1: Using NTEM without a formal model. Different factors were calculated and used for cars, Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV); with different growth factors for cars in the three peak periods assessed.

12.3.2 12 hour Manual Classified Count (MCC) traffic surveys were undertaken on 25th June 2015. Queue surveys were undertaken at the same time.

12.3.3 The growth factors for LGV and HGV traffic have been assumed to be constant over all time periods. The calculation of growth factors for cars for North Tuddenham has used adjusted NTEM factors averaged from the districts of Breckland and South Norfolk. Growth factors for LGV and HGV are based on NTM factors for East of England.

12.3.4 As there are no committed developments directly accessing the scheme, no specific allowance has been made for developments; their impact has been assumed to be included as part of the localised growth factors.

12.3.5 The scheme has been assessed with an anticipated opening year of 2024, a design year of 2036, a horizon year of 2051 and a 60 year assessment from the opening.

12.3.6 Analysis of the link has been based on flows for each hour over an entire year, based on observed TRADS data. Because the analysis has been done on data covering an entire year, an Annualisation factor of 1 has been used.

12.3.7 Future demand flows used in the assessment have been calculated by applying TEMPRO 7.0 and NTM factors to the recorded hourly flows for an entire year and extracted from TRADS. They have been used as the basis of the modelling to predict future traffic performance with and without intervention in the Do-Minimum and Do Something Scenarios.

12.3.8 The modelling covers a core growth scenario, and no high and low forecasts have been developed at this stage.

12.3.9 Seasonality has been included in the modelling because hourly flows for an entire year have been used as the basis of analysis. For the same reason an Annualisation factor of 1 has been applied in the economic analysis.

12.3.10 Norfolk County Council have previously looked at the feasibility of a Western Link Road between the A47 in the Easton area to join up with the end of the NDR and effectively complete the link between the A47 to the west of Norwich. This link is not committed and is therefore not taken into account in the modelling.

13 Engineering Overview of Sifted Options

13.1 Introduction

13.1.1 The following sections describe the engineering features, assessment and key comparison between the 4 options at the time of PCF Stage 1.

13.1.2 The layouts for the 4 options, (Options 1, 3, 4 and 6) were further developed from the layouts used at the time of the sifting exercise to show indicative side road and junction layouts. This indicative side road and junction layout has been included at this stage to allow Highways England's Commercial team to price the options more fully. Junction strategy and side road strategy are not developed and fully considered until later PCF Stages so the layouts should be treated as indicative only. The layouts, for options 1, 3, 4 and 6, with the indicative junction and side road layouts are included in **Appendix L** and are discussed in the following sections.

13.2 Highways Alignment

General

13.2.1 The proposed carriageways would both be 7.3m wide with a provision of 1m hard strips on both sides of the carriageways. The central reserve would be a minimum of 2.5m however it is likely it may be wider at some locations to accommodate forward visibility at bends. The verge width would be a minimum of 2.5m but designed to accommodate forward visibility, traffic signs, vehicle restraints system and other network infrastructure.

13.2.2 At this stage the vertical alignment has not been fully developed in detail, the road would be designed where practical to follow the existing ground to minimise earthworks depths.

13.2.3 The national speed limit would apply on the proposed dual carriageway throughout its length. Any major junctions would be lit, and laybys would be provided on both carriageways at appropriate locations.

13.2.4 Current standards do not include direct access from properties and gaps in the central reserve on dual carriageways due to safety reasons.

13.2.5 Offline options would allow the existing single carriageway A47 to remain and operate as a local access road potentially with improved non-motorised user facilities. Where required, local access roads may need to be diverted or include mitigation measures to provide access to properties and adjacent fields.

Option 1 Offline to the north of the existing

13.2.6 The proposed new dual carriageway would be constructed offline to the north of the existing A47.

13.2.7 The proposed route is offline and because the route does not cross the existing A47 it is therefore not constrained by the existing A47 alignment either horizontally or vertically. Horizontal radii in excess of the Desirable Minimum for the design speed could be used throughout.

13.2.8 The vertical alignment could be improved compared to the existing and the proposal would have vertical crest curve radii greater than the Desirable Minimum for the design

speed. Generally the longitudinal gradients would be 2% or shallower but the gradient at the tie-in to the existing at Easton would be a little steeper at around 2.5%.

13.2.9 Being a reasonable distance offline to the north for the whole route would allow a considerable length of the existing A47 carriageway to be retained and used for local accesses.

Option 3 On-line improvement

13.2.10 The online improvement proposal would be to upgrade the existing single carriageway A47 to a two lane dual carriageway by primarily online widening, with discrete offline sections to avoid or minimise the impact on a number of constraints. Where required, local access roads may need to be diverted or include mitigation measures to provide access to properties and adjacent fields.

13.2.11 The alignment of this online improvement proposal would follow the existing alignment both horizontally and vertically as closely as possible. The existing horizontal road alignment is made up of mostly large radius horizontal curves and straights and the proposed option is likely to have horizontal radii equal to or greater than the desirable minimum for the design speed.

13.2.12 The existing vertical alignment is undulating with some fairly low radius vertical crest curves. Although there will be scope to improve the alignment on the short sections where the proposed deviates from the existing nevertheless the proposed alignment would have crest curve radii less than the Desirable Minimum for the design speed of this road.

13.2.13 Generally, the longitudinal gradients are shallower than 2% but there would be an instantaneous maximum of nearly 3% just to the west of the crossing of the River Tud.

13.2.14 Being on the line of and subsuming much of the existing A47 means that little of the existing road would be left to be used for local accesses and other provision would be required.

Option 4 Off-line improvement

13.2.15 The proposed new dual carriageway would be constructed part offline to the south and part offline to the north of the existing A47. The option would pass to the south around Hockering, crossing the existing alignment near Sandy Lane then passing north past Honingham before tying back in to the existing alignment at Easton.

13.2.16 The proposed route is offline therefore it is not so constrained by the existing A47 alignment as Option 3, although because the route crosses the existing A47 levels would have to be designed such that a through route could be maintained during construction. To move the alignment away from and then across the existing may require horizontal radii smaller than the existing alignment but they would still be in excess of the Desirable Minimum for the design speed.

13.2.17 The vertical alignment could be much improved compared to the existing and the proposal would have vertical crest curve radii greater than the Desirable Minimum for the design speed.

13.2.18 Generally the longitudinal gradients would be 2%.

13.2.19 Being a reasonable distance offline either to the north or south for the whole route would allow a considerable length of the existing A47 carriageway to be retained and used for local accesses.

Option 6 Off-line improvement

13.2.20 The proposed new dual carriageway would be constructed offline to the south of the existing A47.

13.2.21 The proposed route is offline and because the route does not cross the existing A47 it is therefore not constrained by the existing A47 alignment either horizontally or vertically. Horizontal radii in excess of the Desirable Minimum for the design speed could be used throughout.

13.2.22 The vertical alignment could be improved compared to the existing and the proposal would have vertical crest curve radii greater than the Desirable Minimum for the design speed. Generally, the longitudinal gradients would be 2% or shallower but the gradient at the tie-in to the existing at Easton would be a little steeper at around 2.5%.

13.2.23 Being a reasonable distance offline to the south for the whole route would allow a considerable length of the existing A47 carriageway to be retained and used for local accesses.

Junction Strategy

13.2.24 As noted above an indicative side road and junction layout has been developed for each option. This indicative side road and junction layout was included at this, PCF Stage 1 to allow Highways England's Commercial team to price the options more fully. Junction strategy and side road strategy are not developed and fully considered until later PCF Stages so the layouts should be treated as indicative only.

13.2.25 In order to provide a consistent basis for pricing all of the options have been detailed with, as far as practicably possible a similar junction strategy for the main A47 route as follows.

13.2.26 The existing grade separated junction on the A47 at the western end of the scheme where Fox Lane crosses over the existing A47 will be retained. This junction gives connectivity from the local road network onto and off the A47 in both east bound and westbound directions.

13.2.27 A second junction on the A47 will be provided towards the eastern end of the scheme between Easton and Honingham, approximately at the location of the current intersection of Blind Lane and Taverham Road with the A47. The junction will be formed by an over bridge taking the side road over the A47 and on and off slip roads from the side road routing onto and off the A47 in both east bound and westbound directions.

13.2.28 No other junctions or accesses have currently been included in the options being priced. Consideration to other junction locations along the route will be made during later PCF Stages, when the appropriate traffic modelling is available (during PCF Stage 3) to allow scenario testing of different junction and side road strategies.

13.2.29 The way in which the local highway network is amended to accommodate the route options and the junctions above is described in section 13.4 below. Again, this is an indicative strategy for side roads formulated at PCF Stage 1 for pricing of options only.

13.3 Departures from Standards

13.3.1 The Option layouts currently developed do not include any departures from standards, it should be noted that once the design is further developed some of the current relaxations from standards identified may become departures from standards. Further

review of departures from standards will be undertaken as the design develops in later PCF Stages.

Option 1 Offline to the north of the existing

13.3.2 Horizontal and vertical radii in excess of the Desirable Minimum for the design speed should be achievable throughout.

13.3.3 The alignment would include Relaxations from Standard for Stopping Sight Distance. These Relaxations could possibly become Departures from Standards if, once junction locations are confirmed in later PCF Stages, they are coincident with approaches to a junction.

Option 3 On-line improvement

13.3.4 The proposed option is likely to have horizontal radii equal to or greater than the Desirable Minimum for the design speed but crest curve radii less than the Desirable Minimum for the design speed of this road. As the outline design for pricing is close to minimum standards once the alignment is further developed and refined, there may be some Departures from Standard.

13.3.5 The alignment would also include Relaxations from Standard for Stopping Sight Distance. These Relaxations could possibly become Departures from Standards if, once junction locations are confirmed in later PCF Stages, they are coincident with approaches to a junction.

Option 4 Off-line improvement

13.3.6 Horizontal and vertical radii in excess of the Desirable Minimum for the design speed should be achievable throughout.

13.3.7 The alignment would include Relaxations from Standard for Stopping Sight Distance. These Relaxations could possibly become Departures from Standards if, once junction locations are confirmed in later PCF Stages, they are coincident with approaches to a junction.

Option 6 Off-line improvement

13.3.8 Horizontal and vertical radii in excess of the Desirable Minimum for the design speed should be achievable throughout.

13.3.9 The alignment would include Relaxations from Standard for Stopping Sight Distance. These Relaxations could possibly become Departures from Standards if, once junction locations are confirmed in later PCF Stages, they are coincident with approaches to a junction.

13.4 Side Roads, Access and Accommodation Works

13.4.1 As noted in the introduction the side roads, accesses and accommodation works for each of the 4 options at PCF Stage 1 was produced to enable Highways England Commercial to prepare Options estimates.

13.4.2 The indicative junction and side road strategy as shown on the layout for each of the options in Appendix L was developed at PCF Stage 1 for pricing purposes. A detailed junction strategy and side road requirements specific to the preferred option, once determined in PCF Stage 2 will be developed in more detail in later PCF Stages.

13.5 NMU Provision

General

13.5.1 It is currently anticipated that NMUs will not be encouraged to use the proposed A47 due to safety reasons and where practical alternative routes will be provided.

13.5.2 It is not proposed to provide any NMU facilities or at grade NMU crossings on the new carriageway for any of the proposed options.

13.5.3 For all options the side road strategy is currently indicative and has been developed for pricing purposes (see section 3.4) and will be developed further in later PCF Stages once transportation modelling is available (see Chapter 12). There will be changes necessary to the side roads to accommodate all of the options and this is likely to impact on the NMUs using local roads, be it cyclists, equestrians or pedestrians. As the design progresses any such impact would be identified and appropriate mitigation measures developed where practical.

13.5.4 In all cases the design of provision for NMUs would take due regard of the Disabilities Discrimination Act and national guidance on the provision of facilities to allow inclusive access for all those with a disability.

Option 1

13.5.5 Section 16.2.43 also refers to NMUs for Option 1.

13.5.6 This option is wholly offline to the north of the existing A47. The traffic that remains on the existing A47 carriageway would be greatly reduced and make it a friendlier environment for NMU use. The existing carriageway would help make continuity of east/west access through the corridor and would allow the two existing informal crossings of the A47 near Hockering and Honingham to remain unaffected. North/south access across the new route would be restricted to new bridge crossings. Where FP7 crosses the proposed option north of Hockering it could be feasible to divert it onto a bridge carrying Heath Road over the new A47.

Option 3

13.5.7 Section 16.3.36 also refers to NMUs for Option 3.

13.5.8 This option is largely on the line of the existing A47, departing from it in two places: south of Hockering for about 1.5km of its length; and for about 0.6km to the east of St Andrew's Church. To maintain east/west NMU continuity and provide continuity of NMU access to properties along the route it is likely that significant lengths of local access roads would have to be constructed. Being on-line and subsuming the existing carriageway at both of the existing informal crossings of the A47 near Hockering and Honingham this option would have to find alternatives to maintain this north/south connectivity. Although the option is off line where it crosses FP7 it is likely to be at existing ground level and would sever this route also.

Option 4

13.5.9 Section 16.4.41 also refers to NMUs for Option 4.

13.5.10 This option is wholly offline, running to the south of the existing A47 at the western end before crossing the existing line near Sandy Lane then continuing to the north of the existing before tying back in at Easton. The traffic that remains on the existing A47 carriageway would be greatly reduced and make it a friendlier environment for NMU use.

The existing carriageway would help make continuity of east/west access through the corridor providing a suitable bridge crossing could be provided, perhaps in the vicinity of Sandy Lane or Wood Lane.

13.5.11 This option runs to the south of the existing A47 where it crosses Mattishall Lane and is likely to be at existing ground level. It would sever the footway route to the existing western crossing point. Similarly, where it crosses FP7 it is likely to be at existing ground level and would sever this route also. Because it is to the north of the existing in the eastern section the existing informal crossing of the A47 near Honingham would remain unaffected.

Option 6

13.5.12 Section 16.5.42 also refers to NMUs for Option 6

13.5.13 This option is wholly offline to the south of the existing A47. The traffic that remains on the existing A47 carriageway would be greatly reduced and make it a friendlier environment for NMU use.

13.5.14 This option runs to the south of the existing A47 and would cross Mattishall Lane close to where it would cross the river Tud. It is likely that the route would be on an embankment and that a bridge could take Mattishall Lane under the proposed route allowing the existing informal crossings of the A47 near Hockering to remain unaffected. Although the option is off line where it crosses FP7 it is likely to be at existing ground level and would sever this route. The route would run to the south of Honingham and the existing informal crossing of the A47 near Honingham would remain unaffected.

13.6 Drainage and Flooding

13.6.1 Drainage proposals envisaged at PCF Stage 1, were expected to include positive drainage in the form of carrier drains, filter drains, gullies, combined kerb drains (roundabouts), channels etc. These would convey rainwater falling on the carriageways to the nearest existing or proposed outfalls.

13.6.2 Depending on the suitability of the ground conditions, infiltration may be used as a form of disposal of flows from the storage structures.

13.6.3 The carriageway subsurface would also have to be drained. In the case of a carriageway on embankment, the proposed carriageway sub surface would be drained via a system of fin or narrow filter drains, on the lower side of super elevated carriageways, or on both sides for cambered carriageways. In turn, these would discharge into the nearest piped network. In the case of a proposed carriageway in cutting, the subsurface as well as the sloped cutting would be drained via a system of filter drains placed in the verge. Depending on the topography of the surrounding land, filter drains may also be required to collect flows at the top of cuttings.

13.6.4 For information on water courses, flood zones/plains, groundwater source protection zones, ponds and aquifers, see Section 4 (Environment including Environmental Status) and Section 16 (Environmental Assessment). Both temporary and permanent works have to ensure that the aquifer and extraction licences (if any) are unaffected by the works and the EA's consent sought. The provision of treatment facilities in the form of oil interceptors and/or storage ponds etc. would reduce the potential for contamination by hydrocarbons.

13.6.5 Proposals for each of the options will involve works within the flood plains as all options include crossings over the River Tud. This will require the consent of the EA, whether for temporary or permanent works.

13.6.6 The online widening of the existing carriageway at the tie in points, will necessitate the abandonment of some of the existing drainage and replacement with new drainage features for that section of carriageway as well as any side roads. There would also be an increase in the contributing area. Storage would be provided to limit proposed flows to no more than existing peak flows.

13.6.7 HADDMS indicates that a culvert crossing around 30m to the west of The Street on/off slip appears to convey flows from a 'tertiary river' across the A47. It also shows 'tertiary river' crossings under the A47 around 600m to the west of Low Road, and 300m to the west of Norwich Road roundabout. It is therefore likely that at each of these two locations a pipe or culvert exists to convey flows under the A47.

13.6.8 The online widening of the A47 at the western tie in point will require the extension/protection of the two existing concrete culverts. The construction of the new offline route including Link Roads and junctions will require the construction of new culverts at water course crossings.

13.6.9 The proposed works may involve the severing of existing field drainage systems. These systems will have to be reconstructed with the agreement of field owners/occupiers. In any case, any substantial areas of field sloping towards the proposed carriageway will have to be drained by a system of ditches or filter drains.

13.6.10 As most of the proposed carriageway route (including the new Link Roads and junctions) will be in greenfield areas, it may be a requirement for the catchment discharge to be limited to 'Greenfield' run off. This in turn is likely to require substantially sized storage in the form of balancing ponds or oversized pipes. Depending on a number of factors such as the traffic flow and catchment areas, the ponds may also have to have treatment and accidental spillage containment facilities.

13.7 Geotechnical Considerations

13.7.1 A broad level assessment of the currently available information has identified the following potential geological risks that would require further assessment and these are identified below:

13.7.2 The presence of known and unknown buried services beneath the proposed routes including a high-pressure gas pipeline recorded to cross the site in close proximity to Honingham in areas of soft compressible soil layers or layers susceptible to shrinking and swelling presenting potentially significant risk to design and construction, impacting the project programme and associated cost.

13.7.3 There is not adequate ground investigation data beneath the proposed routes and as such variable or unknown ground conditions are likely to be encountered with significant impact on the detailed design and construction stage.

13.7.4 The Superficial geology beneath the site generally comprises of Lowestoft Formation although areas of Sands and Gravels (Sheringham Cliffs Formation) and narrow strips of Alluvium are also recorded across the site. The primary risks associated with the variability of the superficial deposits will be the variability in settlement characteristics and associated differential settlement. This is specifically prevalent where narrow strips of soft Alluvial deposits are bound by predominantly coarse grained soils, and this is a situation that is present at several locations along the scheme extents.

13.7.5 High flooding risks, associated with the presence of a complex river network covering the site, could significantly affect the design and construction stages, imposing health and safety risks to the site personnel or end users. Therefore, raised earthworks may be required as part of the works, leading to increased loading conditions potentially above

areas underlain by compressible strata. Further ground investigation will be required to assess this further.

13.7.6 Potential shallow groundwater, associated with the presence of rivers and their tributaries, in areas of soft compressible soil layers or layers susceptible to shrinking and swelling presenting potentially significant risk to design and construction, impacting the project programme and associated costs. This risk will require assessment through installing groundwater monitoring points across the selected route and the results should be incorporated in the detailed design stage.

13.7.7 Presence of soluble rocks in conjunction with considerable surface or subsurface water could lead to subsidence and affect the design and construction phase. Further ground investigation to obtain adequate information on bedrock properties will be required and the results should be considered at the detailed design stage.

13.7.8 The solid geology of the site predominantly comprises the Lewes Nodular Chalk Formation. As with the Superficial geology beneath the site, there is a lack of reliable ground investigation data for the chalk.

13.7.9 The chalk is classified by the Environment Agency as a Principal aquifer with major vulnerability.

13.7.10 Ceased opencast mines are recorded within close proximity to the site and are indicative of potential presence of backfilled voids which could lead to subsidence or differential settlement after surcharging imposed by the earthworks construction. Further ground investigation may be required to assess these potential hazards.

13.7.11 The Geotechnical Classification as defined by DMRB HD22/08 is considered to be Category 2 for the proposed route options as mentioned in the Statement of Intent. Further assessment of the geotechnical risk classification will take place in the formulation of the scheme Preliminary Sources Study Report (PSSR).

13.7.12 The geotechnical risk register and associated geotechnical hazard plan can be found in the Geotechnical Statement of Intent and will be updated during completion of the PSSR.

13.8 Structures

General

13.8.1 As noted in the introduction an indicative junction and side road strategy as shown on the layout for the option in **Appendix L** was developed at PCF Stage 1 for pricing purposes. A detailed junction strategy and side road requirements specific to each option will be developed in more detail in a later PCF Stage.

13.8.2 The structures requirements for each of the options have been developed for pricing purposes based on the indicative junction and side roads strategy and the alignments shown on the layouts in Appendix L.

Option 1

13.8.3 The proposed new dual carriageway would be constructed offline to the north of the existing A47 between North Tuddenham and Easton. **Table 13-1** below lists the structures which have been identified as required for the Option and gives there location identified by chainages measured along the route.

Table 13-1 Option 1 – Structures

Structure Number	Chainage (m)	Structure Type
1-1	900	Culvert
1-2	970	Culvert
1-3	1550	Culvert
1-4	1870	Culvert
1-5	2200	Culvert
1-6	2400	Single Carriageway Overbridge
1-7	2800	Culvert
1-8	4500	Single Carriageway Overbridge
1-9	5900	Culvert
1-10	6250	Culvert
1-11	6400	Culvert
1-12	7000	Single Carriageway Overbridge
1-13	7300	Dual Carriageway Underbridge

Option 3

13.8.4 The proposed new dual carriageway would be an online widening of the existing A47 between North Tuddenham and Easton. Table 13-2 below lists the structures which have been identified as required for the Option and gives the location identified by chainages measured along the route.

Table 13-2 Option 3 – Structures

Structure Number	Chainage (m)	Structure Type
2-1	900	Culvert
2-2	950	Culvert
2-3	1100	Culvert
2-4	2750	Culvert
2-5	4700	Dual Carriageway Underbridge
2-6	5675	Dual Carriageway Underbridge River Tud
2-7	6050	Culvert
2-8	6450	Single Carriageway Overbridge

Option 4

13.8.5 The proposed new A47 between North Tuddenham and Easton would be offline 200m to the south of Hockering and then offline 480m to the north of Honingham. Table 13-3 below lists the structures which have been identified as required for the Option and gives the location identified by chainages measured along the route.

Table 13-3 Option 3 – Structures

Structure Number	Chainage (m)	Structure Type
4-1	900	Culvert
4-2	2750	Culvert
4-3	4700	Single Carriageway Overbridge
4-4	6300	Culvert
4-5	6450	Culvert
4-6	6950	Single Carriageway Overbridge
4-7	7300	Culvert
4-8	7400	Dual Carriageway Underbridge

Option 6

13.8.6 The proposed new A47 between North Tuddenham and Easton will be offline 650m south of existing A47. Table 13-4 below lists the structures which have been identified as required for the Option and gives their location identified by chainages measured along the route.

Table 13-4 Option 6 – Structures

Structure Number	Chainage (m)	Structure Type
6-1	800	Culvert
6-2	900	Culvert
6-3	1800	Culvert
6-4	1900	Dual Carriageway Underbridge
6-5	1925	Culvert
6-6	2880	Culvert
6-7	2890	Culvert
6-8	4100	Culvert
6-9	4750	Culvert
6-10	6200	Culvert
6-11	6530	Dual Carriageway Underbridge
6-12	6750	Culvert

Structures Types

13.8.7 The tables above for each option identify the Structure Types as either culverts or bridges

13.8.8 For pricing purposes at PCF Stage 1 it was assumed that the culverts required would be a reinforced concrete box culvert constructed by either precast or in-situ solutions, the width and depth of the culvert would be confirmed following further design in later PCF Stages. The culvert is likely to be founded on compacted hardcore, this will be confirmed following further design development and geotechnical investigation in future PCF Stages.

13.8.9 For pricing purposes at PCF Stage 1 it was assumed that the bridges required would be in the form of steel beams acting compositely with a reinforced concrete deck slab on top, which would be supported on RC abutments at both ends. The foundations would be either piles or raft foundations depending on the existing ground conditions.

13.9 Public Utilities

13.9.1 The current utility records available are for the area around the A47. Further statutory undertaker's requests would be made in future PCF Stages to check for positions of utilities remote from the existing A47.

Option 1, 4 and 6 Offline Dualling Options

13.9.2 The offline improvements of the existing A47 alignment would have a relatively low impact on existing statutory undertakers' equipment due to the apparent lack of apparatus and equipment in the vicinity of the route. Existing statutory undertakers' equipment is most likely to be encountered where this offline improvement crosses an existing road, lane or track and where encountered these utilities should be treated appropriately.

13.9.3 Specific services which would require diversion or protection are:

- a communications overhead cable on the A47 eastbound and includes an overhead crossing of the A47 to Oak Farm;
- transverse utility crossings including a high-pressure gas main which should be afforded adequate protection and thickened wall sections;
- high voltage overhead cables which would need to be buried where they cross the route;
- high voltage 132 kV cables that cross the route approximately 400m west of Easton and particular attention should be paid to providing the required minimum clearance to these lines.

Option 3 Online Dualling

13.9.4 The Option 3 online improvement of the A47 between North Tuddenham and Mattishall Lane would have minimal impact on existing utilities due to there being few statutory undertakers' equipment in the immediate vicinity. The exception to this appears to be communications overhead cables on the A47 eastbound side and includes an overhead crossing of the A47 to Oak Farm. This communications crossing would need to be incorporated into any future A47 improvement.

13.9.5 Online improvement of the A47 between Mattishall Lane and Wood Lane would require varying amounts of statutory undertakers' diversion or protection works. Between Mattishall Lane and Sandy Lane relatively little diversion works or protection is required apart from at the start and end of this section where existing road junctions may necessitate some minor diversions or protection to existing water, communications and electricity equipment. There are a number of high voltage overhead and underground electrical cable crossings between Mattishall Lane and Sandy Lane in this section and these should be buried under the route.

13.9.6 An online improvement of the A47 between Wood Lane and Easton Roundabout would require a significant amount of statutory undertakers' diversionary/lateral relocation works to water and foul sewerage in the A47 westbound verge and to communications and high voltage underground cables generally in the A47 eastbound verge. A high pressure gas main crosses the route to the west of Honingham and would need to be relayed with thicker wall sections at considerable cost. Further extensive diversionary works would be required where the route gets closer to the A47 at Easton. Here existing water and foul sewerage in the A47 westbound verge and communications generally in the eastbound verge, need to be relocated laterally. Various existing utilities cross the route in this area, including communications underground and overhead lines and high voltage overhead cables. Particular attention would need to be paid to providing minimum clearance to 132kV overhead electricity lines located approximately 400m to the west of Easton.

13.10 Topography, Land Use, Property and Industry

13.10.1 The River Tud runs through the A47 corridor and will have an influence upon any proposed improvements. The land is primarily of agricultural use with pockets of land associated with residential properties, education, commercial, retail and light industry within or surrounding the three villages along the route.

Option 1 Offline Dualling to the North

Main Road to Heath Road, Hockering

13.10.2 The land affected would be predominately of agricultural use. However, at the tie-in of the new and existing sections of the A47, the works will affect a section of Poppy's Wood

to the north, the access and part of an equestrian centre to the south. North of the village of Hockering the link road will affect an existing sports field and tennis court.

Heath Road, Hockering to Wood Lane

13.10.3 Except for the ponds at Park Farm and a residential property, 20 Heath Road, all the land affected is of agricultural use.

Wood Lane to Easton

13.10.4 Some wooded areas are affected by this option. However, the vast majority of the land area affected is of agricultural use. These agricultural areas include the lowland fens near the River Tud. The new alignment passes close to Hall Farm where the main group of residential / farm buildings are located. Some farm buildings may be affected by this option.

Option 3 Online Dualling

Main Road to Mattishall Lane, Hockering

13.10.5 The land affected would be predominately of agricultural use. However, at the tie-in of the new and existing sections of the A47, the works will affect a section of Poppy's Wood to the north, the equestrian centre and its access from the existing A47 to the south. At Mattishall Lane, the new alignment will affect part of the garden area of No 1 Mattishall Lane.

Mattishall Lane, Hockering to Wood Lane

13.10.6 The land affected by this option is predominately of agricultural use. However, in addition to two private access roads affected, part of a plant nursery, a residential property on Gypsy Lane and part of two front gardens of residential properties near Sandy Lane will be affected.

Wood Lane to Taverham Road

13.10.7 The land affected by this option is predominately of agricultural use. However, in addition to the private access roads, the property known as The Lodge will be affected. Also, a section of the grounds of St Andrew's Church may be affected.

Taverham Road to Easton

13.10.8 The land affected is of agricultural use.

Option 4 – Offline dualling to the south of the existing A47, for the western part of the route and to the north of the existing for the eastern end of the route

Main Road to Mattishall Lane, Hockering

13.10.9 The land affected would be predominately of agricultural use. However, at the tie-in of the new and existing sections of the A47, the works will affect a section of Poppy's Wood to the north. To the south the alignment will severely affect the equestrian centre and its access road. A transmitter mast will also be affected by the works.

Mattishall Lane, Hockering to Sandy Lane

13.10.10 The land affected is predominately of agricultural use.

Sandy Lane to Taverham Road

13.10.11 Some wooded areas are affected by this option. However, the vast majority of the land area affected is of agricultural use. These agricultural areas include the lowland fens near the River Tud. Near Sandy Lane, part of a front garden of one residential property, and part of a residential plot / access will be affected by the construction of the link road. The new alignment passes close to Hall Farm where the main group of residential / farm buildings are located and some farm buildings may be affected.

Taverham Road to Easton

13.10.12 The land affected is predominately of agricultural use.

Option 6 – Offline Dualling just to the South

Main Road to Mattishall Road, Hockering

13.10.13 The land affected would be predominately of agricultural use. However, at the tie-in of the new and existing sections of the A47, the works will affect a section of Poppy's Wood to the north. To the south, the alignment will severely affect the equestrian centre and its access road. Also, affected by the works will be a transmitter mast and the access to the property known as The Lodge on Low Road.

Mattishall Road, Hockering to Church Lane

13.10.14 The land affected is predominately of agricultural use.

Church Lane to Mattishall Road

13.10.15 Except for the wood area at Warren Plantation the land affected is of agricultural use.

Mattishall Road to Easton

13.10.16 The land affected is of agricultural use.

13.11 Buildability

13.11.1 The following section gives an overview of the potential buildability issues with regard to the Options.

13.11.2 Existing ponds are located at various locations along the route and the route crosses a floodplain at two locations. These locations may require special earthworks treatment where earthworks may encounter poor ground conditions.

13.11.3 The River Tud and various other watercourses cross the site at a number of locations. Consideration would be given to methods of maintaining the flow of water of these watercourses while constructing bridges/culverts to accommodate them is carried out.

13.11.4 Three other bridges/structures will be constructed over the line of the route. All three bridges will provide access for existing traffic from one side of the A47 to the other. The use of existing roads can be maintained throughout the construction phase by the construction of temporary diversion routes around the site of the proposed bridges.

13.11.5 Direct access to the villages of Hockering and Honingham and to land on either side of the existing A47 is likely to be affected by the construction works. Access to these locations either by incorporating access into the traffic management arrangements or by the provision of temporary works to facilitate access would be required.

13.11.6 The tie-ins at either end of the scheme where the improvement connects into the existing A47 carriageway would possibly be constructed either under temporary traffic signals, or by temporary diversion works. The construction of the tie-ins may cause some disruption to the travelling public.

Options 1 and 6 Offline Dualling

13.11.7 Options 1 and 6 are considered to have the lowest impact regarding buildability of the scheme. Although construction would cause some disruption to the general public the options can be constructed almost totally offline. This means that for the majority of the time the works can be carried out with only minor traffic management measures required apart from at the tie-ins where more extensive traffic management would be needed.

Option 3 Online Dualling

13.11.8 This Option is considered to have the greatest buildability challenges and would cause disruption to the general public as traffic management measures would be required throughout the length of the scheme to keep traffic segregated from the construction works. This is likely to take the form of single carriageway running of the existing A47 with narrow lanes and is likely to cause disruption to the public during the period that the traffic management is in place.

13.11.9 As detailed in section 13.9, the impact on the existing utilities for option 3 are greater than for the offline options.

Option 4 – Offline Dualling to the South and the North

13.11.10 This Option would have a relatively low impact regarding buildability. As for Option 1 and 6 the option can be constructed almost totally offline. This means that the majority of the works can be carried out with relatively minor traffic management measures. The Option is made more complex and disruptive to construct as compared to Options 1 and 6 as the route crosses the existing A47, mid-way between Hockering and Honingham, and would require more extensive traffic management.

14 Operational, Technology and Maintenance Assessment of Sifted Options

14.1 Operational Assessment

14.1.1 The North Tuddenham to Easton section of the A47 serves as a key local route for local traffic into and out of Norwich as well as part of the strategic highway network from Peterborough to Norwich and beyond, and is a major trunk road on the strategic road network.

14.1.2 The road currently operates as a single carriageway link with local roads linking in along the route.

14.1.3 All Options for the proposed dualling scheme will operate as a dual 2 lane all-purpose highway.

14.1.4 The side road strategy is not developed at PCF Stage 1 but once dualled there will be a reduced number of junctions onto and off the section of road and due to the operating regime of modern dual carriageway standards there will be no direct right turn off or on to the dual carriage way.

14.1.5 The existing single carriageway section of the A47 for options 1, 4 and 6 would remain and become, with suitable adjustment to layout and priorities as necessary, part of the local road network. It is likely that the section of road would be de-trunked and Norfolk County Council would become Highway Authority for these sections.

14.2 Technology Assessment

14.2.1 As detailed in section 3.11 there is limited technology in the section of the A47 between North Tuddenham and Easton.

14.2.2 The technology equipment will be affected by all of the 4 options and will be replaced as required and as appropriate to the design of the preferred option once chosen.

14.2.3 Emergency telephone provision will be reviewed in the preliminary design stage (Stage 3) and appropriate provision made.

14.2.4 The current route is predominantly unlit with lighting at the at grade roundabout junctions. It is likely that the new scheme will follow a similar lighting strategy, however street lighting provision along the scheme will be reviewed in stage 2 and appropriate street lighting will be provided as required.

14.2.5 Any offline dualling may require additional technology to support the operation of the road. At this PCF Stage, no consideration has been given to this and this will be reviewed in future PCF Stages.

14.3 Maintenance Assessment

14.3.1 Maintenance considerations will be developed further as the scheme progresses through to the next stage. A Maintenance Repair Strategy Statement (MRSS) is produced in PCF Stage 2.

15 Safety Assessment of Sifted Options

15.1 Introduction

15.1.1 This section discusses the consideration of safety in the design considerations and how these align with Highways England's RIS and Delivery Plan.

15.2 Summary of Safety Assessment

Highways England Delivery Plan 2015-2020: A safe and serviceable network

15.2.1 The Highways England Delivery Plan 2015-2020 sets out the following safety measures that will result in noticeable improvements for customers and will contribute significantly to achieving the 40% reduction in KSIs. A commentary is provided below about how the options identified align with these measures.

Upgrades to junctions and removing some of the worst bottlenecks

15.2.2 All the options identified seek to upgrade the A47 from single carriageway to dual carriageway over the length of the Scheme this will remove the current bottleneck caused by this section of single carriageway and join the two existing sections of dual carriageway with a continuous section of dual carriageway from Norwich to Dereham.

Developing higher standard A roads, to be known as 'Expressways'

15.2.3 The RIS sets out its vision of the network toward 2040. The A47 North Tuddenham to Easton Scheme is not identified in the "current, planned and potential Expressways" category.

15.2.4 Should the 'Expressways' network be expanded to include the A47 North Tuddenham to Easton scheme the key relevant criteria to these schemes is "Junctions which are largely or entirely grade separated, so traffic on the main road can pass over or under roundabouts without stopping." Junction Strategy for the route options would be developed in later PCF Stages, the route options do not currently preclude a change to 'Expressway Standards'.

Upgrading central barriers

15.2.5 The existing highway layout does not include a central reserve barrier as the section of the road within the scheme is single carriageway. All of the proposed options are dual carriageway and would incorporate appropriate central reserve barrier. All of the Options, will as required, tie in to the existing central reservation barrier at the ends of the Scheme.

Providing safer verges with improved run off protection

15.2.6 Providing safer verges with improved run off protection is a detailed consideration which will be considered during following PCF stages.

Improved road signing and markings

15.2.7 All of the options identified offer the opportunity to undertake a detailed review of the existing road signings and markings, and upgrade and replace these as necessary.

Upgrading lay-bys

15.2.8 There are 5 existing laybys on the existing A47 section of single carriageway where appropriate these will be replaced within the scheme with suitable standard laybys.

Developing and deploying technology to prevent, detect and monitor incidents.

15.2.9 The current scheme scope does not necessitate the introduction of technology to prevent, detect and monitor incidents.

Using designated safety funding to deliver targeted safety improvements.

15.2.10 Opportunities for use of designated safety funding to deliver targeted safety improvements will be explored in the following stages.

16 Environmental Assessment of Sifted Options

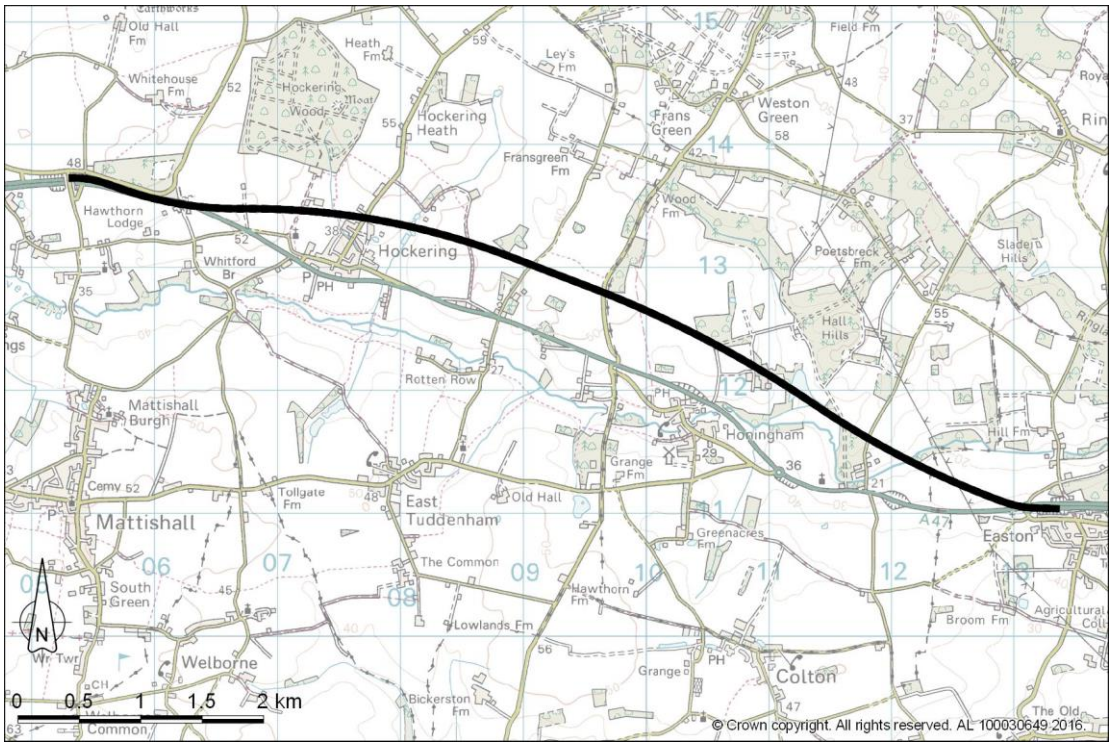
16.1 Introduction

16.1.1 Chapter 11 describes the options sifting process and identified that Options 1, 3, 4 and 6 will be taken forward for further assessment. The following sections provide an initial environmental review of these four options undertaken in PCF Stage 1. This environmental review was undertaken in relation to each of the environmental topics described in Chapter 4.

16.2 Option 1 (PCF Stage 1)

16.2.1 Option 1 is an offline dualling to the north of the existing A47 route as shown in **Figure16-1**. The proposed route of the A47 corridor to the north of the existing is effectively a new highway corridor and it would therefore be necessary to acquire land along the route to accommodate the improvement.

Figure 16-1 Option 1 (PCF Stage 1)



Air Quality

16.2.2 With Option 1, the road moves away from sensitive receptors in Honingham and the southern edge of Hockering, but closer to the residential receptors at the north of Hockering. The new alignment will also move the road closer to a number of individual properties that are scattered throughout the rural environment. This reduces the distance between the pollutant source and the receptors and may adversely affect local air quality.

16.2.3 For those receptors that will have the road closer to them, there will be a consequent decrease in local air quality. However, the dualling of the A47 should improve traffic flow which will reduce low speed traffic, and lead to improvements in local air quality. In addition,

there will be improvements in local air quality for the receptors in Honingham and south Hockering as the road moves away from them.

16.2.4 A reduction in queueing traffic may allow vehicles to travel at greater speeds, leading to greater greenhouse gas emissions. Changes in composition can affect ambient air quality due to an increase in diesel powered HGV and LGV traffic that could result in an increase of PM and NO_2 levels.

16.2.5 All human receptors within the study area are exposed to the risk of health impacts from the inhalation of construction dust. Construction dust can also affect ecosystems through deposition that acts as a physical barrier to photosynthesising plants, and through the effects of its chemical constituents on sensitive ecological receptors.

16.2.6 At this stage, impacts on air quality from Option 1 are considered to be **neutral**.

Mitigation

16.2.7 If significant adverse effects on air quality are predicted, mitigation measures would take the form of a review of the proposed design of the option to consider relocating some sections of road further away from sensitive receptors, or reviewing speed limits to improve emissions from vehicles, or the consideration of options to manage the volumes of traffic using the new road alignments.

16.2.8 In accordance with the Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction, a dust risk assessment will be carried out and the appropriate mitigation measures will be implemented during the construction phase to minimise adverse impacts from dust emissions and vehicle emissions on nearby sensitive receptors.

Cultural Heritage

16.2.9 Within the study area there are 21 listed buildings and numerous recorded archaeological sites and historic buildings. There are no listed buildings within the footprint of the option. The closest listed buildings to Option 1 are Church of St Michaels (Grade I), Church Farm House and Barn (Grade II) and Church of St Peters (Grade II) which are within 200m. They are unlikely to be directly affected by Option 1, but there may be impacts on their settings.

16.2.10 The known archaeological site record within the study area suggests that there is high potential for further buried archaeological remains to survive and there are numerous undesignated historic environment sites within the footprint of Option 1. In addition, there is potential for the new road alignment to affect subsurface remains and archaeological features. Construction activities could disturb or destroy these features.

16.2.11 At this stage, impacts on cultural heritage from Option 1 are considered to be **minor adverse**.

Mitigation

16.2.12 It is likely that archaeological mitigation measures can be put in place through a Written Scheme of Investigation (WSI) to reduce the impact on the historic environment. Mitigation measures may include, but are not limited to, geophysical survey, field walking, evaluation excavation and landscape screening.

Landscape and Visual

16.2.13 Option 1 is wholly offline running through a tranquil, rural landscape and would have an associated loss of landscape features including hedgerows, trees, ponds, woodland and arable land. It is unlikely to affect the regional landscape character, however it is likely to

affect the local landscape with the pattern, scale and appearance and tranquillity of the landscape all potentially affected.

16.2.14 Visual receptors to the north of Hockering are likely to experience adverse impacts from Option 1 as the proposed alignment skirts the north of the village, which is currently agricultural land with open views into the countryside. It is likely that Option 1 will significantly change the views currently experienced by these properties and the new road alignment may be a visible feature in the landscape.

16.2.15 At this stage, impacts on landscape and visual receptors from Option 1 are considered to be **moderate adverse**.

Mitigation

16.2.16 Mitigation should seek to integrate the new route into the landscape as far as possible. Potential mitigation could consist of screen planting or reinstatement of woodland to limit views of this from receptors at the north of Hockering and to integrate the scheme into the landscape. However it may take over 15 years to mature sufficiently to provide the same level of screening.

Nature Conservation and Biodiversity

16.2.17 Hockering Wood SSSI is within 300m of Option 1. Large areas of the woodland are undisturbed and contain rare and local species and Option 1 could adversely affect these species by disturbance during construction.

16.2.18 Option 1 cuts across the southern extent of Park Grove, an ancient woodland designated as a CWS, and would likely require removal of part of the ancient woodland, which would have significant impacts on biodiversity. In addition, as Option 1 is offline, it runs through numerous areas of priority habitat including deciduous woodland, lowland fens, coastal and floodplain grazing marsh and good quality semi-improved grassland, parts of which would be lost as a result of the option.

16.2.19 Option 1 would also require the loss of hedgerows and trees which will result in habitat loss for birds and bats, as well as affecting commuter routes for bats. The creation of new junctions can result in severance of habitats as well as habitat loss and disturbance.

16.2.20 There are approximately eight ponds within the footprint of Option 1, of which one has confirmed presence of GCN (Pond ID: 82).

16.2.21 Preliminary surveys for the project identified that Option 1 could affect areas of habitat that potentially support the following protected species - breeding birds, bats, desmoulin's whorl snail, water vole (where Option 1 crosses the River Tud) and reptile.

16.2.22 Indirect impacts of noise, watercourse pollution / sediment dust, lighting, increased human disturbance, potential for invasive non-native species from works at various locations and operational traffic also have potential to adversely affect various species. Some of the resulting effects may be temporary or permanent, and of varying magnitude, which may in turn be significant or not significant.

16.2.23 At this stage, impacts on nature conservation and biodiversity from Option 1 are considered to be **moderate adverse**.

Mitigation

16.2.24 Options to avoid/reduce/mitigate/compensate for any potential adverse effects on designated sites and protected/notable habitats and species should be undertaken as the scheme evolves. Standard mitigation measures are also to be considered which include pollution

prevention control measures, standard control measures to control dust from construction activities, preconstruction surveys, Ecological Construction Environmental Management Plan (EcoCEMP); and production of a Handover Environmental Management Plan (HEMP).

16.2.25 Additional mitigation measures to also consider during the scheme design, construction and operation, include: retention of habitats and on-site soft landscaping which would also benefit flora and fauna species and meet the objectives of local and Highways England BAP; off-site mitigation and enhancement areas (where this cannot be met within the proposed scheme boundary); biodiversity no net loss assessment; enhancing the wildlife corridor and ecosystem function of the proposed scheme e.g. through appropriate habitat creation, wildlife tunnels, underpasses and culvert/bridge design; mammal fencing to minimise operational effects on fauna e.g. badger and otter (where applicable); and on-going monitoring surveys with a feedback mechanism in place to ensure results are fed into the detailed design.

16.2.26 The scheme will look at ways that net-gains in biodiversity could potentially be achieved, which would meet objectives in the Highways England Biodiversity Plan ahead of the 2040 target. These gains may be achieved through the creation of new habitats, wildlife corridors and by improving existing habitats and habitat interconnectivity.

16.2.27 Further baseline surveys are required at PCF Stage 2 to inform fully mitigation proposals. Consultation will also be required with ecological stakeholders on the mitigation proposed.

Noise and Vibration

16.2.28 Option 1 moves the existing A47 alignment away from sensitive receptors in Honingham and the southern end of Hockering, all of which will experience a reduction in present noise levels with Option 1. It will however introduce a new noise source to properties at the northern extent of Hockering resulting in an increase in noise levels in an otherwise quiet rural location. Similarly there will be increased noise levels at scattered rural properties currently in quiet settings. Overall, more receptors are likely to experience a decrease in noise levels than an increase.

16.2.29 Noise levels at 3 NIA (5200 at Hockering, 5201 at Park Lane/Sandy Lane and 6287 at Church House Lodge) are likely to decrease as Option 1 moves the road alignment away from the NIAs. There will be no change in noise levels at the NIA in Easton (5202) as there is no change to the carriageway alignment at this point.

16.2.30 No details of the construction works required for this option are currently available. However, there is the potential for significant noise effects at the closest receptors to the works, in particular if night time works are required. Vibration effects would only occur if works such as impact piling or vibratory ground improvement are required.

16.2.31 At this stage, impacts on noise and vibration from Option 1 are considered to be **minor adverse** due to the expected increase in noise levels at the northern edge of Hockering and at scattered properties.

Mitigation

16.2.32 Mitigation measures that could be considered to reduce the impact of traffic noise on local receptors, if required, include:

- Maximising the distance between new/realigned sections of road and nearby receptors;
- Minimising changes in traffic on existing roads due to the scheme;
- Earth bunds/noise barriers to screen nearby receptors. Where there is sufficient land available, earth bunds/noise barriers can be designed in conjunction with the landscape design to help integrate the route of new/realigned sections of road into the surrounding area. This can also provide visual mitigation;

- Low noise surfacing, if traffic speeds are sufficient for a low noise surface to be effective. Current guidance in the DMRB advises that a noise benefit from a low noise surface should only be assumed at speeds of 75 km/hr or more; and
- Noise insulation of individual properties to protect the internal noise environment.

16.2.33 Construction works should be carried out in accordance with BS 5228-1 and -2 2009+2014 amendments 'Noise Control on Construction and Open Sites' to mitigate temporary noise impacts.

Road Drainage and Water Environment

16.2.34 Option 1 has the potential to significantly affect the water environment as it requires one new crossing of the River Tud and passes through numerous ponds and areas of lowland fen habitat. Impacts could include hydrological changes, habitat loss, disturbance of species or water pollution events.

16.2.35 There are areas of medium to high flood risk (Flood Zones 2 and 3) along the River Tud that could be affected by any land take required for the new crossing of the river. There are also flood defences along both banks of the River Tud and so existing flood risk could be affected if any changes are required to the defences to construct the new river crossing.

16.2.36 There is a Groundwater Source Protection Zone located at the eastern extent of Option 1 that may be affected by excavations and changes in local drainage. The aquifer underlying the option is a principal aquifer which is highly productive, and changes in hydrology from excavations and road drainage have potential to affect groundwater.

16.2.37 At this stage, impacts on road drainage and the water environment from Option 1 are considered to be **moderate adverse**.

Mitigation

16.2.38 The junction would require a HAWRAT assessment to quantitatively assess potential impacts to the water environment from the junction. A HAWRAT assessment would indicate if spillage containment is required to satisfy the spillage risk assessment and whether attenuation of pollution is required for routine runoff.

16.2.39 Mitigation requirements would be those needed to reduce impacts identified in DMRB HD45/09 assessments to an acceptable level and may require attenuation measures to be included within the drainage design which may require land take.

16.2.40 The proposed scheme includes construction within areas classified as Flood Zone 2 and 3 and requires a new crossing of the River Tud. A standalone Flood Risk Assessment would outline the mitigation requirements to be included within the future design. Mitigation requirements would need to take into account sustainable drainage principles and the advice of the Environment Agency.

16.2.41 The new crossing of the River Tud would need to be designed so as to minimise impact upon the watercourse.

16.2.42 The procedures for managing the water resources implications during scheme construction would be defined in the CEMP, and would therefore comply with current planning policies / regulations for the protection of water resources. This document would be compiled, reviewed and revised as the project progresses to the construction stage.

People and Communities

16.2.1 One of the key constraints within the study area is the movement of NMU. At this stage, it appears that Option 1 could sever a number of well-used PRoW and side roads (Heath Road,

Sandy Lane, Wood Lane and Taverham Road) that run north/south in the study area and connect small villages with the A47 and the larger settlements. These serve an important recreational purpose and in some cases, provide an important means of access for the local population using community facilities in Hockering, Honingham and Easton. It is likely that alternative means of access could be provided through overbridges or underpasses, however this is not known at this stage.

16.2.2 Option 1 requires a large amount of land take from grade 2 (very good) and grade 3 (moderate to good) agricultural land. Loss of such land could have significant implications for farm viability. In addition, the offline nature of Option 1 means that severance of farms is likely and current access arrangements may be affected.

16.2.3 Option 1 may also influence development land to the north of the existing A47, impacting upon access, and with the potential for some land take, particularly to the north of Hockering.

16.2.4 The offline dualling will improve traffic flow and result in less congestion, having a beneficial effect on journey ambience and vehicle travellers. The removal of the roadside hedges will result in more open views across the landscape for travellers, which will become more enclosed as replanting matures.

16.2.5 At this stage, impacts on people and communities from Option 1 are considered to be **moderate adverse**.

Mitigation

16.2.6 Severance of PRoW and side roads could be mitigated through the introduction of new access routes connecting the settlements including provision for NMU. There is also potential to introduce new cycleways and further pedestrian footpaths to improve accessibility within the study area.

16.2.7 Mitigation or compensatory measures will need to be developed for the loss of agricultural land, which could include a range of measures from providing alternative means of access to financial compensation.

16.2.8 Mitigation measures should also include; the contractor undertaking the construction of the proposed scheme planning road junction closures and restrictions in agreement with Highways England and other appropriate stakeholders. The appointed contractor will adhere to current best practice techniques during the construction phrase. Appropriate landscape planting will be implemented to minimise visual impacts.

Geology, Soils and Materials

16.2.9 Option 1 does not affect any areas designated for their geological interest, but will result in the loss of agricultural soils to provide the new alignment and associated junctions. The soils are of good quality, as evidenced by the arable production of a range of cereal crops and vegetables in the area. The option also has potential to affect hydrogeology in the area through changes in drainage and land use. The aquifers, groundwater and surface water resources in the study area are of high importance for drinking water supplies.

16.2.10 As with all major construction projects, the offline dualling is likely to involve the use of a considerable amount of materials and production of waste. There is potential for retention and use on site of excavated materials pending appropriate testing for contaminants and geotechnical suitability. Unsuitable materials will require appropriate off site waste management.

16.2.11 At this stage, impacts on geology, soils and materials are considered to be **minor adverse**.

Mitigation

16.2.12 The principal mitigation measures to prevent adverse effects on soils and geology during the works would be to ensure appropriate and thorough ground investigations have been conducted and good site practice and management in line with the current legislation are carried out. Best practice techniques should be utilised in order to reduce risks from contaminated materials, reduce the quantity of raw materials and material wastage needed to complete the scheme.

16.2.13 As noted above mitigation or compensatory measures will need to be developed for the loss of agricultural land, which could include a range of measures from providing alternative means of access to financial compensation.

16.2.14 Where contamination is identified, or expected, appropriate sampling, analysis and risk assessment would be undertaken and suitable measures (for containment, storage, handling and off site waste management) put in place to disrupt any existing pollutant linkages and prevent the creation of additional pollutant linkages to potentially sensitive receptors. Where necessary, a phase 1 and/or phase II contaminated land assessment should be undertaken, in conjunction with a preliminary geotechnical ground investigation. The contaminated land assessment should be undertaken in accordance with CIRIA guidance, CIRIA 107 remedial treatment for contaminated land, 1995 and DEFRA's Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, April 2012.

16.2.15 Guidance in materials use and resourcing can be found within the DfT's Sustainable Highways: A Short Guide, June 2008. Maximising the reuse of materials won on site such as through the use of a Materials Management Plan (MMP) or Soils Resource Plan (SRP) will lead to a reduction in the volume of materials used on site. A watching brief for contaminated materials should be maintained during construction works, particularly excavation.

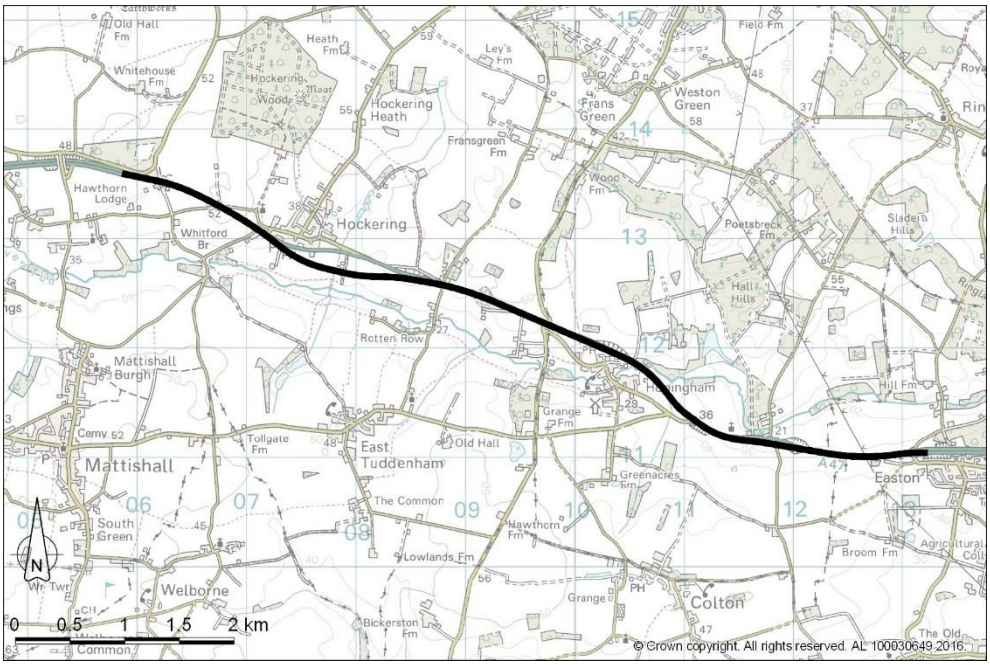
16.2.16 Construction works should be in compliance with the guidance provided in the BS 3882:2015 'British Standard Specification for Topsoil', 2015 – sourcing suitable topsoil, handling topsoil in an appropriate manner (weather, machinery), and avoiding stockpiling where possible. Where possible, the excavated soils should be reused on site to minimise the amount of material to be imported. Additional guidance can be found within DEFRA's 'Construction Code of Practice for the Sustainable Use of Soils on Construction Sites', 2009.

16.3 Option 3 (PCF Stage 1)

16.3.1 Option 3 is an online dualling following the existing A47 route as shown in **Figure 16-2**. The single carriageway section of the A47 between North Tuddenham and Easton would be improved to current dual carriageway standards by the construction of a new section of online dual carriageway with appropriate junction improvements. The alignment of the new dual carriageway would follow as closely as practical to the existing A47 highway corridor.

16.3.2 Improvements to the existing alignment to bring the route up to modern standards and the practicalities and safety of construction will make it necessary for the alignment in some sections to move away from the existing highway corridor particularly as the route passes to the south of the Village of Hockering.

Figure 16.2 Option 3 (PCF Stage 1)



Air Quality

16.3.3 Option 3 will move the route slightly further away from the receptors at south edge of Hockering; however, the change in alignment is such that effects on air quality are not likely to be significant.

16.3.4 The dualling of the A47 is not expected to result in a significant change in traffic volumes. A reduction in queueing traffic may allow vehicles to travel at greater speeds, leading to greater greenhouse gas emissions. Changes in composition can affect ambient air quality due to an increase in diesel powered HGV and LGV traffic that could result in an increase of PM and NO_2 levels.

16.3.5 All human receptors within the study area are exposed to the risk of health impacts from the inhalation of construction dust. Construction dust can also affect ecosystems through deposition that acts as a physical barrier to photosynthesising plants, and through the effects of its chemical constituents on sensitive ecological receptors.

16.3.6 At this stage, impacts on air quality from Option 3 are considered to be **neutral**.

Mitigation

16.3.7 If significant adverse effects on air quality are predicted, mitigation measures would take the form of a review of the proposed design of the option to consider relocating some sections of road further away from sensitive receptors, or reviewing speed limits to improve emissions from vehicles, or the consideration of options to manage the volumes of traffic using the new road alignments.

16.3.8 In accordance with the IAQM Guidance on the assessment of dust from demolition and construction, a dust risk assessment will be carried out and the appropriate mitigation measures will be implemented during the construction phase to minimise adverse impacts from dust emissions and vehicle emissions on nearby sensitive receptors.

Cultural Heritage

16.3.9 There are no listed buildings within the footprint of the option. The closest listed buildings to Option 3 are Church of St Michaels (Grade I), Manor Farmhouse and Manor House (Grade II), Church of St Andrew (Grade II*) and Church of St Peters (Grade I) which are within 200m. They are unlikely to be directly affected by Option 3, but there may be impacts on their settings through widening of the existing A47.

16.3.10 The known archaeological site record within the study area suggests that there is high potential for further buried archaeological remains to survive and there are numerous undesignated historic environment sites within the footprint of Option 3. In addition, there is potential for the new road alignment to affect subsurface remains and archaeological features.

16.3.11 At this stage, impacts on cultural heritage from Option 3 are considered to be **minor adverse**.

Mitigation

16.3.12 It is likely that archaeological mitigation measures can be put in place through a WSI to reduce the impact on the historic environment. Mitigation measures may include, but are not limited to, geophysical survey, field walking, evaluation excavation and landscape screening.

Landscape and Visual

16.3.13 As Option 3 is largely online, it is not likely to adversely affect the regional landscape. The small offline section south of Hockering may affect local landscape character and there are likely to be adverse visual impacts for a small number of scattered properties to the south of Hockering who may have views of the new alignment.

16.3.14 At this stage, impacts on landscape and visual receptors from Option 3 are considered to be **minor adverse**.

Mitigation

16.3.15 Mitigation should seek to integrate the offline sections of the route into the landscape as far as possible. Potential mitigation could consist of screen planting or planting of trees/woodland to limit views of this from receptors and to integrate the scheme into the landscape. However, it may take over 15 years to mature sufficiently to provide the same level of screening.

Nature Conservation and Biodiversity

16.3.16 Option 3 does not affect any areas designated for nature conservation. Widening the existing A47 will result in the loss of a number of mature trees and hedgerows with associated impacts for bat and bird species. The offline section south of Hockering will require the loss of agricultural land and is within close proximity to coastal and floodplain grazing marsh priority habitat.

16.3.17 There are two ponds in close proximity to the A47 which could be lost from the road widening (neither of which have confirmed presence of GCN), and the existing crossing of the River Tud in Honingham may need to be strengthened which could cause habitat loss or disturbance during construction.

16.3.18 Indirect impacts of noise, watercourse pollution / sediment dust, lighting, increased human disturbance, potential for invasive non-native species from works at various locations and operational traffic also have potential to adversely affect various species. Some of the resulting effects may be temporary or permanent, and of varying magnitude, which may in turn be significant or not significant.

16.3.19 At this stage, impacts on nature conservation and biodiversity from Option 3 are considered to be **minor adverse**.

Mitigation

16.3.20 Options to avoid/reduce/mitigate/compensate for any potential adverse effects on designated sites, and protected/notable habitats and species should be undertaken as the scheme evolves. Standard mitigation measures are also to be considered which include pollution prevention control measures, standard control measures to control dust from construction activities, preconstruction surveys, EcoCEMP and production of a HEMP.

16.3.21 Additional mitigation measures to also consider during the scheme design, construction and operation, include: retention of habitats and on-site soft landscaping which would also benefit flora and fauna species and meet the objectives of local and HE BAP; off-site mitigation and enhancement areas (where this cannot be met within the proposed scheme boundary); biodiversity no net loss assessment; enhancing the wildlife corridor and ecosystem function of the proposed scheme e.g. through appropriate habitat creation, wildlife tunnels, underpasses and culvert/bridge design; mammal fencing to minimise operational effects on fauna e.g. badger and otter (where applicable); and on-going monitoring surveys with a feedback mechanism in place to ensure results are fed into the detailed design.

16.3.22 The scheme would look at ways that net-gains in biodiversity could potentially be achieved, which would meet objectives in the Highways England Biodiversity Plan ahead of the 2040 target. These gains may be achieved through the creation of new habitats, wildlife corridors and by improving existing habitats and habitat interconnectivity.

16.3.23 Further baseline surveys are required at Stage 2 to inform fully mitigation proposals. Consultation will also be required with ecological stakeholders on the mitigation proposed.

Noise and Vibration

16.3.24 Option 3 moves a section of the existing A47 alignment away from sensitive receptors at the southern edge of Hockering, all of which will experience a reduction in present noise levels as with Option 1. There will be no change in the noise levels for properties at Honingham. As with Option 1, there may be increased noise levels for a small number of scattered properties to the south of Hockering, however overall the majority of receptors will see either no change or a decrease in noise levels.

16.3.25 Noise levels at NIA 5200 at Hockering will improve with Option 3 as the carriageway moves away from the NIA. There are no changes expected in noise levels at the other three NIA; however, modelling will be required to confirm this.

16.3.26 At this stage, impacts on noise and vibration from Option 3 are considered to be **neutral**.

Mitigation

16.3.27 Mitigation measures that could be considered to reduce the impact of traffic noise on local receptors, if required, include:

- Maximising the distance between new/realigned sections of road and nearby receptors;
- Minimising changes in traffic on existing roads due to the scheme;
- Earth bunds/noise barriers to screen nearby receptors. Where there is sufficient land available, earth bunds/noise barriers can be designed in conjunction with the landscape design to help integrate the route of new/realigned sections of road into the surrounding area. This can also provide visual mitigation;

- Low noise surfacing, if traffic speeds are sufficient for a low noise surface to be effective. Current guidance in the DMRB advises that a noise benefit from a low noise surface should only be assumed at speeds of 75 km/hr or more; and
- Noise insulation of individual properties to protect the internal noise environment.

16.3.28 Construction works should be carried out in accordance with BS 5228-1 and -2 2009+2014 amendments 'Noise Control on Construction and Open Sites' to mitigate temporary noise impacts.

Road Drainage and Water Environment

16.3.29 The existing bridge structure over the River Tud at Honingham may need to be widened and strengthened for Option 3 which could have adverse effects on the water environment, largely during the construction phase. In addition, there are two ponds within close proximity to the existing A47 which could be lost by the road widening.

16.3.30 The Groundwater Source Protection Zone located close to the bridge over the River Tud in Honingham could be affected by excavations and changes in local drainage. The aquifer underlying the option is a principal aquifer which is highly productive, and changes in hydrology from excavations and road drainage have potential to affect groundwater.

16.3.31 Existing flood risk is not likely to be affected by Option 3.

16.3.32 At this stage, impacts on road drainage and the water environment from Option 3 are considered to be **minor adverse**.

Mitigation

16.3.33 The junction would require a HAWRAT assessment to quantitatively assess potential impacts to the water environment from the junction. A HAWRAT assessment would indicate if spillage containment is required to satisfy the spillage risk assessment and whether attenuation of pollution is required for routine runoff.

16.3.34 Mitigation requirements would be those needed to reduce impacts identified in DMRB HD45/09 assessments to an acceptable level and may require attenuation measures to be included within the drainage design which may require land take.

16.3.35 The procedures for managing the water resources implications during scheme construction would be defined in the CEMP, and would therefore comply with current planning policies / regulations for the protection of water resources. This document would be compiled, reviewed and revised when the project progresses to the construction stage.

People and Communities

16.3.36 Option 3 is not expected to have significant permanent impacts on people and communities. The small offline section south of Hockering will require the loss of small areas of agricultural land and may have implications for existing PRoW.

16.3.37 However, there will be significant disruption caused during construction of the online scheme which will likely have adverse effects on the movements of NMU around the A47 and affect their ability to access community facilities and local services. Traveller speeds and journey times will be impacted by construction works and this will consequently impact upon fear of accidents. Construction traffic leaving the construction site and entering the road network has the potential to deposit mud and debris onto road surfaces. Spray rising from moving traffic has the potential to land on vehicle windscreens and reduce driver vision potentially increasing the fear of accidents. Changes to traffic management measures during the construction phase may also generate confusion leading to a fear of accidents. However,

these impacts will be temporary and Option 3 will lead to a reduction in driver stress due to a decrease in journey times and reduced congestion.

16.3.38 Users of the road network are likely to experience route uncertainty because of temporary lane or road closures and diversion routes. Lane restrictions in certain areas during construction could increase route uncertainty, particularly during peak hours and a temporary minor adverse effect will be experienced by travellers attributed to increased route uncertainty.

16.3.39 The online widening will improve traffic flow and result in less congestion, having a beneficial effect on vehicle travellers. The removal of the roadside hedges will result in more open views across the landscape for travellers, which will become more enclosed as replanting matures.

16.3.40 At this stage, impacts on people and communities from Option 3 are considered to be **minor adverse**.

Mitigation

16.3.41 Severance of PRoW could potentially be reinstated where possible. There is also potential to introduce new cycleways and further pedestrian footpaths to improve accessibility around the local villages.

16.3.42 Mitigation measures should include; the contractor undertaking the construction of the proposed scheme planning road junction closures and restrictions in agreement with Highways England and other appropriate stakeholders. The appointed contractor will adhere to current best practice techniques during the construction phrase. Appropriate landscape planting will be implemented to minimise visual impacts.

Geology, Soils and Materials

16.3.43 Option 3 does not affect any areas designated for their geological interest however it will result in the loss of agricultural soils to provide the new offline alignment. The soils are of good quality, as evidenced by the arable production of a range of cereal crops and vegetables in the area.

16.3.44 Impacts on geology, geomorphology, hydrogeology and groundwater are uncertain at this stage as ground conditions for earthworks are not currently understood. Investigations should confirm the suitability of the ground conditions including the geotechnical, geochemical conditions beneath the site including for Waste Acceptance Criteria.

16.3.45 There is potential for retention and use on site of excavated materials pending appropriate testing for contaminants and geotechnical suitability. Unsuitable materials will require appropriate off site waste management.

16.3.46 At this stage, impacts on geology, soils and materials from Option 3 are considered to be **minor adverse**.

Mitigation

16.3.47 The principal mitigation measures to prevent adverse effects on soils and geology during the works would be to ensure appropriate and thorough ground investigations have been conducted and good site practice and management in line with the current legislation are carried out. Best practice techniques should be utilised in order to reduce risks from contaminated materials, reduce the quantity of raw materials and material wastage needed to complete the scheme.

16.3.48 Where contamination is identified or expected, appropriate sampling, analysis and risk assessment would be undertaken and suitable measures (for containment, storage,

handling and off site waste management) put in place to disrupt any existing pollutant linkages and prevent the creation of additional pollutant linkages to potential sensitive receptors. Where necessary, a phase 1 and phase II contaminated land assessment should be undertaken. The contaminated land assessment should be undertaken in accordance with CIRIA guidance, CIRIA 107 remedial treatment for contaminated land, 1995 and DEFRA's Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, April 2012. Guidance in materials use and resourcing can be found within the DfT's Sustainable Highways: A Short Guide, June 2008.

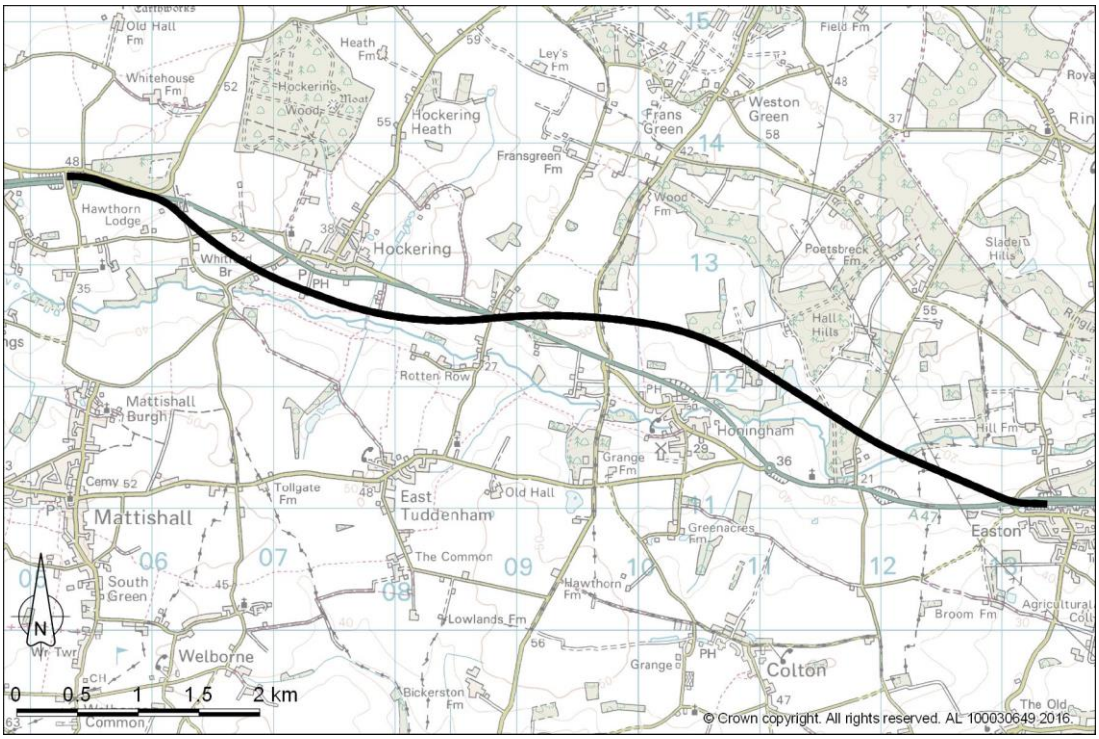
16.3.49 Maximising the reuse of materials won on site such as through the use of a MMP or SRP will lead to a reduction in the volume of materials used on site. A watching brief for contaminated materials should be maintained during construction works, particularly excavation.

16.3.50 Construction works should be in compliance with the guidance provided in the BS 3882:2015 'British Standard Specification for Topsoil', 2015 – sourcing suitable topsoil, handling topsoil in an appropriate manner (weather, machinery), and avoiding stockpiling where possible. Where possible, the excavated soils should be reused on site to minimise the amount of material to be imported. Additional guidance can be found within DEFRA's 'Construction Code of Practice for the Sustainable Use of Soils on Construction Sites', 2009.

16.4 Option 4 (PCF Stage1)

16.4.1 Option 4 is an offline dualling to the south of the existing A47, for the western part of the route past Hockering and to the north of the existing carriageway for the eastern end of the route past Honingham as shown in **Figure 16-3**.

Figure 16-3 Option 4 (PCF Stage 1)



Air Quality

16.4.2 Option 4 moves the road alignment away from the residential properties at Hockering and Honingham. The new alignment will also move the road closer to a number of individual properties that are scattered throughout the rural environment. This reduces the distance between the pollutant source and the receptors and may adversely affect local air quality.

16.4.3 For those receptors that will have the road closer to them, there will be a consequent decrease in local air quality. However, the dualling of the A47 should improve traffic flow which will reduce low speed traffic, and lead to improvements in local air quality. In addition, there will be improvements in local air quality for the receptors in Honingham and Hockering as the road moves away from them.

16.4.4 The dualling of the A47 is not expected to result in a significant change in traffic volumes. A reduction in queueing traffic may allow vehicles to travel at greater speeds, leading to greater greenhouse gas emissions. Changes in composition can affect ambient air quality due to an increase in diesel powered HGV and LGV traffic that could result in an increase of PM and NO_2 levels.

16.4.5 All human receptors within the study area are exposed to the risk of health impacts from the inhalation of construction dust. Construction dust can also affect ecosystems through deposition that acts as a physical barrier to photosynthesising plants, and through the effects of its chemical constituents on sensitive ecological receptors.

16.4.6 At this stage, impacts on air quality from Option 4 are considered to be **neutral**.

Mitigation

16.4.7 If significant adverse effects on air quality are predicted, mitigation measures would take the form of a review of the proposed design of the option to consider relocating some sections of road further away from sensitive receptors, or reviewing speed limits to improve emissions from vehicles, or the consideration of options to manage the volumes of traffic using the new road alignments.

16.4.8 In accordance with the IAQM Guidance on the assessment of dust from demolition and construction, a dust risk assessment will be carried out and the appropriate mitigation measures will be implemented during the construction phase to minimise adverse impacts from dust emissions and vehicle emissions on nearby sensitive receptors.

Cultural Heritage

16.4.9 There are no listed buildings within the footprint of the option. The closest listed buildings to Option 4 are Church Farmhouse and Barn (Grade II) and Church of St Peters (Grade I) which are within 200m. They are unlikely to be directly affected by Option 4, but there may be impacts on their settings from the new road alignment.

16.4.10 The known archaeological site record within the study area suggests that there is high potential for further buried archaeological remains to survive and there are numerous undesignated historic environment sites within the footprint of Option 4. In addition, there is potential for the new road alignment to affect subsurface remains and archaeological features.

16.4.11 At this stage, impacts on cultural heritage from Option 4 are considered to be **minor adverse**.

Mitigation

16.4.12 It is likely that archaeological mitigation measures can be put in place through a WSI to reduce the impact on the historic environment. Mitigation measures may include, but are not limited to, geophysical survey, field walking, evaluation excavation and landscape screening.

Landscape and Visual

16.4.13 Option 4 is almost wholly offline, and runs through a tranquil, rural landscape and will have an associated loss of landscape features including hedgerows, trees, ponds, woodland and arable land. It is unlikely to affect the regional landscape character, however it is likely to affect the local landscape with the pattern, scale and appearance and tranquillity of the landscape all potentially affected.

16.4.14 As Option 4 moves the road alignment away from Hockering and Honingham there will be few visual impacts on these receptors, however there may still be adverse visual impacts on scattered rural properties which are in close proximity to Option 4.

16.4.15 At this stage, impacts on landscape and visual receptors from Option 4 are considered to be **minor adverse**.

Mitigation

16.4.16 Mitigation should seek to integrate the offline sections into the landscape as far as possible. Potential mitigation could consist of screen planting of trees/woodland to limit views of this from residential areas and to integrate the scheme into the landscape. However, it may take over 15 years to mature sufficiently to provide the same level of screening.

Nature Conservation and Biodiversity

16.4.17 Option 4 does not affect any areas designated for nature conservation. In addition, as Option 4 is offline it runs through numerous areas of priority habitat including deciduous woodland, lowland fens, coastal and floodplain grazing marsh and good quality semi-improved grassland, parts of which would be lost as a result of the option.

16.4.18 Option 4 would also require the loss of hedgerows and trees which will result in habitat loss for birds and bats, as well as affecting commuter routes for bats. The creation of new junctions can result in severance of habitats as well as habitat loss and disturbance.

16.4.19 Option 4 requires one new crossing of the River Tud and there are approximately four ponds within the footprint of Option 4 which may be lost, none of which have confirmed presence of GCN.

16.4.20 Preliminary surveys for the project identified that Option 4 could affect areas of habitat that potentially support the following protected species - breeding birds, bats, desmoulin's whorl snail, water vole (where Option 4 crosses the River Tud) and reptile.

16.4.21 Indirect impacts of noise, watercourse pollution / sediment dust, lighting, increased human disturbance, potential for invasive non-native species from works at various locations and operational traffic also have potential to adversely affect various species. Some of the resulting effects may be temporary or permanent, and of varying magnitude, which may in turn be significant or not significant.

16.4.22 At this stage, impacts on nature conservation and biodiversity from Option 4 are considered to be **moderate adverse**.

Mitigation

16.4.23 Options to avoid/reduce/mitigate/compensate for any potential adverse effects on designated sites, and protected/notable habitats and species should be undertaken as the scheme evolves. Standard mitigation measures are also to be considered which include pollution prevention control measures, standard control measures to control dust from construction activities, preconstruction surveys, EcoCEMP and production of a HEMP.

16.4.24 Additional mitigation measures to also consider during the scheme design, construction and operation, include: retention of habitats and on-site soft landscaping which would also benefit flora and fauna species and meet the objectives of local and Highways England BAP; off-site mitigation and enhancement areas (where this cannot be met within the proposed scheme boundary); biodiversity no net loss assessment; enhancing the wildlife corridor and ecosystem function of the proposed scheme e.g. through appropriate habitat creation, wildlife tunnels, underpasses and culvert/bridge design; mammal fencing to minimise operational effects on fauna e.g. badger and otter (where applicable); and on-going monitoring surveys with a feedback mechanism in place to ensure results are fed into the detailed design.

16.4.25 The scheme would look at ways that net-gains in biodiversity could potentially be achieved, which would meet objectives in the Highways England Biodiversity Plan ahead of the 2040 target. These gains may be achieved through the creation of new habitats, wildlife corridors and by improving existing habitats and habitat interconnectivity.

16.4.26 Further baseline surveys are required at Stage 2 to inform fully mitigation proposals. Consultation will also be required with ecological stakeholders on the mitigation proposed.

Noise and Vibration

16.4.27 Noise levels will be decreased for properties in Honingham and Hockering with Option 4 as the road alignment moves away from the villages. As with the other options, there will be increased noise levels at scattered rural properties that are currently in a quiet setting. However, the majority of receptors will experience a reduction in noise levels.

16.4.28 Noise levels at NIA 5200 at Hockering and NIA 6287 at Church House Lodge will improve with Option 4 as the carriageway moves away from the NIA. There are no changes expected in noise levels at the other two NIA, but modelling will be required to confirm this.

16.4.29 At this stage, impacts on noise and vibration from Option 4 are considered to be **neutral**.

Mitigation

16.4.30 Mitigation measures that could be considered to reduce the impact of traffic noise on local receptors, if required, include:

- Maximising the distance between new/realigned sections of road and nearby receptors;
- Minimising changes in traffic on existing roads due to the scheme;
- Earth bunds/noise barriers to screen nearby receptors. Where there is sufficient land available, earth bunds/noise barriers can be designed in conjunction with the landscape design to help integrate the route of new/realigned sections of road into the surrounding area. This can also provide visual mitigation;
- Low noise surfacing, if traffic speeds are sufficient for a low noise surface to be effective. Current guidance in the DMRB advises that a noise benefit from a low noise surface should only be assumed at speeds of 75 km/hr or more; and
- Noise insulation of individual properties to protect the internal noise environment.

16.4.31 Construction works should be carried out in accordance with BS 5228-1 and -2 2009+2014 amendments 'Noise Control on Construction and Open Sites' to mitigate temporary noise impacts.

Road Drainage and Water Environment

16.4.32 Option 4 has the potential to significantly affect the water environment as it requires one new crossing of the River Tud and passes through numerous ponds and areas of lowland fen habitat. Impacts could include hydrological changes, habitat loss, disturbance of species or water pollution events.

16.4.33 There are areas of medium to high flood risk (Flood Zones 2 and 3) along the River Tud that could be affected by any land take required for the new crossing of the river. There are also flood defences along both banks of the River Tud and so existing flood risk could be affected if any changes are required to the defences to construct the new river crossing.

16.4.34 There is a Groundwater Source Protection Zone running through the study area that may be affected by excavations and changes in local drainage. The aquifer underlying the option is a principal aquifer which is highly productive, and changes in hydrology from excavations and road drainage have potential to affect groundwater.

16.4.35 At this stage, impacts on road drainage and the water environment from Option 4 are considered to be **moderate adverse**.

Mitigation

16.4.36 The junction would require a HAWRAT assessment to quantitatively assess potential impacts to the water environment from the junction. A HAWRAT assessment would indicate if spillage containment is required to satisfy the spillage risk assessment and whether attenuation of pollution is required for routine runoff.

16.4.37 Mitigation requirements would be those needed to reduce impacts identified in DMRB HD45/09 assessments to an acceptable level and may require attenuation measures to be included within the drainage design which may require land take.

16.4.38 The proposed scheme includes construction within areas classified as Flood Zone 2 and 3 and requires a new crossing of the River Tud. A standalone Flood Risk Assessment would outline the mitigation requirements to be included within the future design. Mitigation requirements would need to take into account sustainable drainage principles and the advice of the EA.

16.4.39 The new crossing of the River Tud would need to be designed so as to minimise impact upon the watercourse.

16.4.40 The procedures for managing the water resources implications during scheme construction would be defined in the CEMP, and would therefore comply with current planning policies / regulations for the protection of water resources. This document would be compiled, reviewed and revised when the project progresses to the construction stage.

People and Communities

16.4.41 One of the key constraints within the study area is the movement of NMUs. At this stage, it appears that Option 4 could sever a number of well-used PRoWs in the River Tud valley and the link roads to the south of Hockering (Mattishall Lane, Mill Lane and Church Lane) and to the north of Honingham (Wood Lane and Taverham Road). These serve an important recreational purpose and in some cases, provide an important means of access for the local population using community facilities in Hockering, Honingham and Easton. It is likely that alternative means of access could be provided through overbridges or underpasses, however this is not known at this stage.

16.4.42 Option 4 requires a large amount of land take from grade 2 (very good) and grade 3 (moderate to good) agricultural land. Loss of such land could have significant implications for farm viability. In addition, the offline nature of Option 4 means that severance of farms is likely and current access arrangements may be affected.

16.4.43 The offline dualling will improve traffic flow and result in less congestion, having a beneficial effect on journey ambience and vehicle travellers. The removal of the roadside hedges will result in more open views across the landscape for travellers, which will become more enclosed as replanting matures.

16.4.44 At this stage, impacts on people and communities from Option 4 are considered to be **moderate adverse**.

Mitigation

16.4.45 Severance of PRoW and side roads could be mitigated through the introduction of new NMU routes throughout the site connecting the settlements. There is also potential to introduce new cycleways and further pedestrian footpaths to improve accessibility within the vicinity of the proposed A47 route.

16.4.46 Mitigation or compensatory measures will need to be developed for the loss of agricultural land, which could include a range of measures from providing alternative means of access to financial compensation.

16.4.47 Mitigation measures should include; the contractor undertaking the construction of the proposed scheme planning road junction closures and restrictions in agreement with Highways England and other appropriate stakeholders. The appointed contractor will adhere to current best practice techniques during the construction phrase. Appropriate landscape planting will be implemented to minimise visual impacts.

Geology, Soils and Materials

16.4.48 Option 4 does not affect any areas designated for their geological interest, but will result in the loss of agricultural soils to provide the new alignment and associated junctions. The soils are of good quality, as evidenced by the arable production of a range of cereal crops and vegetables in the area. The option also has potential to affect hydrogeology in the area through changes in drainage and land use. The aquifers, groundwater and surface water resources in the study area are of high importance for drinking water supplies

16.4.49 As with all major construction projects, the offline dualling is likely to involve the use of a considerable amount of materials and production of waste. There is potential for retention and use on site of excavated materials pending appropriate testing for contaminants and geotechnical suitability. Unsuitable materials will require appropriate off site waste management.

16.4.50 At this stage, impacts on geology, soils and materials from Option 4 are considered to be **minor adverse**.

Mitigation

16.4.51 The principal mitigation measures to prevent adverse effects on soils and geology during the works would be to ensure appropriate and thorough ground investigations have been conducted and good site practice and management in line with the current legislation are carried out. Best practice techniques should be utilised in order to reduce risks from contaminated materials, reduce the quantity of raw materials and material wastage needed to complete the scheme.

16.4.52 As noted above mitigation or compensatory measures will need to be developed for the loss of agricultural land, which could include a range of measures from providing alternative means of access to financial compensation.

16.4.53 Where contamination is identified, or expected, appropriate sampling, analysis and risk assessment would be undertaken and suitable measures (for containment, storage, handling and off site waste management) put in place to disrupt any existing pollutant linkages and prevent the creation of additional pollutant linkages to potential sensitive receptors. Where necessary, a phase 1 and phase II contaminated land assessment should be undertaken. The contaminated land assessment should be undertaken in accordance with CIRIA guidance, CIRIA 107 remedial treatment for contaminated land, 1995 and DEFRA's Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, April 2012. Guidance in materials use and resourcing can be found within the DfT's Sustainable Highways: A Short Guide, June 2008.

16.4.54 Maximising the reuse of materials won on site such as through the use of a MMP or SRP will lead to a reduction in the volume of materials used on site. A watching brief for contaminated materials should be maintained during construction works, particularly excavation.

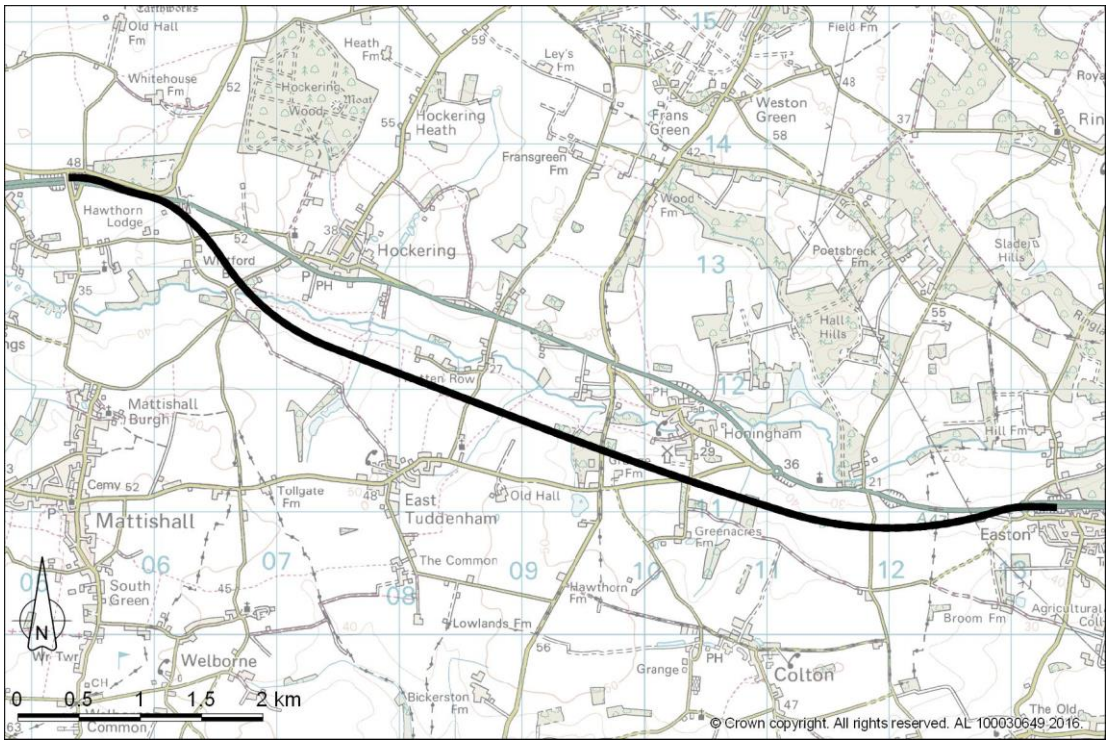
16.4.55 Construction works should be in compliance with the guidance provided in the BS 3882:2015 'British Standard Specification for Topsoil', 2015 – sourcing suitable topsoil, handling topsoil

in an appropriate manner (weather, machinery), and avoiding stockpiling where possible. Where possible, the excavated soils should be reused on site to minimise the amount of material to be imported. Additional guidance can be found within DEFRA's 'Construction Code of Practice for the Sustainable Use of Soils on Construction Sites', 2009.

16.5 Option 6 (PCF Stage 1)

16.5.1 Option 6 is an offline dualling to the south of the existing A47 route as shown on **Figure 16-4**. The proposed new dual carriageway for this option follows an alignment running parallel and approximately 700m to the south of the existing A47 highway corridor. At the western end of the scheme, the proposed alignment crosses the River Tud running through predominantly open lowland grassland and meadow land before passing to the south of the Village of Honingham and returning to the A47 at Easton

Figure 16-4 Option 6 (PCF Stage 1)



Air Quality

16.5.2 Option 6 moves the road alignment away from the residential properties at Hockering as well as properties in the northern part of Honingham. The new alignment will also move the road closer to a number of individual properties that are scattered throughout the rural environment, in particular the sensitive receptors at Earthsea School and House and Ailwyn House. Option 6 will also move the road closer to properties at the south of Honingham.

16.5.3 For those receptors that will have the road closer to them, there will be a consequent decrease in local air quality. However, the dualling of the A47 should improve traffic flow which will reduce low speed traffic, and lead to improvements in local air quality. In addition, there will be improvements in local air quality for the receptors in Honingham and Hockering as the road moves away from them.

16.5.4 The dualling of the A47 is not expected to result in a significant change in traffic volumes. A reduction in queueing traffic may allow vehicles to travel at greater speeds, leading to greater greenhouse gas emissions. Changes in composition can affect ambient air quality due to an

increase in diesel powered HGV and LGV traffic that could result in an increase of PM and NO_2 levels.

16.5.5 All human receptors within the study area are exposed to the risk of health impacts from the inhalation of construction dust. Construction dust can also affect ecosystems through deposition that acts as a physical barrier to photosynthesising plants, and through the effects of its chemical constituents on sensitive ecological receptors.

16.5.6 At this stage, impacts on air quality from Option 6 are considered to be **minor adverse**.

Mitigation

16.5.7 If significant adverse effects on air quality are predicted, mitigation measures would take the form of a review of the proposed design of the option to consider relocating some sections of road further away from sensitive receptors, or reviewing speed limits to improve emissions from vehicles, or the consideration of options to manage the volumes of traffic using the new road alignments.

16.5.8 In accordance with the IAQM Guidance on the assessment of dust from demolition and construction, a dust risk assessment will be carried out and the appropriate mitigation measures will be implemented during the construction phase to minimise adverse impacts from dust emissions and vehicle emissions on nearby sensitive receptors.

Cultural Heritage

16.5.9 There are no listed buildings within the footprint of the option, however the Icehouse (Grade II) lies within 50m of Option 6 and could experience both direct and indirect impacts from the new road alignment.

16.5.10 The known archaeological site record within the study area suggests that there is high potential for further buried archaeological remains to survive and there are numerous undesignated historic environment sites within the footprint of Option 6. In addition, there is potential for the new road alignment to affect subsurface remains and archaeological features.

16.5.11 At this stage, impacts on cultural heritage from Option 6 are considered to be **moderate adverse** given the proximity of the Icehouse to the proposed alignment.

Mitigation

16.5.12 Mitigation will be required to ensure that Option 6 does not affect the Icehouse, which could include modifications to the design.

16.5.13 It is likely that archaeological mitigation measures can be put in place through a Written Scheme of Investigation to reduce the impact on the historic environment. Mitigation measures may include, but are not limited to, geophysical survey, field walking, evaluation excavation and landscape screening.

Landscape and Visual

16.5.14 Option 6 is wholly offline running through the River Tud valley which is a tranquil, rural landscape. It will have an associated loss of landscape features including hedgerows, trees, ponds, woodland and arable land. It is unlikely to affect the regional landscape character however, it is likely to affect the local landscape with the pattern, scale and appearance and tranquillity of the landscape all potentially affected.

16.5.15 Visual receptors to the south of Honingham are likely to experience adverse impacts from Option 6 as the proposed alignment skirts the south of the village, which is currently

agricultural land with open views into the countryside. It is likely that Option 6 will significantly change the views currently experienced by these properties and the new road alignment may be a visible feature in the landscape.

16.5.16 At this stage, impacts on landscape and visual receptors from Option 6 are considered to be **moderate adverse**.

Mitigation

16.5.17 Mitigation should seek to integrate the offline sections of the route into the landscape as far as possible. Potential mitigation could consist of screen planting or planting of trees/woodland to limit views of this from receptors and to integrate the scheme into the landscape. However, it may take over 15 years to mature sufficiently to provide the same level of screening.

Nature Conservation and Biodiversity

16.5.18 Option 6 will lead to the loss of land. The affected land is largely arable and of lower ecological quality. Areas of priority habitat, including deciduous woodland and coastal and floodplain grazing marsh will still be affected.

16.5.19 Option 6 would also require the loss of hedgerows and trees which will result in habitat loss for birds and bats, as well as affecting commuter routes for bats. The creation of new junctions can result in severance of habitats as well as habitat loss and disturbance.

16.5.20 Option 6 required one new crossing of the River Tud along with the loss of approximately six ponds within the footprint of Option 6, of which one has confirmed presence of GCN (ID: 23A).

16.5.21 Preliminary surveys for the project identified that Option 6 could affect areas of habitat that potentially support the following protected species - breeding birds, bats, desmoulin's whorl snail, water vole (where Option 6 crosses the River Tud) and reptile.

16.5.22 Indirect impacts of noise, watercourse pollution / sediment dust, lighting, increased human disturbance, potential for invasive non-native species from works at various locations and operational traffic also have potential to adversely affect various species. Some of the resulting effects may be temporary or permanent, and of varying magnitude, which may in turn be significant or not significant.

16.5.23 At this stage, impacts on nature conservation and biodiversity from Option 6 are considered to be **minor adverse**.

Mitigation

16.5.24 Options to avoid/reduce/mitigate/compensate for any potential adverse effects on designated sites, and protected/notable habitats and species should be undertaken as the scheme evolves. Standard mitigation measures are also to be considered which include pollution prevention control measures, standard control measures to control dust from construction activities, preconstruction surveys, EcoCEMP and production of a HEMP.

16.5.25 Additional mitigation measures to also consider during the scheme design, construction and operation, include: retention of habitats and on-site soft landscaping which would also benefit flora and fauna species and meet the objectives of local and Highways England BAP; off-site mitigation and enhancement areas (where this cannot be met within the proposed scheme boundary); biodiversity no net loss assessment; enhancing the wildlife corridor and ecosystem function of the proposed scheme e.g. through appropriate habitat creation, wildlife tunnels, underpasses and culvert/bridge design; mammal fencing to minimise operational effects on fauna e.g. badger and otter (where applicable); and on-going monitoring surveys with a feedback mechanism in place to ensure results are fed into the detailed design.

16.5.26 Net-gains in biodiversity could potentially be achieved, which would meet objectives in the Highways England Biodiversity Plan ahead of the 2040 target. These gains may be achieved through the creation of new habitats, wildlife corridors and by improving existing habitats and habitat interconnectivity.

16.5.27 Further baseline surveys are required at Stage 2 to inform fully mitigation proposals. Consultation will also be required with ecological stakeholders on the mitigation proposed.

Noise and Vibration

16.5.28 Noise levels will be decreased for properties in Hockering and northern Honingham with Option 6 as the road alignment moves away from the villages. There will be increased noise levels at scattered rural properties that are currently in a quiet setting in particular the sensitive receptors at Earthsea School and House and Ailwyn House. Option 6 will also move the road closer to properties at the south of Honingham.

16.5.29 Noise levels at NIA 5200 at Hockering, NIA 5201 at Park Lane/Sandy Lane and NIA 6287 at Church House Lodge will improve as the carriageway moves away from the NIAs. There are no changes expected in noise levels at the NIA in Easton, but modelling will be required to confirm this.

16.5.30 At this stage, impacts on noise and vibration from Option 6 are considered to be **minor adverse**.

Mitigation

16.5.31 Mitigation measures that could be considered to reduce the impact of traffic noise on local receptors, if required, include:

- Maximising the distance between new/realigned sections of road and nearby receptors;
- Minimising changes in traffic on existing roads due to the scheme;
- Earth bunds/noise barriers to screen nearby receptors. Where there is sufficient land available, earth bunds/noise barriers can be designed in conjunction with the landscape design to help integrate the route of new/realigned sections of road into the surrounding area. This can also provide visual mitigation;
- Low noise surfacing, if traffic speeds are sufficient for a low noise surface to be effective. Current guidance in the DMRB advises that a noise benefit from a low noise surface should only be assumed at speeds of 75 km/hr or more; and
- Noise insulation of individual properties to protect the internal noise environment.

16.5.32 Construction works should be carried out in accordance with BS 5228-1 and -2 2009+2014 amendments ‘Noise Control on Construction and Open Sites’ to mitigate temporary noise impacts.

Road Drainage and Water Environment

16.5.33 Option 6 has the potential to significantly affect the water environment as it requires one new crossing of the River Tud and passes through six ponds and areas of lowland fen habitat. Impacts could include hydrological changes, habitat loss, disturbance of species or water pollution events.

16.5.34 There are areas of medium to high flood risk (Flood Zones 2 and 3) along the River Tud that could be affected by any land take required for the new crossing of the river. There are also flood defences along both banks of the River Tud and so existing flood risk could be affected if any changes are required to the defences to construct the new river crossing.

16.5.35 There is a Groundwater Source Protection Zone running through the study area that may be affected by excavations and changes in local drainage. The aquifer underlying the option is a principal aquifer which is highly productive, and changes in hydrology from excavations and road drainage have potential to affect groundwater.

16.5.36 At this stage, impacts on road drainage and the water environment from Option 6 are considered to be **moderate adverse**.

Mitigation

16.5.37 The junction would require a HAWRAT assessment to quantitatively assess potential impacts to the water environment from the junction. A HAWRAT assessment would indicate if spillage containment is required to satisfy the spillage risk assessment and whether attenuation of pollution is required for routine runoff.

16.5.38 Mitigation requirements would be those needed to reduce impacts identified in DMRB HD45/09 assessments to an acceptable level and may require attenuation measures to be included within the drainage design which may require land take.

16.5.39 The proposed scheme includes construction within areas classified as Flood Zone 2 and 3 and requires a new crossing of the River Tud. A standalone Flood Risk Assessment would outline the mitigation requirements to be included within the future design. Mitigation requirements would need to take into account sustainable drainage principles and the advice of the Environment Agency.

16.5.40 The new crossing of the River Tud would need to be designed so as to minimise impact upon the watercourse.

16.5.41 The procedures for managing the water resources implications during scheme construction would be defined in the CEMP, and would therefore comply with current planning policies / regulations for the protection of water resources. This document would be compiled, reviewed and revised when the project progresses to the construction stage.

People and Communities

16.5.42 One of the key constraints within the study area is the movement of NMUs. At this stage, it appears that Option 6 could sever a number of well-used PRoWs in the River Tud valley and the link roads to the south of Hockering and Honingham (Mattishall Lane, Church Lane, Berrys Lane and Mattishall Road). These serve an important recreational purpose and in some cases provide an important means of access for the local population using community facilities in Hockering, Honingham and Easton. It is likely that alternative means of access could be provided through overbridges or underpasses, however this is not known at this stage.

16.5.43 In addition, at this stage it appears that Option 6 may sever access to Earthsea School and House and Ailwyn House, which is a significant impact. It is likely that alternative access would be provided, however this is not known at this stage.

16.5.44 Option 6 requires a large amount of land take from grade 2 (very good) and grade 3 (moderate to good) agricultural land. Loss of such land could have significant implications for farm viability. In addition, the offline nature of Option 6 means that severance of farms is likely and current access arrangements may be affected.

16.5.45 Development land to the west of Easton may also be affected, either directly through land take or in terms of changes to access.

16.5.46 At this stage, impacts on people and communities from Option 6 are considered to be **moderate adverse**.

Mitigation

16.5.47 Severance of PRoW and side roads could be mitigated through the introduction of new NMU routes throughout the site connecting the settlements. There is also potential to introduce new cycleways and further pedestrian footpaths to improve accessibility within the vicinity of the proposed A47 route.

16.5.48 Mitigation or compensatory measures will need to be developed for the loss of agricultural land, which could include a range of measures from providing alternative means of access to financial compensation.

16.5.49 Mitigation measures should include; the contractor undertaking the construction of the proposed scheme planning road junction closures and restrictions in agreement with Highways England and other appropriate stakeholders. The appointed contractor will adhere to current best practice techniques during the construction phrase. Appropriate landscape planting will be implemented to minimise visual impacts.

Geology, Soils and Materials

16.5.50 Option 6 does not affect any areas designated for their geological interest, but will result in the loss of agricultural soils to provide the new alignment and associated junctions. The soils are of good quality, as evidenced by the arable production of a range of cereal crops and vegetables in the area. The option also has potential to affect hydrogeology in the area through changes in drainage and land use. The aquifers, groundwater and surface water resources in the study area are of high importance for drinking water supplies

16.5.51 As with all major construction projects, the offline dualling is likely to involve the use of a considerable amount of materials and production of waste. There is potential for retention and use on site of excavated materials pending appropriate testing for contaminants and geotechnical suitability. Unsuitable materials will require appropriate off site waste management.

16.5.52 At this stage, impacts on geology, soils and materials from Option 6 are considered to be **minor adverse**.

Mitigation

16.5.53 The principal mitigation measures to prevent adverse effects on soils and geology during the works would be to ensure appropriate and thorough ground investigations have been conducted and good site practice and management in line with the current legislation are carried out. Best practice techniques should be utilised in order to reduce risks from contaminated materials, reduce the quantity of raw materials and material wastage needed to complete the scheme.

16.5.54 As noted above mitigation or compensatory measures will need to be developed for the loss of agricultural land, which could include a range of measures from providing alternative means of access to financial compensation.

16.5.55 Where contamination is identified, or expected, appropriate sampling, analysis and risk assessment would be undertaken and suitable measures (for containment, storage, handling and off site waste management) put in place to disrupt any existing pollutant linkages and prevent the creation of additional pollutant linkages to potential sensitive receptors. Where necessary, a phase 1 and phase II contaminated land assessment should be undertaken. The contaminated land assessment should be undertaken in accordance with CIRIA guidance, CIRIA 107 remedial treatment for contaminated land, 1995 and DEFRA's Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, April 2012. Guidance in materials use and resourcing can be found within the DfT's Sustainable Highways: A Short Guide, June 2008.

16.5.56 Maximising the reuse of materials won on site such as through the use of a MMP or SRP will lead to a reduction in the volume of materials used on site. A watching brief for contaminated materials should be maintained during construction works, particularly excavation.

16.5.57 Construction works should be in compliance with the guidance provided in the BS 3882:2015 'British Standard Specification for Topsoil', 2015 – sourcing suitable topsoil, handling topsoil in an appropriate manner (weather, machinery), and avoiding stockpiling where possible. Where possible, the excavated soils should be reused on site to minimise the amount of material to be imported. Additional guidance can be found within DEFRA's 'Construction Code of Practice for the Sustainable Use of Soils on Construction Sites', 2009.

17 Detailed Cost Estimate of Sifted Options

17.1 Introduction

17.1.1 As a project develops through the PCF Stages the scheme costs are estimated based on the level of detail available at that time. For PCF Stage 1 an estimate was undertaken for each of the options as recommended by the sifting review meeting. The estimates were produced to demonstrate the affordability of the project. The Options Estimates were used in the decision-making process by Highways England to determine whether the scheme progressed into PCF Stage 2.

17.1.2 During PCF Stage 1, an options estimate was prepared for the one identified as being the most viable. Option 4 was selected as being viable to be put forward into PCF Stage 2 based on the option being offline along the majority of the route hence would be less disruptive during construction. Approximate relative estimates for Options 1, 3, and 6 were derived from the Option 4 estimate which was produced by Highways England Commercial. These are discussed in section 17.5.

17.2 Options Estimate

17.2.1 The Options Estimate for Option 4 was prepared in accordance with the Highways England Commercial Cost Estimation Manual, which produces a three point range estimate that identifies:

- The minimum;
- The most likely; and
- The maximum cost.

17.2.2 The Options Estimates include a consideration of uncertainties associated with the scheme via an assessment of risk. Project risks have been identified and recorded within the scheme risk register. The risk register has been considered in the three-point range estimate.

17.3 Review of the Estimate

17.3.1 The estimate has been reviewed in accordance with the Highways England Cost Estimating Manual. The reviews include independent peer reviews, Estimating Manager reviews and a review by the Head of Cost Planning.

17.3.2 In addition to these reviews, the estimate was presented to the project team for their input and confirmation of correct approach and assumptions.

17.4 Summary of Estimate

17.4.1 Table 17-1 below presents the range of cost estimates for Option 4.

Table 17-1 – Cost Estimates

Option	Range Min(£M)	Range Most Likely (£M)	Range Max (£M)
1	**	**	**

3	**	**	**
4	153.378	199.506	281.981
6	**	**	**

**Option price not available at this point in PCF Stage 1

17.4.2 The Range Estimates for the Proposed Scheme at PCF Stage 0, derived from the Order of Magnitude Estimate, are as detailed in Table 17-2 below:

Table 17-2 – October 2015 Order of Magnitude Estimate

Representative Scheme	Range MIN (£M)	Most Likely (£M)	Range MAX (£M)
Outturn Costs (Oct 15)	109.984	130.245	160.510

17.4.3 The outturn range estimate prepared for the 2014 route Feasibility Study (published in February 2015) reported a range estimate of £110M to £155M.

17.5 Relative Estimates for Other Options

17.5.1 In order to be able to produce relative Economic Assessments for all four Options (see section 18) approximate relative estimates for Options 1,3, and 6 were derived from the Option 4 estimate which had been produced by Highways England Commercial.

17.5.2 The estimates used the Option 4 data and the cost estimate provided by Highways England was used as a base to provide approximate estimates for the remaining options. Table 17-3 presents a summary of the appraisal for all the options including an assessment of the key differences which are reflected by the variance in cost between the options.

17.5.3 Those key differences include factors such as scheme length, online/offline, construction period, traffic management, land take, volume of earthworks and treatments required, accommodation works required, number of structures, de-trunking required and statutory undertaker costs. In each instance the differences in the schemes were appraised and assessed to calculate the likely cost variance.

17.5.4 It was assumed that the percentage split of overall costs over time for each category of expenditure (Preparation, Supervision, Works and Land) is the same as that for option 4.

Table 17-3 – Relative Estimates based on Single Option Estimate

	Estimate status	Relative estimates based on most likely Option 4	% (Option 4 100%)	Key Differences/comparators to Option 4
Option 1	approximate estimate based on Option 4 (below) adjusted for appraised key scheme differences	£ 204,788,460	102.65%	□ Scheme length shorter □ Additional structures costs □ Slightly less Stats impact □ Additional structures required □ Similar earthworks volumes and specialist treatments to ponds and historic workings □ Increased land cost □ Similar Traffic Management – tie ins

				□ Similar construction period
Option 3	approximate estimate based on Option 4 (below) adjusted for appraised key scheme differences	£ 207,257,478	103.89%	□ Scheme length longer □ Additional traffic management □ Less detrunking costs □ Additional construction period as phasing more complex □ Less earthworks volumes / less earthworks treatments to ponds and historic mineral mine workings □ Increased Statutory Undertakers impact □ Similar structures required □ Reduced land costs
Option 4	estimate most likely from HE Commercial estimate	£ 199,505,627	100.00%	□ Base position
Option 6	approximate estimate based on Option 4 (above) adjusted for appraised key scheme differences	£ 197,753,838	99.12%	□ Scheme length longer □ Similar Stats impact □ Additional minor structures (culverts) □ Similar earthworks volumes less earthworks treatments to pond areas/ similar open mineral mine workings □ Slightly reduced land costs □ Similar Traffic Management – tie ins □ Similar construction period

18 Economic Assessment

18.1 Introduction

18.1.1 This section describes the economic appraisal process of the sifted options.

18.1.2 As noted in Chapter 12 the modelling work to update and validate the NATS model was not complete at the end of PCF Stage 1. To inform the PCF Stage 1 Stage Gate Review in November 2016 and the Investment Decision Committee (IDC) meeting in December 2016 a separate "Transportation and Economic PCF Stage 1 Products" Technical Note was prepared.

18.1.3 The Value for Money assessment in the Technical Note was based on a spreadsheet transportation assessment of the options similar to the assessment undertaken in PCF Stage 0+, the methodology for the transportation assessment is outlined in section 12.

18.1.4 The methodology for the economic assessment undertaken in PCF Stage 1 is described in the sections below.

18.2 Economic assessment methodology

18.2.1 User benefits of the scheme were assessed using TUBA 1.9.7 software. Costs for Option 4 were provided by Highways England Commercial team. The costs used in the assessment of the other options have been developed by the project team as outlined in Chapter 17.

18.2.2 The assessment includes accident benefits as calculated in Stage 0. Accident benefits were calculated using COBALT version 2013.02 accident analysis software.

18.2.3 The only differentiation between the options in the assessment is the length of the scheme and the associated journey times. The number of trips is assumed to be constant between the do minimum scenario and each of the do something options.

18.2.4 Journey time reliability, wider impacts and social and distributional impacts have only been considered qualitatively as part of the assessment.

18.2.5 The economic appraisal process follows WebTAG guidance and assumptions, where practical, for the assessment. For the economic appraisal, TUBA 1.9.7 software has been used. The key input data relate to traffic volumes, journey times, and distances.

18.2.6 Traffic volumes and journey times have been taken from the modelling undertaken. The distances of each do-something option have been taken from the long section plans produced by the engineering team. Default journey purposes and vehicle split/user classes from WebTAG have been used.

18.2.7 The economic assessment reported here has two elements. The first is an estimation of costs and benefits associated with the representative scheme (do-something) compared to the existing conditions (do-nothing). This element considers the user benefits of savings in travel time and vehicle operating costs against the costs of implementing the scheme and is given a monetary value in present values discounted to 2010, in 2010 prices. Discount rates are based on Table A1.1.1 of WebTAG November 2014, and apply 3.5% per annum for up to 30 years from current year and 3.0% from 31 to 60 years. The second element of the economic assessment considers

the use benefit of the improvement to journey time reliability, and regeneration impacts of the scheme which are described qualitatively below.

18.3 Travel Time and Vehicle Operating Costs

18.3.1 The user benefits of the scheme are the savings in travel time and vehicle operating cost, accrued over 60 years following the assumed opening of the scheme in 2021. Journey time savings and changes in vehicle operating costs have been calculated for the representative scheme, compared to the Do-Nothing, using TUBA 1.9.7.

18.3.2 The User Benefits to travel time and vehicle operating costs, in present values discounted to 2010, in 2010 prices, are shown in the Economics Summary tables below.

18.4 Accidents

18.4.1 The benefit from a reduction in collisions has been calculated using Cobalt v2013_02. Collisions have been assessed using a combined link and junction based assessment. In the Do Minimum, link type 8 has been assumed which represents a single carriageway A road designed to modern standards. In the Do Something, link type 10 has been assumed which represents a dual carriageway with two lanes in each direction designed to modern standards.

18.4.2 The results are included in the AMCB table, Table 29-8.

18.5 Other Benefits

18.5.1 Other benefits such as regeneration effects have not been monetised at this stage, relying on the regional growth scenario to determine the level of regeneration expected for the scheme. It is recognised that there is the potential for benefits to be derived from the scheme, including:

- Expected journey time benefits for business users will help support planned residential and employment regeneration in the Norwich Area;
- Improvements in journey times will improve access to services in Norwich from the areas local to the scheme;
- Benefits in journey time savings will improve resilience and reliability which directly affect journey quality, predominantly associated with traveller stress; and
- Benefits in journey time savings will result in fuel efficiencies for all users.

18.5.2 An assessment of wider economic benefits has not been carried out.

18.5.3 An assessment of greenhouse gases has not been carried out.

18.5.4 There are a number of local development projects which have been put forward to local planning authorities via Local Devlopment Order (LDO) application and responses to call for sites from Breckland, Broadland and South Norfolk District Councils, which are likely to positively impact the economic scheme. In particular, Breckland District Council are currently considering an LDO application for a 10ha. Food Hub site to the west of Easton adjacent to the A47, the LDO is likely to be determined in early 2017. Breckland and the Developer involved have indicated that the LDO application is phase 1 of a much wider Food Hub and extensive residential proposal for the surrounding area.

18.6 Journey Time Reliability

18.6.1 Journey time reliability is typically impacted by two main sources: incidents and congestion. Incidents are those which reduce or stop carriageway capacity, typically accidents or vehicle breakdowns. Congestion affects journey time reliability when the flow exceeds capacity and a break down in the flow occurs. Anecdotal evidence suggests that journey time reliability on the A47 is also affected by the presence of agricultural vehicles and limited safe overtaking opportunities.

18.6.2 Dualling the A47 would address the two main typical sources impacting journey time reliability; the A47 would be more resilient to incidents and the increased capacity would reduce the incidence of congestion causing a break down in flow. The effect of the presence of agricultural vehicles would be reduced by providing a second lane which other vehicles could use to overtake.

18.7 Option Estimate

18.7.1 The Options estimates used in the economic assessment are described in section 17. Highways England Commercial Team provided a signed off and validated Option Estimate for Option 4 with associated re based input data for use in the economics assessment. The costs for the other options 1, 3 and 6 used in the economics assessment were calculated on a pro rata basis from the relative cost estimates presented in Table 17-3 of Section 17.

18.8 Economic Summary Tables

Table 18-1 Transport Economic Efficiency

	Value (in £Ms)			
Non-Business: Commuting User benefits	**Option 1**	**Option 3**	**Option 4**	**Option 6**
Travel Time	40.595	39.217	40.33	39.826
Vehicle Operating Costs	0.472	0.102	0.287	-0.053
NET NON-BUSINESS BENEFITS: COMMUTING (1a)	41.067	39.318	40.617	39.773
Non-Business: Other ***User benefits***				
Travel Time	86.804	83.631	86.132	84.847
Vehicle Operating Costs	0.378	-0.334	0.018	-0.647
NET NON-BUSINESS BENEFITS: COMMUTING (1b)	87.182	83.297	86.149	84.2
Business ***User benefits***				
Travel Time	210.121	202.717	208.603	205.765
Vehicle Operating Costs	2.775	0.992	1.895	0.255
NET BUSINESS IMPACT (5)	212.896	203.708	210.498	206.02
TOTAL				
Present Value of Transport Economic Efficiency Benefits (TEE) (6) = (1a) + (1b) + (5)	341.145	326.323	337.264	329.993

Table 18-2 Public Accounts

Central Government Funding: *Transport*	**Value (in £Ms)**			
	Option 1	**Option 3**	**Option 4**	**Option 6**
Investment Costs	134.374	135.994	130.907	129.758
Central Government Funding: *Non-Transport*				
Indirect Tax Revenues	-2.095	-2.903	-2.531	-3.341
TOTAL				
Broad Transport Budget	134.374	135.994	130.907	129.758
Wider Public Finances	-2.095	-2.903	-2.531	-3.341

Table 18-3 Economic Summary

Economic Summary	**Value (in £Ms)**			
	Option 1	**Option 3**	**Option 4**	**Option 6**
TEE Benefits (e)	341.145	326.323	337.264	329.993
Accident Benefits (j)	5.126	5.126	5.126	5.126
Total Present Value of Benefits (PVB) (k) = (e) + (j)	346.271	331.449	342.390	335.119
Total Present Value of Costs (PVC) = (i)	134.374	135.994	130.907	129.758
Net Present Value (NPV) = (k) – (i)	211.897	192.234	208.084	202.371
Benefit to Cost Ratio (BCR) = (k) / (i)	2.58	2.44	2.62	2.58

18.9 Value for Money

18.9.1 Value for Money assessments are produced to support scheme and programme decisions, whereby the performance of the scheme, utilising the BCR can be appraised on a common scale. That scale is defined as follows:

Table 18-4 Value for Money Categories

Rating	BCR
Poor	< 1.0
Low	> 1.0 and < 1.5
Medium	> 1.5 and < 2.0
High	> 2.0 and < 4.0
Very High	> 4.0

18.9.2 The calculated BCR at this time (end of PCF Stage 1) suggested that the scheme had a HIGH value for money according to the Value for Money categories.

19 Assessment Summary of Sifted Options

19.1 Introduction

19.1.1 At the end of PCF Stage 1, as instructed by Highways England, the reporting process was drawn to an early conclusion in order to meet project governance timescales and to maintain project programme. Therefore, completion of assessment summary and comparison of the options was deferred and it was agreed that it would be undertaken early in PCF Stage 2. At the end of PCF Stage 1, it was intended that once the option estimates were available and the transportation modelling was completed that the Assessment Summary and Technical Appraisal Report would be completed. Events in PCF Stage 2 superseded this approach (see Chapters 20 & 21).

19.2 Appraisal Summary Table (ASTs)

19.2.1 As explained in Chapter 12 and 13, to inform the PCF Stage 1 Stage Gate Review in November 2016 and the Investment Decision Committee (IDC) meeting in December 2016 a "Transportation and Economic PCF Stage 1 Products" Technical Note was prepared including an Appraisal Summary Table (AST) for Option 4.

19.2.2 The PCF Stage 1 AST for Option 4 is included in Appendix M.

19.3 Summary of Consultation with Public Bodies

19.3.1 A summary of stakeholder engagement which took place in PCF Stage 1 that included Highways England is detailed below.

Norfolk County Council (NCC)

19.3.2 During PCF Stage 1 there were a number of liaison meetings with NCC. These focused on keeping NCC updated on progress and programme for the overall A47 programme, discussions and handover of model data of NATS model and discussion around the options being considered for the scheme. The following meetings have been held:

- 4th November 2015 – Initial discussions regarding PCF Stage 1
- 17th November 2015 – Initial discussion regarding NATS model
- 15th December 2015 – Lessons Learnt from Norwich Northern Distributor Road DCO
- 28th January 2016 – Detailed discussion NATS model and NDR programme
- 11th April 2016 - Initial discussion regarding programme for Western Link Road
- 4th May 2016 – Initial Options review meeting
- 27th July 2016 – Progress update and options review
- 13th October 2016 – A47 Programme update to NCC elected members and officers

Breckland District Council

19.3.3 A meeting was held on the 6th of September 2016 with Breckland District Council to discuss the overall A47 programme and the North Tuddenham to Easton scheme and to discuss the potential approach to PCF Stage 2 consultations.

Broadland District Council

19.3.4 The following meetings have been held with the Planning Officers of Broadland District Council to discuss planning proposals in the area of the scheme and in particular the LDO for the Greater Norwich Food Enterprise Zone (GNFEZ):

- 24th May 2016 – Initial discussions regarding planning in Broadland area
- 28th July 2016 – Initial discussion regarding GNFEZ LDO
- 18th August 2016 – Discussion with regard to GNFEZ LDO and call for sites

Environmental Bodies

19.3.5 A meeting was held on 31 August 2016 with the Environment Agency, Natural England and Historic England where an introduction and update on all the 6 schemes in the A47 Programme was completed.

Other Public Bodies

The Planning Inspectorate (PINS)

19.3.6 Meetings have been held with PINS to discuss the relevant consenting matters that need to be taken into consideration for all the A47 Schemes including the North Tuddenham to Easton Scheme.

- 20 April 2016
- 21 June 2016
- 13 July 2016

A47 Alliance

19.3.7 A meeting was held with the A47 Alliance on 26 January 2016 and 12 July 2016 when discussions were held regarding the A47 Programme and schemes contained in this including North Tuddenham to Easton.

Members of Parliament

19.3.8 There have been a number of meetings with Members of Parliament where details of the A47 Schemes have been discussed.

- 19 January 2016
- 07 July 2016

19.4 Assessment of Planning Requirements

19.4.1 In order to secure the necessary consents, all significant highways schemes are subject to statutory processes in order to demonstrate that they have followed due process and guidance set out in relevant Acts of Parliament.

19.4.2 The key Acts of Parliament to consider for this scheme are:

- Highways Act 1980
- Planning Act 2008

19.4.3 A determination is required to establish which Act is relevant to this scheme. This is dependent on a number of factors including:

- The type of scheme
- The area of land required for the scheme
- The environmental impact of the scheme

19.4.4 Given the scale of the existing layout of the single lane carriageway, and the expectation that more substantial improvements may be needed at the location (based on the findings of the Feasibility Study), it is considered likely that improvements to this stretch of carriageway will as a result of the amount of land take being in excess of 60 ha meet the criteria for a Nationally Significant Infrastructure Project and will therefore be required to obtain development consent under the Planning Act 2008.

20 Stage 1 Conclusion and Transition to Stage 2

20.1 Transition to PCF Stage 2

20.1.1 The PCF Stage 1 study confirmed the transport problems described in Section 1.3.

20.1.2 In seeking to resolve the transport problem a number of potential options were developed and have been considered in the first part of this report (Chapters 1 -19).

20.1.3 Options 1, 3, 4 and Option 6 are all expected to resolve the transport problem in so much that they will increase the capacity of the link and reduce congestion allowing for a safer, swifter movement of traffic along the route.

20.1.4 Indications from the limited economics information available at the end of PCF Stage 1 were positive in that a high BCR (2.62 for Option 4) value was likely.

20.1.5 Equally there were a number of issues which needed to be resolved as the Scheme progressed through development in subsequent PCF Stages, they included:

- The designs taken forward to PCF Stage 2 will be developed in more detail in order to make a recommendation on the preferred route.
- More detailed environmental investigations to enable completion of an Environmental Impact Assessment and an Environmental Statement (during PCF Stage 3) giving greater understanding of the impacts in the area.
- Affordability and Value Management. A Value Management exercise was to be carried out early in PCF Stage 2 including input from buildability contractors. The outputs to be detailed in a Value Management Workshop Report. Further value management interventions will be carried out as the Scheme progresses to reduce the value of future Options Estimates.
- An appropriate level of flood risk assessment to assist and determine the preferred route.
- Appropriate topographical survey data to be obtained to enable a greater understanding of the topography of the area and link in with the construction process.
- More detailed investigations and recommendations regarding NMU provisions.
- Buildability of the options and understanding the arrangements in regards to Traffic Management required during construction to minimise disruption.

20.2 Transition to PCF Stage 2

20.2.1 As explained in Chapter 1, in order to meet a March 2020 start on site date the programme dictated that PCF Stage 1 could not extend beyond November 2016 to allow adequate time for future stages. At the end of each PCF Stage, Highways England holds a Stage Gate review to enable the progress of the scheme to be reviewed, known as a Stage Gate Assessment Review (SGAR).

20.2.2 The SGAR provides basic assurance that:

- The stage is complete and is within tolerance
- The project control framework (PCF) has been followed

- The project is ready to proceed to the next stage, subject to investment authorisation

20.2.3 As detailed at the start of the assessment Chapters 12, 17, 18 and 19, at the time of SGAR 1 (end of PCF Stage 1), only one option estimate was available from Highways England commercial. It was therefore not possible for the detailed technical assessments to be completed for all four options and reported for the end of PCF Stage 1, however they were completed early in stage 2 and validated, with costs estimates undertaken in June and October 2017.

20.2.4 In order to allow the Scheme to be reviewed at the SGAR, the assessments were concluded based on comparative cost estimates and updated local transport modelling which was reported to the SGAR by the production of a Technical Note. This was on the understanding that detailed estimates for the 4 options and the strategic modelling would be completed in PCF Stage 2. This would allow the TAR to be completed and reported within the Scheme Assessment Report (SAR), this document, in PCF Stage 2.

20.2.5 A positive (green) status was received at the SGAR in November 2016 based on the submitted material which meant the Scheme could proceed to PCF Stage 2, subject to the confirmation of funding for PCF Stage 2 from the Investment Decision Committee (IDC) held in December 2016.

20.2.6 At the end of PCF Stage 1, Highways England Investment Committee indicated that the scheme would progress to PCF Stage 2 with the caveat that at the start of PCF Stage 2 a review of the affordability and value for money of the scheme was undertaken to demonstrate that a scheme could be delivered within the budget which was likely to achieve a BCR in excess of 1.5. The results of the review were presented to the Investment Committee for sign off prior to public consultation launch.

20.2.7 A process of value management and an affordability review was therefore undertaken. This allowed a review of the construction cost estimates provided by Highways England Commercial, to revisit the scheme options design to reduce the estimated cost of the project with the aim of bringing the estimated scheme costs within budget.

20.2.8 Chapter 21 presents the Value Management Deep Dive undertaken as a result of the IDC request at the start of PCF Stage 2. Further detail is contained in the PCF Product Value Management Workshop Report, document reference A47IMPS2-AMY-TE-ZZ-DO-J0041.

21 Scheme Value Management Deep Dive

21.1 Introduction

21.1.1 This section describes the process that was undertaken early in PCF Stage 2 to review the outline PCF Stage 1 design proposals and resulting cost estimates to ensure that a viable and affordable scheme could be promoted and progress through PCF Stage 2. Further information is detailed in the PCF Product Value Management Workshop Report, document reference A47 IMPS2-AMY-TE-ZZ-DO-J0041.

21.2 PCF Stage 1 Cost Estimate

21.2.1 During PCF Stage 1, on the basis that all four options would be estimated in further detail in PCF Stage 2, it was decided to undertake a single estimate for the scheme based on one of the route options which could be used to assess the overall viability of the scheme in terms of cost.

21.2.2 The PCF Stage 1 range estimate undertaken gave a most likely outturn cost of £199.506M which was in excess of the Order of Magnitude estimate undertaken for the DfT Feasibiltiy Study of October 2015 which had a most likely estimate of £130.245M. See table 21-1 below for details of the range estimate figures.

Table 21-1 – PCF Stage 1 Comparison to Feasibility Stage Cost Estimate

Stage	Range MIN (£M)	Most Likely (£M)	Range MAX (£M)
Range Estimate undertaken in November 2016 (PCF Stage 1)	153.378	199.506	281.981
Outturn Costs Order of Magnitude Estimate(Oct 15)	109.984	130.245	160.510

21.2.3 At the end of PCF Stage 1, Highways England Investment Committee indicated that the scheme should progress to PCF Stage 2 with the caveat that at the start of PCF Stage 2 a review of the affordability and value for money of the scheme was undertaken to demonstrate that a scheme could be delivered within the budget which was likely to achieve a BCR in excess of 1.5. The results of the review were to be presented to the Investment Committee for sign off prior to public consultation launch.

21.3 Summary of Value Management Deep Dive Process

21.3.1 The affordability review process followed a series of Value Management (VM) workshops which started with a review of the high-level breakdown of the estimate prepared in PCF Stage 1 and a review of the scheme to determine where potential savings could be made.

21.3.2 To produce an estimate for the review, the PCF Stage 1 estimate was used as a basis. The estimate was then adjusted for the changes from the Value Engineering initiatives and any assumptions and high level engineering judgements made, were recorded in the report. This was undertaken for a single option (see below) with the agreed

assumption that the outcomes from the Value Management Deep Dive could be applied in equal measure to all options.

21.3.3 The following series of VM workshops were held between Amey, Highways England and Taylor Woodrow for the scheme to review and develop potential value engineering options which could achieve the required cost reduction.

Table 21-2 – Value Management Key Dates

Value Management Workshop Date	Attendees
04/01/2017	Amey/Highways England
10/01/2017	
18/01/2017	
25/01/2017	Amey/Highways England/Taylor Woodrow
02/02/2017	
08/02/2017	

21.3.4 Due to the constraints of the programme timescale, it was not possible to produce an updated indicative design solution and put this design through the fully assured Highways England estimating process. To produce and estimate for the review, the PCF Stage 1 estimate was used as a basis, the estimate was then adjusted for the changes from the Value Engineering initiatives

21.3.5 The following value engineering initiatives were taken forward to the revised unassured estimate:

- Bridgeworks removed by removing grade separation at Easton and Wood Lane over bridge
- Review of earthworks and remove disposal items assume material can be reused on site over provision in earthworks
- Pavement reduction in cost for assumption that can reduce hardstrips to 0.5m width rather than 1.0m width
- Associated works with grade separation and Wood Lane for earthworks, roadworks, kerbing etc
- Kerbing removed by drainage switch above
- Drainage review of scope and change from positive drainage with kerbs to over the edge
- Removal of communications provision for expressway
- Other Savings – Construction duration reduced by 6 months, risk level reduced. Consequential reductions in direct costs leads to savings in Non-Recoverable Value Added Tax, Inflation, Unscheduled Items, Risk, Contractors Costs

21.3.6 For the purposes of the estimate, it was agreed that Cost Planning would complete their assessment of costs using the same tools and processes that were in place at the time of the officially released estimates, to enable like-for-like comparisons across the outputs.

21.3.7 The results from the value management exercise are presented in the table below

Table 21-3 Outcomes from Value Management Deep Dive

Released Most Likely Outturn PCF Stage1 Estimate(£M)	Value Engineered Most Likely Outturn Estimate(£M)	Potential Most Likely Costs Savings from VE Works (£M)
199.5	131.3	68.2 (±25%)

21.3.8 Cost Planning advised the project teams, in advance of issuing the figures, that the figures provided are highly indicative and carry a low level of assurance. The information provided does not represent a standard Commercial Services Division output and should not be treated as such.

21.4 Review Outcomes and Impact on Previous Assessments

21.4.1 An unassured assessment of the BCR based on a limited assessment of the change in benefits from the feasibility assessment was undertaken to support the affordability review. The unassured BCR calculated indicated that the scheme would be likely to outturn a medium value for money.

21.4.2 The Value Management review provided sufficient evidence to the Investment Committee to demonstrate that the scheme should be taken through the public consultation and the options further assessed during PCF Stage 2.

21.4.3 The potential changes to the options from the Value Management Deep Dive process have not changed the assessments undertaken during the initial sifting process described in section 10. The changes made at affordability review have not changed the option alignments of the routes.

21.4.4 The changes which have been made are predominantly around assumptions made in the estimate around design elements for which the detail will be developed in later PCF Stages, such as method of drainage, kerb types, junction and side road strategy. Any changes from the affordability review could apply to any of the route options.

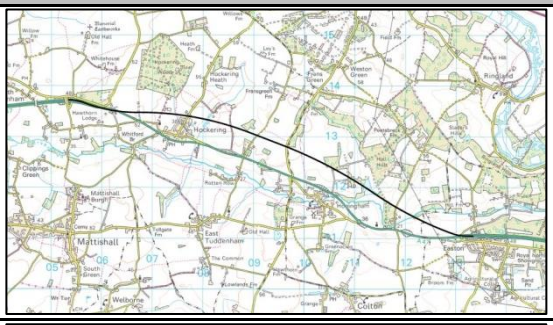
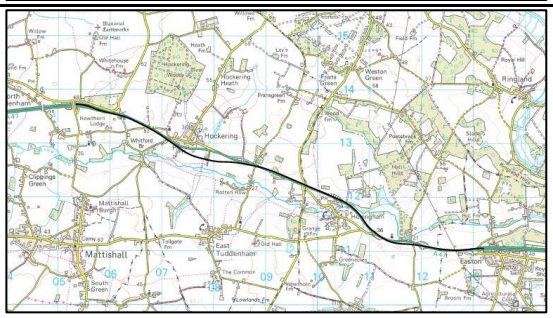
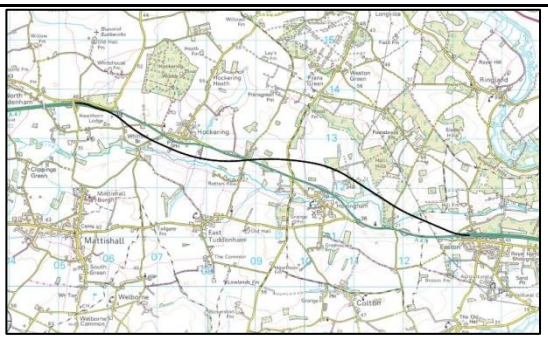
22 Option Renumbering for Consultation

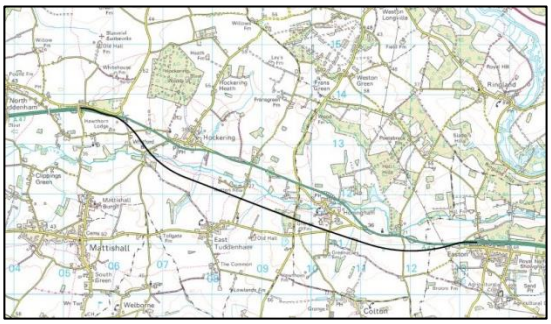
22.1 Option Numbers for Assessment and Consultation

22.1.1 For simplicity in gathering public comment and for presentation at public consultation it was decided that the 4 options to be taken forward should be renumbered 1 to 4.

22.1.2 The Options were renumbered as shown in the table below

Table 22-1: Route Option Renumbering

Option Number at Stage 1	Option Number at consultation	Route Plan (see section 9)
Option 1	Option 1	
Option 3	Option 2	
Option 4	Option 3	

Option 6	Option 4	

23 Engineering Overview of Affordable Options

23.1 Introduction

23.1.1 The results from the Value Management Deep Dive exercise were used to develop 4 indicative option layouts for the 4 route options to allow fully assured estimates to be developed for each of the options in PCF Stage 2. These option layouts show indicative junctions and side road arrangements for estimating and route assessment purposes. The side road and junction strategy will be developed in PCF Stage 2 during preliminary design.

23.1.2 The four indicative route option layouts:

- Option 1 an offline dualling to the north of the existing
- Option 2 an online dualling following the existing A47 route
- Option 3 an offline dualling to the south of the existing A47 for the western part of the route and to the north of the existing for the eastern part of the route
- Option 4 an offline dualling to the south of the existing A47 route

23.1.3 The Options developed based on the route alignments from PCF Stage 1 with indicative side roads and junction layouts based on the outcomes of the Value Management Deep Dive Review, are presented in Appendix N. These layouts were used for route assessment purposes in the transportation and environmental assessments detailed in subsequent sections of this report.

23.2 Alignment

Option 1

23.2.1 The proposed new dual carriageway would be constructed offline to the north of the existing A47.

23.2.2 The proposed route is offline and because the route does not cross the existing A47 it is therefore not constrained by the existing A47 alignment either horizontally or vertically. Horizontal radii in excess of the Desirable Minimum for the design speed could be used throughout.

23.2.3 The vertical alignment could be improved compared to the existing and the proposal would have vertical crest curve radii greater than the Desirable Minimum for the design speed. Generally the longitudinal gradients would be 2% or shallower but the gradient at the tie-in to the existing at Easton would be a little steeper at around 2.5%.

23.2.4 Being a reasonable distance offline to the north for the whole route would allow a considerable length of the existing A47 carriageway to be retained and used for local accesses.

Option 2

23.2.5 The online improvement proposal would be to upgrade the existing single carriageway A47 to a two lane dual carriageway by primarily online widening, with discrete offline sections to avoid or minimise the impact on a number of constraints. Where required,

local access roads may need to be diverted or include mitigation measures to provide access to properties and adjacent fields.

23.2.6 The alignment of this online improvement proposal would necessarily follow fairly closely the existing both horizontally and vertically. The existing road alignment is made up of mostly large radius horizontal curves and straights and the proposed option is likely to have horizontal radii equal to or greater than the Desirable Minimum for the design speed.

23.2.7 The existing vertical alignment is undulating with some fairly low radius vertical crest curves. Although there will be scope to improve the alignment on the short sections where the proposed deviates from the existing nevertheless the proposed alignment would have crest curve radii less than the Desirable Minimum for the design speed of this road.

23.2.8 Generally the longitudinal gradients are shallower than 2% but there would be an instantaneous maximum of nearly 3% just to the west of the crossing of the River Tud.

23.2.9 Being on the line of and subsuming much of the existing A47 means that little of the existing road would be left to be used for local accesses and other provision would be required.

Option 3

23.2.10 The proposed new dual carriageway would be constructed part offline to the south and part offline to the north of the existing A47. The option would pass to the south around Hockering, crossing the existing alignment near Sandy Lane then passing north past Honingham before tying back in to the existing alignment at Easton.

23.2.11 The proposed route is offline therefore it is not so constrained by the existing A47 alignment as Option 3, although because the route crosses the existing A47, levels would have to be designed such that a through route could be maintained during construction. To move the alignment away from and then across the existing may require horizontal radii smaller than the existing alignment but they would still be in excess of the Desirable Minimum for the design speed.

23.2.12 The vertical alignment could be much improved compared to the existing and the proposal would have vertical crest curve radii greater than the Desirable Minimum for the design speed.

23.2.13 Generally, the longitudinal gradients would be 2%.

23.2.14 Being a reasonable distance offline either to the north or south for the whole route would allow a considerable length of the existing A47 carriageway to be retained and used for local accesses.

Option 4

23.2.15 The proposed new dual carriageway would be constructed offline to the south of the existing A47.

23.2.16 The proposed route is offline and because the route does not cross the existing A47 it is therefore not constrained by the existing A47 alignment either horizontally or vertically. Horizontal radii in excess of the Desirable Minimum for the design speed could be used throughout.

23.2.17 The vertical alignment could be improved compared to the existing and the proposal would have vertical crest curve radii greater than the Desirable Minimum for the design speed. Generally, the longitudinal gradients would be 2% or shallower but the gradient at the tie-in to the existing at Easton would be a little steeper at around 2.5%.

23.2.18 Being a reasonable distance offline to the south for the whole route would allow a considerable length of the existing A47 carriageway to be retained and used for local accesses.

23.3 Junctions on the Route

23.3.1 Junction and side road strategy will be completed in later PCF Stages following preferred route announcement. In order to produce detailed estimates for the scheme options and to enable scheme assessments a number of assumptions were needed to be made about the form of the junctions and connectivity of the side roads, for each of the options.

23.3.2 There are existing junctions adjacent to each end of the scheme. There is firstly an existing grade separated interchange located on the A47 at the extreme western end of the scheme and consists of 2 left in and left out junctions connected by Fox lane and Main Road. Secondly there is an existing grade separated dumbbell junction (Longwater Interchange) located on the A47 to the east of Easton.

23.3.3 The indicative junction strategy for estimating, is currently to provide 2 new at grade roundabout junctions along the new route with the existing roundabout at Easton to be removed. The position and connectivity is clearly different for each of the 4 route options as follows:

Option 1 – indicative junctions

23.3.4 This option includes a new at grade roundabout located to the northwest of Honingham with connections to Wood Lane to the north and the south and a new at grade roundabout located midway between Honingham and Easton with connections to Taverham Road to the north and the south.

23.3.5 Access to the A47 from the village of Hockering can be gained by travelling east along the old A47 to the junction with Wood Lane. At this junction, traffic would turn left into Wood Lane and head north to the new roundabout located on the A47 from which access can be made to the A47 westbound and eastbound carriageways.

23.3.6 Traffic wishing to access the A47 from the north of Hockering can travel south along Heath Road into Hockering then head east along The Street to the Old A47 and accessing the A47 via the roundabout on Wood Lane. Alternatively, traffic may travel south along Wood Lane where it can access the A47 at the Wood Lane intersection.

23.3.7 Access to the A47 from the village of Honingham can be achieved by travelling west along Dereham Road and turning right into Berry's Lane. Traffic should travel across the staggered junction at the old A47 and travel north along Wood Lane to the new roundabout located on the A47 where it can access the eastbound and westbound carriageway.

23.3.8 Access to the A47 eastbound carriageway from the village of Honingham may also be achieved by travelling east along Norwich Road to the existing roundabout situated on the old A47. From here traffic will travel east along the old A47 until it reaches Taverham Road where it will turn left and travel north to the roundabout on the proposed A47 where there is access to the eastbound and westbound carriageways.

23.3.9 Traffic wishing to access the A47 from the existing roundabout to the west of Easton will no longer be able to undertake this manoeuvre as this existing roundabout will be removed. Vehicles will be able to access the A47 to the east of Easton via the new roundabout on Taverham Road. This can be reached when travelling west from Easton by using a small diversion which links Dereham Road to the old A47. Traffic will continue along the old A47 and continue west to Taverham Road where the traffic will turn right and travel north to the new roundabout located on the A47. Traffic from Easton will still be able to access the A47 from the Longwater Interchange located to the east of Easton.

23.3.10 Access to the A47 for vehicles travelling from the north of Easton will be gained by travelling north along Ringland Road and bearing left at the junction of Weston Road. Traffic will travel northwest until it reaches Taverham Road where it turns left and travels south to the roundabout located on the A47.

23.3.11 A link road has been provided at the western end of the scheme linking Main Road with Heath Road. This should facilitate future maintenance works and possible road closures of the A47.

Option 2 – indicative junctions

23.3.12 This option includes a new at grade roundabout located to the northwest of Honingham with connections to Wood Lane to the north and Berry's Lane to the south and a new at grade roundabout located adjacent to the existing A47 roundabout at the junction with Norwich Road. There are connections to Norwich Road to the west and to a new diversion route leading to Church Lane to the east.

23.3.13 Access to the A47 from the village of Hockering and from north of Hocking can be gained by travelling east along the old A47 to Sandy Lane. At Sandy Lane, the old A47 becomes part of a new diversion route which continues east to a T junction at Wood Lane. At Wood Lane, the traffic would turn right and travel south to the new roundabout on the A47 where vehicles can join the eastbound and westbound carriageways.

23.3.14 Access to the A47 westbound carriageway from the village of Honingham can be achieved by travelling west along Dereham Road and turning right into Berry's Lane. Traffic will then travel north to the new roundabout located on the A47 where the westbound carriageway can be accessed.

23.3.15 Access to the A47 eastbound carriageway from the village of Honingham can be achieved by travelling east along Norwich Road to the new roundabout situated on the A47.

23.3.16 Traffic wishing to access the A47 from the existing roundabout to the west of Easton will no longer be able to undertake this manoeuvre as this existing roundabout will be removed. Vehicles in Easton wishing to access the A47 should travel east along Dereham Road to the Longwater Interchange, located to the east of Easton, where both carriageways can be accessed.

23.3.17 Access to the A47 for vehicles travelling from the north of Easton will be gained by travelling along a new diversion which starts at Church Lane and runs parallel with the A47 tying into the new roundabout located to the east of Honingham.

23.3.18 A link road has been provided at the western end of the scheme linking Main Road with Hockering. This should facilitate future maintenance works and possible road closures of the A47.

23.3.19 At this stage no assessment has been made regarding upgrading requirements for local roads.

Option 3 – indicative junctions

23.3.20 This is a new at grade roundabout located to the northwest of Honingham with connections to Wood Lane to the north and the south and a new at grade roundabout located midway between Honingham and Easton with connections to Taverham Road to the north to a new road connecting the A47 to the existing A47 roundabout to the east of Honington.

23.3.21 Access to the A47 from the village of Hockering and from the area to the north of Hockering can be gained by travelling west along the old A47 east of Hockering. The old A47 then runs into a new section of road that connects to Main Road which leads to the existing interchange located at the west of the scheme. The eastbound carriageway can be accessed via the junction with Main Road while the west bound carriageway is accessed by Fox Lane.

23.3.22 Access to the A47 from the village of Hockering and from the area to the north of Hockering can also be gained by travelling east along the old A47 to the east of Hockering. On reaching Sandy Lane, the old A47 runs into a new section of road that runs parallel with the A47 and continues east forming a T junction at Wood Lane. Traffic turns right into Wood Lane and travels south before connecting to the new roundabout on the A47.

23.3.23 Vehicles wishing to access the A47 from the south of Hockering may travel east along Mattishall Lane to the junction with Berry's Lane. At the crossroads, the traffic should turn left and proceed north along Berry's Lane to the junction with the old A47 where it should cross the old A47 into Wood Lane and continue to head north accessing the A47 at the new roundabout.

23.3.24 Access to the A47 from the village of Honingham can be achieved by travelling west along Dereham Road and turning right into Berry's Lane. Traffic should travel across the staggered junction at the old A47 and travel north along Wood Lane to the new roundabout located on the A47.

23.3.25 Access to the A47 eastbound carriageway from the village of Honingham can be achieved by travelling east along Norwich Road to the existing roundabout situated on the old A47. From here traffic will travel north on the new section of road that connects to the new roundabout located on the A47 at Taverham Road.

23.3.26 Traffic wishing to access the A47 from the existing roundabout to the west of Easton will no longer be able to undertake this manoeuvre as this existing roundabout will be removed. Vehicles will be able to access the A47 to the east of Easton via the new roundabout at Taverham Road. This can be reached when travelling west from Easton by using a new small diversion which links Dereham Road to the old A47 continuing west along the old A47 to the roundabout located at the junction with Norwich Road. At this roundabout, the traffic will turn right and travel north on the new section of road that connects to the new roundabout located on the A47 at Taverham Road.

23.3.27 Traffic from Easton will still be able to access the A47 via the Longwater Interchange located to the east of Easton.

23.3.28 Access to the A47 for vehicles travelling from the north of Easton will be gained by travelling north along Ringland Road and bearing left at the junction of Weston Road. Traffic will travel northwest until it reaches Taverham Road where it will turn left and travel south to the roundabout located on the A47.

Option 4 – indicative junctions

23.3.29 A new at grade roundabout located to the northwest of Honingham with connections to Berry's Lane to the north and the south and a new at grade roundabout located to the east of Honingham with a connection to the existing roundabout at the A47/Norwich Road junction.

23.3.30 Access to the A47 from the village of Hockering and to the area local to Hockering can be gained by travelling west along the old A47 to the west of Hockering. The old A47 then runs into a new section of road that connects to Main Road which leads to the existing interchange located at the west of the scheme. The eastbound carriageway can be accessed via the junction with Main Road while the westbound carriageway is accessed via Fox Lane.

23.3.31 Access to the A47 from the village of Hockering and to the area local to Hockering can also be gained by travelling east along the old A47 to the east of Hockering. At the junction with Berry's Lane traffic should turn right and travel south to the new roundabout located on the A47.

23.3.32 Any traffic currently located south of Hockering and also south of the proposed route can gain access by travelling east along Mattishall Road to the junction with Berry's Lane. At Berry's Lane traffic should travel north where it will connect to the new roundabout on the A47.

23.3.33 Access to the A47 from the village of Honingham can be achieved by travelling west along Dereham Road and turning left into Berry's Lane. Traffic should travel south along Berry's Lane where it will connect to the new roundabout on the A47. Alternatively, Honingham traffic may travel east along Norwich Road to the existing roundabout located on the old A47. At the roundabout, traffic should take the third exit and travel south along the new road that links the existing A47 roundabout to the new roundabout located on the A47.

23.3.34 Vehicles wishing to access the A47 from the village of Colton which is located to the south of Honingham should travel north along Colton Lane to the junction with Mattishall Road. Traffic should turn left into Mattishall Road then take an immediate right into Berry's Lane travelling north and connecting to the new roundabout located on the A47.

23.3.35 Traffic wishing to access the A47 from the existing roundabout to the west of Easton will no longer be able to undertake this manoeuvre as this existing roundabout will be removed. Vehicles in Easton wishing to access the A47 should travel east along Dereham Road to the Longwater Interchange located to the east of Easton where both carriageways can be accessed.

23.3.36 Access to the A47 for vehicles travelling from the north of Easton will be gained by travelling along a new diversion which starts at Church Lane and runs into the old A47. Traffic should continue west along the old A47 until arriving at the existing roundabout at Norwich Road. At the roundabout, traffic should take the first exit and travel south along the new road that links the existing A47 roundabout to the new roundabout located on the A47.

23.4 Departures from Standards

23.4.1 The Option layouts currently developed do not include any departures from standards. It should be noted that once the design is further developed some of the current relaxations from standards identified may become departures from standards. Further

review of departures from standards will be undertaken as the design develops in later PCF Stages.

23.5 NMU Provision

23.5.1 Proposed NMU access has been discussed in section 13.4 for the four options. An NMU context report has been prepared in PCF Stage 2, document A47 IMPS2-AMY-TE-ZZ-DO-J0059. The findings from this Report will be used at PCF Stage 3 to inform and develop the preliminary design of the scheme.

23.5.2 This report has established the background information on current and potential NMU issues related to the scheme. Based on the review of the current NMU provision, desire lines and potential use.

23.5.3 The report recommends:

- maintaining PRoWs within the study area and providing suitable NMU crossing facilities where PRoWs are crossed by the new A47 alignment with minimal diversion;
- If an offline option is selected, ensure the legacy A47 roadway is suitable for the use of NMUs;
- Provide NMU facilities at new junctions;
- NMU audits to be carried out at the end of each PCF stage.

23.6 Drainage and Flooding

23.6.1 The drainage section in Section 13.6 provides a commentary on drainage and flooding for the 4 options, a 'positive drainage' system including kerbs and gullies was identified and costed in the PCF Stage 1 estimate. At the start of PCF Stage 2, alternative methods of draining the carriageway were investigated as potential value engineering opportunities.

23.6.2 An alternative 'over the edge drainage' system was included in the PCF Stage 2 drainage strategy assumptions made in preparation of the PCF Stage 2 estimate. An 'over the edge drainage' system would allow the water from the carriageway to flow over the carriageway edge and directly into perforated (carrier/filter) drains or swales or ditches in the verges and central reserves. This would eliminate the requirements for gullies, kerbs, channels associated with positive drainage.

23.6.3 The drainage strategy and the type of drainage for each section of the new road will be reviewed in PCF Stage 3 as the detail of the drainage system is developed as part of the preliminary design.

23.6.4 Drainage surveys will be carried out in PCF Stage 3.

23.6.5 The Environment Agency needs to be consulted in PCF Stage 3 with regards to the need for a Flood Risk Assessment.

23.7 Geotechnical Considerations

23.7.1 A Preliminary Sources Study Report (PSSR) was produced in PCF Stage 2 document reference A47IMPS2-AME-TE-ZZ-DO-J0049.

23.7.2 The primary geological risk anticipated at this stage is the lack of ground investigation information within the study area and this is included in the PSSR. While the basic geological make up beneath the site is understood there is no detailed information available that could be used to assess the potential impact of geological features in any significant detail.

23.7.3 Ground investigations will be carried out early in PCF Stage 3 – preliminary design.

23.8 Structures – High Level Structures Strategy

23.8.1 The structures identified for each option at PCF Stage 1 are described in Section 13.8. Following the Value Management Deep Dive and the removal of the grade separation at junctions, all of the over and under bridges listed in the tables in section 13.8 with the exception of the bridge required at the River Tud have been omitted from the scheme. The culverts listed in the tables will be required to convey watercourses below the new dual carriageway.

23.8.2 A structures options report and an Approval In Principal for each structure needed for the scheme will be prepared in PCF Stage 3 as the preliminary design is developed.

23.9 Public Utilities

23.9.1 Details for each option can be found in Chapter 13.9.

23.9.2 Further statutory undertaker's requests would be made in PCF Stage 3 and future stages to check for detailed positions of utilities and to obtain more accurate estimates for utility diversions.

23.10 Topography, Land Use, Property and Industry

23.10.1 Details for each option can be found in Chapter 13.10.

23.10.2 Topography surveys will be carried out in PCF Stage 3.

23.11 Effective Construction Management – Construction (Design and Management) Regulations 2015 – PCF Stage 2

23.11.1 Amey were appointed as Principal Designer, by Highways England, for PCF Stage 2 to plan, manage, monitor and co-ordinate health and safety in the pre-construction phase of the project. The PD therefore:

- sought to ensure that the Design Risk Register identified, eliminated and controlled the foreseeable risks. All identified risks were captured and recorded in the project risk register.
- ensured that designers carried out their duties, by means of design reviews, meetings, and assessments on PCF Stage 2 drawings (route options).
- prepared and provided relevant information to other duty holders (e.g. Principal Contractor) such as the Pre-construction Information documents (see PCF Product Pre-Construction Information, document reference A47IMPS2-AMY-GJ-ZZ-DO-J-0019). Data was obtained from existing asset information databases and residual risk data bases (asbestos register for example) as well as data gathered from site surveys and ground investigations which could be used by the principal contractor to help them plan, manage, monitor and co-ordinate health and safety in the construction phase.

23.11.2 Amey were also appointed as Designer, by Highways England, for PCF Stage 2. As Designer, the main responsibilities included the preparation/modification of designs to eliminate, reduce or control the foreseeable risks that may arise during, design, construction and the maintenance of the constructed schemes. This was achieved through the following tasks:

- CDM audits followed by CDM workshops
- CDM compliance workshop
- Design reviews, with changes captured on the design review form and translated in to the Pre-construction information where necessary

23.12 Operational, Technology, Safety and Maintenance Assessment

23.12.1 The information contained in this section updates the information from Chapters 14 and 15 of this report.

Operational Assessment

23.12.2 The operational assessment described in section 14.1 is still applicable at PCF Stage 2 but will need to be reviewed in detail in later PCF Stages once the side road and junction strategy have been confirmed.

Technology Assessment

23.12.3 The Technology Assessment made at PCF Stage 1 (see section 14.2) is still applicable to PCF Stage 2.

Maintenance Assessment

23.12.4 Maintenance considerations have been detailed in the PCF Stage 2 Maintenance and Repair Strategy Statement PCF Product, document reference A47IMPS2-AMY-TE-ZZ-DO-J0030.

Safety Assessment

23.12.5 The safety of the road user has been considered to a level appropriate to this stage in the design process. Neither a NMU survey nor Road Safety Audit (RSA) has been completed and so specific safety concerns have not been developed any further during PCF Stage 2. These surveys will be conducted during later PCF stages to inform and develop the design.

23.11.7 Further consideration has been given to the safety of the design and is detailed in the PCF Stage 2 Safety Plan Product, document reference number A47IMPS2-AMY-TE-ZZ-DO-J-0008.

24 Non Statutory Public Consultation

24.1 Introduction

24.1.1 The four options identified in section 11 were put forward in a non-statutory public consultation exercise. The consultation was organised and managed by Highways England and ran from 13 March 2017 to 21 April 2017.

24.1.2 The purpose of the public consultation was to seek views on the 4 options and the scheme from the general public, statutory consultees, including local authorities, and other interested bodies.

24.1.3 It was stated that comments received as a result of the consultation process will be considered by Highways England as the scheme progresses.

24.1.4 The public consultation period was from 13 March 2017 to 21 April 2017.

24.1.5 This section provides an overview of the public consultation. There is a separate more comprehensive report on the consultation process which has been produced as part of PCF Stage 2 entitled 2017 06 29 A47IMPS2-AMY-TE-ZZ-DR-J-0007 Report on Public Consultation.

24.2 Public Information Process

24.2.1 The public consultation was intended to seek the views of the public and other stakeholders on the scheme proposals and the four options being considered. The public consultation was advertised by Highways England as follows:

- Highways England website for the A47 Improvement:

  http://www.highways.gov.uk/a47Improvement;

- Highways England press notice (published on 15 March 2017):

  https://www.gov.uk/government/news/have-your-say-on-plans-to-dual-and-improve-junctions-on-the-a47;

- Invitation to local MPs, local councillors and other key stakeholders to attend a preview of the exhibition before it opened to the public, sent on 02 March 2017;
- Advertisements in local newspapers ('EDP', 'Norwich Evening News', 'Diss Wymondham & Attleborough Mercury', 'Norwich Extra') on 16 March 2017;
- Interviews on local television news and radio;
- Notices posted at strategic locations around the Honningham, Hockering and Easton area before the exhibition;
- Leaflet drops were undertaken around the Honningham, Hockering and Easton area;
- Notices posted at the exhibition venue on the days of the exhibition;
- A 'static' advertisement was set up at the Forum in central Norwich and Dereham Library (refer to Section 3.6 for further details).
- Details on those invited to the preview event and the distribution of the advertising leaflet and further details on the advertising of the public consultation exhibitions are included in the Public Consultation Report - 2017 06 29 A47IMPS2-AMY-TE-ZZ-DR-J-0007 Report on Public Consultation.

24.2.2 Some of the local parish councils also advertised the consultations via their websites.

24.2.3 The public and other stakeholders were asked to provide feedback on the information presented in the brochure and at the public consultation events via the questionnaire which was available online and in hard copy at the public information exhibitions.

Data receipt and digitisation of all submissions

24.2.4 Consultation responses were handled differently according to the format in which they were received. Every consultation response was assigned a unique reference number and recorded in a bespoke consultation database. Responses were received in a number of formats as follows:

- Responses via the website
- Paper response forms and letters received via the freepost address
- Email responses
- Responses containing non-text elements

24.2.5 All responses were captured in the database. For submissions containing images, maps and other non-text content a reference to a PDF version of the original submission was made available to analysts so this information could be viewed when necessary. For further details see the 2017 06 29 A47IMPS2-AMY-TE-ZZ-DR-J-0007 Report on Public Consultation.

Analysis of Responses

24.2.6 A coding framework was created to ensure a thorough and fair analysis of the views expressed by respondents. The coding framework enabled analysts to organise responses by themes and issues so that key ideas as well as specific points of detail could be captured and reported.

24.2.7 A senior analyst reviewed an early set of responses to formulate an initial framework of codes. A two-tier approach was taken to coding, starting with high level themes and then specific codes. The top-level themes are listed below. The full coding framework is available in the 2017 06 29 A47IMPS2-AMY-TE-ZZ-DR-J-0007 Report on Public Consultation.

- Improvements Needed
- Proposed Option
- Non-motorised users (NMUs)
- General
- Consultation Process
- Other

24.2.8 Each code within a theme represents a specific issue or point of view raised in responses. We use natural language codes (rather than numeric sets) as this allows analysts to suggest refinements as well as aiding quality control and external verification.

24.2.9 The application of a code to part of a response was achieved by highlighting the relevant text and recording the selection. A single submission could receive multiple codes. Where similar issues were raised, care was taken to ensure that these were coded consistently.

24.2.10 The results of the analysis are contained in detail in the 2017 06 29 A47IMPS2-AMY-TE-ZZ-DR-J-0007 Report on Public Consultation, with a summary and overview in Section 25 below.

24.3 Public Information Exhibition

24.3.1 The Public Information Exhibitions (PIEs) were held on 6, 7 and 8 April 2017. Details are shown in Table 24.1, including the number of visitors that attended. The exhibition was attended by staff from Highways England, its Consulting Engineers, Amey, and Norfolk County Council, who were available to answer questions on the information provided and the proposals from members of the public.

24.3.2 The venues were selected with the aim of providing the optimum opportunity for members of the public across the area to attend, as well as offering the most suitable facilities locally to hold such an exhibition.

24.3.3 The PIEs presented the scheme proposals on display boards, with a combination of drawings and descriptive text.

24.3.4 Copies of the brochure and questionnaire were available at the exhibitions. Members of the public were advised that to give their feedback and express their views and other comments, they should either complete a hard copy of the questionnaire and post it back to Highways England using the Freepost envelope provided or complete the questionnaire online at the website detailed in the brochure.

24.4 Public Information Materials

24.4.1 The following public consultation material was produced to support the public consultation process and to inform the public about the scheme.

24.4.2 Brochure and Questionnaire

24.4.3 A brochure was produced and available on request and copies were available online on Highways England's website, with hard copies at the exhibitions. The brochure included:

- Information on the scheme proposals and route options
- Details of the exhibition dates and venues
- Contact details to enable comments to be made to Highways England. These consisted of postal address, email and website address, and telephone number.

24.4.4 A questionnaire document for respondents to complete and return to Highways England was available online or in hard copy at exhibitions. The questionnaire included questions asked to gain information such as type and location of user, frequency and purpose of use, and to obtain feedback on the options shown. Information and analysis of the questionnaire responses received is provided in the following Sections. Respondents were also invited to make additional comments if they wished to do so.

24.4.5 The consultation brochure and questionnaire were distributed to the general public at the Public Information Events (PIEs) which were held between 6 April 2017 and 8 April 2017 in Honingham, Hockering and Easton.

24.4.6 Brochures and questionnaires were also deposited at The Forum in the centre of Norwich and Dereham Library.

Illustrative Design Drawings and Display Material

24.4.7 Presentation pull-ups were displayed at the exhibitions based on the information and drawings in the brochure. The display material contained information about the scheme and the issues surrounding it. The display material included the following:

- Welcome board (including an introduction to the scheme);
- A47 North Tuddenham to Easton (including details of why the scheme is needed);
- Objectives of the scheme;
- Proposed option 1 (with an illustrative layout drawing of the proposed option);
- Proposed option 2 (with an illustrative layout drawing of the proposed option);
- Proposed option 3 (with an illustrative layout drawing of the proposed option);
- Proposed option 4 (with an illustrative layout drawing of the proposed option);
- Environmental constraints plan;
- What happens next? (with board details of the overall scheme programme);
- How to respond? (with details of the various methods for completing the questionnaire).

24.5 Numbers of Attendees at Exhibition and Responses received

Attendance at Public Information Exhibitions

24.5.1 The total number of visitors that attended the public information exhibitions held are detailed in Table 24.1 below.

Table 24.1 Public Information Exhibitions Details and Numbers of Attendees

Venue	Date (s)	Opening Times	Number of Visitors
The Forum Norwich (static panel, brochures and questionnaire only unstaffed display)	Tue 14 March 2017 to 21 April 2017	9am – 5pm (MPs, Councillors and stakeholder preview on the 14th March 2017 1pm to 3pm)	Not recorded
Dereham Library (static panel, brochures and questionnaire only unstaffed display)	Tue 14 March 2017 to 21 April 2017	9am – 5pm	Not recorded
Honningham Village Hall	Thurs 6 April 2017	3pm – 8pm	196

Venue	Date (s)	Opening Times	Number of Visitors
Hockering Village Hall	Fri 7 April 2017	10am – 8pm*	209
Easton Village Hall	Sat 8 April 2017	10am – 4pm*	77

*An extension to the exhibition opening advertised in the brochure was requested by Hockering Parish Council for Fri 7 Apr. Due to incorrect information advertising the PIE, the timings were also extended for the exhibition held on Saturday 8 April 2017.

Responses to the Questionnaire

24.5.2 The total number of respondents to the consultation was 529, which includes responses from stakeholders and members of the public. Therefore the findings set out in the North Tuddenham to Easton Report on Consultation August 2017 should be treated with caution and not be interpreted as representative of the views of the wider population of North Tuddenham to Easton and the surrounding area.

25 Assessment of Consultation Responses

25.1 Introduction

25.1.1 Feedback from consultations was collated and analysed by Dialogue by Design – a company that specialises in bespoke public and stakeholder engagement and consultation services. Further detail can be found in the North Tuddenham to Easton Report on Consultation August 2017. Dialogue by Design received feedback via:

- Completed Questionnaires sent by post
- Completed Questionnaire online via Highways England's website
- Email responses via Highways England

25.2 Key Response Statistics

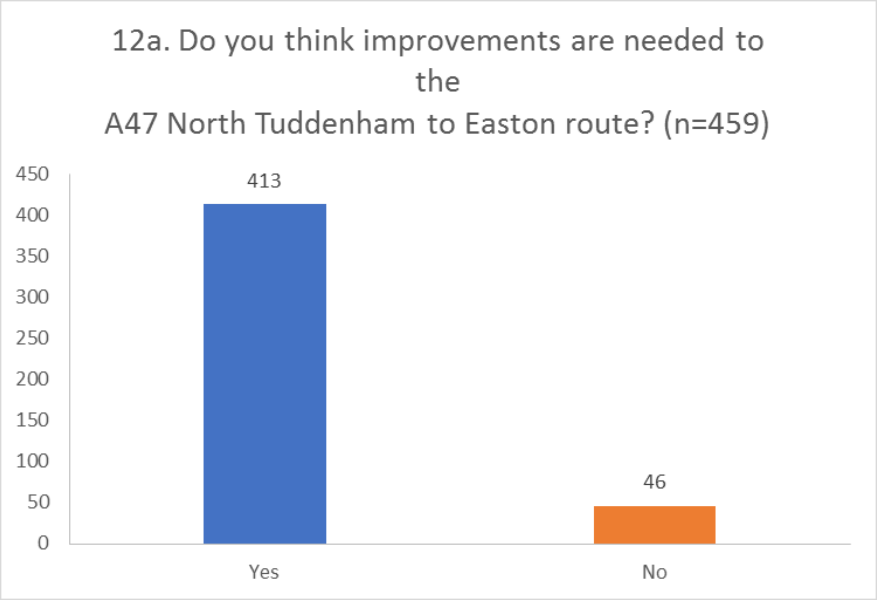
25.2.1 The total number of respondents to the consultation was 529, which includes responses from stakeholders and members of the public. Therefore the findings set out in the North Tuddenham to Easton Report on Consultation August 2017 should be treated with caution and not be interpreted as representative of the views of the wider population of North Tuddenham to Easton and the surrounding area.

25.2.2 The following are the key response statistics from the returned questionnaires with regard to the need for the road and the preference of options. Statistics from the consultation questionnaire responses and more detailed analysis and commentary can be found in the North Tuddenham to Easton Report on Consultation August 2017.

The need for Improvement

25.2.3 Question 12a asks respondents to select whether they agree or disagree that improvements are needed to the A47 North Tuddenham to Easton route and these responses are shown in the chart 5 in Figure 25.1 below:

Figure 25.1 Chart 5: Responses on the need for improvements to the A47 North Tuddenham to Easton

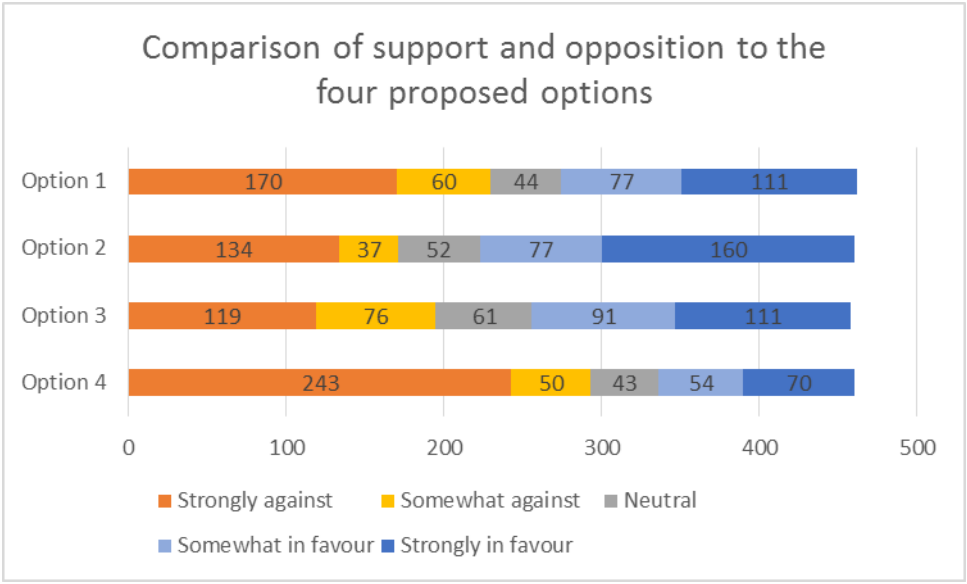


25.2.4 Of the 459 respondents to this question, 413 believe improvements are needed, while 46 respondents do not believe improvements are needed.

Responses to Option Preferences

25.2.5 The chart below, Figure 25.2, summaries the responses to questions 13 to 16 which ask respondents to express their views and preferences for the four options presented for public consultation.

Figure 25.2 Chart: Comparison of support and opposition of the proposed options



25.2.6 Looking at the responses to closed questions 13a, 14a, 15a and 16a, Option 2 receives the highest proportion of support, with 160 respondents strongly in favour and

77 somewhat in favour. 171 respondents say they are strongly against Option 2, compared to 293 against Option 4, 230 against Option 1 and 195 against Option 3. Option 4 receives by far the most opposition from respondents. A similar number of respondents select the neutral choice for each of the four options.

25.3 Key Stakeholder Responses

Norfolk County Council

25.3.1 Norfolk County Council supported the scheme and made comments about the individual options but did not express an opinion on Route Option Preference.

25.3.2 The following quotes are extracted from the Norfolk County Council response:

> *Norfolk County Council welcomes proposed improvements on the A47. This road forms the major strategic east west link connecting Norfolk to the Midlands and the north of England. It passes through major settlements within the county including Norwich, Great Yarmouth and King's Lynn. Major investment is required to overcome current and predicted future traffic problems, and to ensure that the road supports the economic potential of the area. This potential includes major growth in the key settlements along the road, comprising both jobs and housing. The proposed improvements are fundamental upgrades that we have sought for decades. Previous cuts to government programmes has seen virtually no investment (planned or delivered) in Norfolk for over a decade. These improvements are vital and the county council would be concerned if there were any threat to their delivery; in principle we want to see them delivered at the earliest opportunity.*
>
> *The county council leads the A47 Alliance, which supports full dualling of the road with grade separation. The investment as part of the Roads Investment Strategy 1 will be a step towards achieving this goal, following many years of little or no investment into the A47. Norfolk County Council supports delivery of the proposals at the earliest opportunity.*

Broadland District Council

25.3.3 Broadland District Council supported the scheme and offered a route option preference, see table 25.3 below.

25.3.4 The following quotes are extracted from the Broadland District Council response:

> *Broadland District Council strongly support Highways England's proposal to make improvements to the A47 across 6 schemes. The council are committed to ensuring that the route options carried forward are wholly in line with the best interests of local residents, businesses and communities. This current section of the existing A47 suffers from frequent congestion and road traffic accidents. It is also the main route to Norwich from the Midlands and the North of England.*
>
> *The Council has major reservations regarding any online improvement of this stretch of the A47. The impact of the improvements along this stretch of the A47 upon the villages of Hockering and Honingham will be an important consideration, as will the environmental and ecological impact of an offline improvement to the north of the existing A47.*
>
> *The GNFEZ (Greater Norwich Food Enterprise Zone) LDO is currently being pursued by Broadland District Council which should be taken into account -*

http://broadland.limehouse.co.uk/portal/fez/ldo. Located to the west of Easton / east of Honingham this development would be of major significance for the local economy.

Looking ahead, Norfolk County Council as Highway Authority has identified as a key priority, a scheme for the completion of the Norwich Northern Distributor Road to connect this road to the A47 at Easton / Honingham. This opportunity must also be an important consideration to bear in mind when deciding upon a route option and the subsequent design of the junctions and roundabouts required.

The location of the new roundabout at Easton should be designed with these factors in mind.

Breckland District Council

25.3.5 Breckland District Council supported the scheme and made comments about the individual options but did not express opinion on Route Option Preference.

25.3.6 The following quotes are extracted from the Breckland District Council response:

"The district council supports full dualling of the A47 with grade-separation at the junctions. We therefore fully support a dual carriageway, and would support the junctions at either end of the scheme being grade-separated. This would improve the strategic flow along the A47 as well as ensuring that they can best accommodate existing and future pressures"

"In conclusion we are positive about the start of this process and wish to engage fully and constructively to assist in full delivery of the North Tuddenham to Easton road improvements. At the recent consultation the offer for Highways England to meet members of Breckland District Council was again reiterated. This would be a very helpful immediate next step while the consultation responses are digested. We would like to see this offer followed through in the near future and look forward to hearing from you"

South Norfolk Council

25.3.7 South Norfolk Council supported the scheme but had no clear preference with regard to route option, see table 25.3 below.

25.3.8 The following quote is extracted from the South Norfolk Council response:

Firstly, the Council is very supportive in principle of improvement measures to the A47. As Highways England recognises, there are various clear justifications for the improvement measures (due to, amongst other issues, road safety concerns, traffic congestion and the need to take into account future housing and economic growth). Whilst the Council shares the ambition of the A47 Alliance for complete dualling of the A47, the proposed improvement measures are very welcome.

East Tuddenham Parish Council

25.3.9 East Tuddenham Parish Council supported the scheme and offered a route option preference, see table 25.3 below.

Easton Parish Council

25.3.10 Easton Parish Council supported the scheme and offered a route option preference, see table 25.3 below.

Hockering Parish Council

25.3.11 Hockering Parish Council supported the scheme and offered a route option preference, see table 25.3 below.

Honingham Parish Council

25.3.12 There were two responses from Honingham Parish Council. Both supported the need for improvements and the second response offered a route option preference, see table 25.3 below.

Lyng Parish Council

25.3.13 Lyng Parish Council supported the scheme but did not express an opinion on route option preference.

Marlingford and Colton Parish Council

25.3.14 Marlingford and Colton Parish Council did not indicate if they supported the scheme but offered a preference for an option that retains Matishall Road Roundabout and noted that Option 2 was their least favoured option.

North Tuddenham Parish Council

25.3.15 North Tuddenham Parish Council supported the scheme and offered a route option preference, see table 25.3 below.

Weston Longville Parish Council

25.3.16 Weston Longville Parish Council supported the scheme and offered a route option preference, see table 25.3 below.

Costessey Town Council

25.3.17 Costessey Town Council supported the scheme and offered a route option preference, see table 25.3 below.

Other responses on behalf of Organisations

25.3.18 In addition to the responses from councils there were also responses from the following organisations:

- CPRE Norfolk
- Norwich Cycling Campaign
- Norfolk Wildlife Trust
- NCC-Western Link Working Group (also Member of Morton-on-the-Hill Parish Council)
- Norwich Green Party
- The Ramblers (Norfolk Area)
- Wensum Valley Alliance
- Norwich Diocesan Board of Finance
- Royal Norfolk Agricultural Association

- Earthsea House School
- Petition regarding Park Farm Lakes
- Easton Estates
- Solicitors for Hopkins Moore Developments
- The Rampton Property Trust
- Solicitors for Mr DN Alston Settlement and AL Alston Company Ltd

25.3.19 Their responses to the need for the improvement scheme and views on options is given in table 25.3 below.

Table 25.3 Responses on behalf of Organisations

Response from	Opinion on need for improvements	View on Option 1	View on Option 2	View on Option 3	View on Option 4
Norfolk County Council	yes	Preference not offered			
Breckland District Council	yes	Preference not offered			
Broadland District Council	yes	Some what in favour	Strongly against	Strongly in favour	Somewhat in favour
South Norfolk Council	yes	No clear preference Option 2 is not preferred due to disruption during construction			
Easton Parish Council	yes	Strongly against	Strongly against	Strongly in favour	Strongly against
East Tuddenham Parish Council	yes	Neutral	Strongly in favour	Somewhat against	Strongly against
Hockering Parish Council	yes	Strongly against	Strongly against	Strongly in favour	Strongly against
Honingham Parish Council Honingham Parish Council	yes	Strongly against	Some what in favour	Strongly in favour	Strongly against
North Tuddenham Parish Council	yes	neutral	neutral	Somewhat against	Strongly against
Weston Longville Parish Council	yes	Strongly against	Somewhat in favour	Somewhat in favour	Somewhat against
Lyng Parish Council	yes	Not answered			
Marlingford and Colton Parish Council	Not answered	Preferences for the options that would retain the Mattishall Road roundabout, and would provide an alternative route, when there is an accident. Option 2 is the Council's least favoured option			
Costessey Town Council	yes	Somewhat against	Somewhat in favour	Strongly in favour	Strongly against
CPRE Norfolk		Strongly against	Most favoured	Strongly against	Less favoured than option 2
Norwich Cycling Campaign	Not answered	No preference given			
Norfolk Wildlife Trust	Not		Preferred		

Response from	Opinion on need for improvements	View on Option 1	View on Option 2	View on Option 3	View on Option 4
	answered		option		
As a member of the NCC-Western Link Working Group (also Member of Morton-on-the-Hill Parish Council)	yes	Strongly against	Somewhat in favour	Strongly in favour	Strongly against
Norwich Green Party	no	Strongly against	Somewhat against	Strongly against	Strongly against
The Ramblers (Norfolk Area)	yes	neutral	neutral	neutral	neutral
Wensum Valley Alliance	yes	Strongly *against*	Strongly against	Strongly against	Strongly against
		No direct junction at Wood Lane of A47 and B1535 If this addressed then:			
			'strongly in favour'	'somewhat in favour'	
Norwich Diocesan Board of Finance	yes	No preference offered but commented Option 2 requires less land			
Royal Norfolk Agricultural Association	yes	Somewhat against	Strongly against	Strongly in favour	Somewhat in favour
Earthsea House School There are also 10 other responses from Childhood First – Earthsea House	yes	Strongly in favour	Strongly in favour	neutral	Strongly against

25.4 Main Response Themes

There are a number of main themes from the responses given to the questionnaire some of these are highlighted below, these do not cover the option specific issues raised in comments received on the individual options these are covered in detail in the North Tuddenham to Easton Report on Consultation August 2017.

25.4.1 Most respondents agree that improvements are needed to the A47 North Tuddenham to Easton route. The reasons they give include improved safety, faster and more reliable journey times, improved quality of life for residents of villages currently used as 'rat-runs' and better access to other locations - locally, regionally and nationally.

25.4.2 Whilst the vast majority of respondents support the idea of improvements in principle, most do so with caveats. The amounts of land-take, the cost and the impact on the environment are concerns for many respondents, who would like to see any improvements made 'with sympathy', including minimising damage to wildlife habitats, mitigating against increased pollution and respecting the rural setting of the road.

Improving the existing route without dualling

25.4.3 The majority of respondents support the need for improvement in general, but many make suggestions about amending the design and construction of the road in its present location, rather than undertaking any of the options proposed in the consultation document.

25.4.4 Many respondents suggest that positive changes could be made through adjustments to turn permissions, the creation of central safety turns and improvements to the design of the Honingham roundabout, rather than dualling. The roundabout at Honingham is frequently mentioned, as many respondents believe its design may have improved safety but has exacerbated congestion. They believe the addition of a slip-road or the reconfiguration of priorities would create a better flow of traffic, rendering dualling unnecessary.

Environmental

25.4.5 Many respondents believe improvements will mean local villages, such as Mattishall, East Tuddenham, Colton, Easton, Marlingford, Hockering and Bawburgh, will no longer be used as 'rat-runs'. They welcome the perceived environmental benefits this will bring to local communities, improving air quality and reducing noise pollution.

25.4.6 The rural nature of the area and the land-take necessary to construct the new road lead a few respondents to oppose the project as proposed.

Economic Benefits

25.4.7 Several respondents believe that improvements to the A47 between North Tuddenham to Easton will lead to economic benefits for local businesses.

Safety

25.4.8 The majority of respondents believe the current junctions between North Tuddenham and Easton are not safe, especially during rush hour. They give examples of accidents, including fatalities, which they say happen on a regular basis. They highlight the difficulties and dangers of turning right to and from side roads on this stretch of the A47, at any time of day or night. They also suggest that over-taking slow moving vehicles is difficult, as there are currently no safe passing places.

25.4.9 A few respondents oppose the project, questioning whether creating a faster road will improve safety, suggesting that accidents will be more serious because traffic will be moving at greater speeds. These respondents make the case that the accidents that happen on this stretch of road are caused by bad driving and not by the design of the road itself. They claim that impatience, poor judgement and use of mobile devices at the wheel cause accidents and challenge the assumption that this project would improve this situation.

25.4.10 Many respondents believe that provision for NMUs should be provided alongside the new development to ensure their safety. Several of these respondents note how dangerous the A47 currently is and argue there is no dedicated route alongside the A47 to walk, ride or cycle safely.

25.4.11 Some respondents suggest that providing for NMUs will cost relatively little in the context of the whole project, making the safety benefits more attractive. Several respondents suggest the reason there are so few NMUs along this stretch of road is due to the perceived lack of safety. They argue that providing for NMUs in this development will encourage more people to cycle or walk, taking cars off the road and improving public health.

25.4.12 Some respondents, including Easton Parish Council, suggest methods of improving the safety for NMUs such as building footbridges for safer crossings. Some respondents say isolating NMUs from fast moving traffic is essential to ensuring their safety on a dual carriageway. They argue that cycle lanes, bridleways and footpaths should be built separately to the A47, as well as on the surrounding roads and lanes.

Pedestrians

25.4.13 Many of the respondents who comment upon the provision for NMUs argue that facilities for pedestrians must be supplied whichever route option is chosen. East Tuddenham Parish Council is among those who argue that the proposed scheme will cut through many footpaths, forcing pedestrians to cross the dual carriageway. They feel that adequate footpaths and safe road crossings must therefore be provided along this stretch of the A47. Several respondents argue that providing such access will encourage more people to walk, providing health benefits as well as reducing traffic on the roads. They say the use of newly built pedestrian footpaths has shown the local demand for such access ways.

25.4.14 Some respondents suggest that pedestrians should be separated from the traffic on the A47, either through the provision of a separate footpath or by utilising the old road. They feel this would be the safest option for pedestrians and vehicles. Several respondents suggest creating grade separated crossings along the A47, either through the construction of footbridges or tunnels, to allow safe and easy access across the dual carriageway. Hockering Parish Council, however, suggest that footbridges should be avoided where possible, especially those with steep gradients.

25.4.15 Several respondents object to such provision, primarily because they feel that not enough pedestrians would use such footpaths to justify the investment. A few draw attention to the new footpath between Hockering and North Tuddenham which they believe is rarely used and an example of wasted investment. Some respondents argue that for pedestrians to use such a route would be unsafe and as such Highways England should not encourage pedestrian access.

25.4.16 Some respondents raise objections to Option 1 and Option 2 as they feel they will significantly impact on pedestrian access to amenities along the A47, as well as interrupting popular footpaths and nature walks. Many respondents object to Option 3 and Option 4 for similar reasons, with both North and East Tuddenham Parish Councils arguing that numerous public footpaths will be cut in half by these options. They feel that more footpaths will be affected through this option than any other, and they strongly oppose it for this reason.

25.4.17 A few respondents, including East Tuddenham Parish Council, express support for Option 2 as they believe that by online dualling the current A47 it will avoid the issues of disruption to public footpaths and Pubic Rights of Way.

Cyclists

25.4.18 Many respondents argue that provision for cyclists must be included in any scheme selected by Highways England. Norwich Cycling Campaign and Hockering Parish Council are among those who believe such provision should be made, highlighting Highways England's own Cycling Strategy, which commits them to encouraging and facilitating cycling on their road networks.

25.4.19 Several respondents refer to the cycle path between Hockering and North Tuddenham which they believe to be regularly used. They feel this is a good indication of the demand for further cycle paths.

25.4.20 Several respondents suggest building cycle or bridleways off the A47 route to separate the flow of NMUs from motorised traffic. Other respondents suggest providing the old A47 for cyclists if Option 2 is not the selected option. A few respondents suggest that all new routes should be surfaced suitably for cycling to encourage their use and ensure the safety of cyclists.

25.4.21 Several respondents argue that a dual carriageway would not be a suitable road to cycle upon as it would be too dangerous for both cyclists and motorists. Some respondents argue that provision for cyclists on the A47 would slow traffic when the aim of the scheme is to speed up the flow of motorists.

25.4.22 A few respondents express their belief that demand for cycle lanes would be very low in the local community, as they do not see many cyclists in the local area. A few respondents object to the provision for cyclists as they feel cyclists do not contribute towards road improvements. They argue that the priority for Highways England and local councils should be fixing potholes in the roads which affect motorised users.

25.4.23 A few respondents raise objections to Option 2 as they feel that online dualling of the current A47 will present significant safety issues for NMUs. If Option 2 is selected, some respondents suggest that Hall Lane, Grange Lane and Broom Lane should be hard surfaced to produce a cycle way from North Tuddenham to Easton.

25.4.24 Several respondents express support for Option 3, including Easton Parish Council, arguing that it provides a safer, less congested environment for NMUs.

Junctions and Side Roads

25.4.25 A number of the respondents comment regarding the need for the correct consideration to be given to junctions and access to the A47 from side roads. Ensuring the suitability of connectivity of side roads to the dualled link in particular with side roads with high HGV movements. In particular there are frequent comments about connectivity at Woods Lane and connectivity to the potential Western Link of the NDR.

25.4.26 Some of the respondents are in favour of grade separation of junctions on the new dualled carriageway.

26 Detailed Cost Estimate of Affordable Options

26.1 Options Estimate

26.1.1 As a project develops through the PCF Stages the scheme costs are estimated based on the level of detail available at that time. The estimate is produced for use in the economic assessment of the project (see Chapter 29 for details) and as a check at each stage of the project of the affordability of the scheme.

26.1.2 The 4 route options as described in section 23 along with other background information was used by Highways England Commercial as a basis to produce the Options Estimate for the scheme.

26.1.3 The Options Estimate for the scheme was prepared in accordance with the Highways England Commercial Cost Estimation Manual as explained in section 17.

26.2 Summary of Estimate

26.2.1 Table 26-1 below presents the range cost estimates for the Options described in section 23.

Table 26-1 – Cost Estimates

Option	Range Min (£M)	Range Most Likely (£M)	Range Max (£M)
1	101.86	151.02	261.68
2	92.76	138.80	238.42
3	89.53	133.16	232.90
4	88.48	131.87	230.24

26.3 Derivation of Costs for Economic Assessment

26.3.1 The cost and expenditure profile for the scheme is shown in Table 26-2. The construction costs were firstly inflated to outturn costs using construction-specific inflation projected by Highways England and then rebased to 2010 values using the Gross Domestic Product (GDP) deflator series in the WebTAG Data Book.

Table 26-2: Estimated costs for scheme at base year values and prices

Design option	Cost category	Total expenditure	Percentage of cost spent in				
			2017	2018	2019	2020	2021
Option 1	Preparation	£8,625,249	24%	20%	48%	8%	0%
	Supervision	£1,119,758	0%	0%	0%	72%	28%
	Works	£96,838,698	0%	0%	0%	61%	39%
	Land	£10,925,268	11%	0%	0%	89%	0%
	Total	**£117,508,973**	**2.8%**	**1.5%**	**3.5%**	**59.8%**	**32.4%**
Option 2	Preparation	£8,849,744	19%	22%	47%	12%	0%
	Supervision	£1,970,621	0%	0%	0%	38%	62%
	Works	£90,624,687	0%	0%	0%	44%	56%

	Land	£5,993,587	24%	0%	0%	76%	0%
	Total	**£107,438,639**	**2.9%**	**1.9%**	**3.8%**	**43.0%**	**48.4%**
Option 3	Preparation	£8,544,109	22%	20%	50%	8%	0%
	Supervision	£1,087,831	0%	0%	0%	72%	28%
	Works	£87,138,887	0%	0%	0%	60%	40%
	Land	£6,677,405	24%	0%	0%	76%	0%
	Total	**£103,448,233**	**3.4%**	**1.6%**	**4.1%**	**57.0%**	**33.9%**
Option 4	Preparation	£8,452,704	22%	20%	50%	8%	0%
	Supervision	£1,264,067	0%	0%	0%	72%	28%
	Works	£86,556,044	0%	0%	0%	60%	40%
	Land	£6,142,502	26%	0%	0%	74%	0%
	Total	**£102,415,317**	**3.4%**	**1.6%**	**4.1%**	**56.8%**	**34.1%**

26.3.2 Further information on the economics assessment is contained in Chapter 29.

27 Preferred Route Decision Process

27.1 Introduction

27.1.1 As part of Highways England's procurement process for a PCF Stage 3 supplier, a more detailed programme review of PCF Stage 3, determined that, to meet the March 2020 start on site date that PCF Stage 3 work would need to commence in September 2017.

27.1.2 To facilitate a September 2017 start of PCF Stage 3 the programme review concluded that a Preferred Route Announcement would need to be made in mid-August 2017.

27.1.3 To give sufficient time for internal Highways England governance, preparation of PRA leaflets and DfT reviews a preferred route decision would be needed by mid-June 2017.

27.1.4 Highways England took the decision to organise and hold a preferred route decision (PRD) workshop and meeting in mid-June 2017 to review the technical assessments undertaken to date and review the assessment of the public consultation and to determine, based on the information available at that date, a preferred route.

27.1.5 PCF Stage 2 assessment and reporting work had originally been programmed to complete in September 2017. Therefore, due to the timing of the PRD being part way through PCF Stage 2, all of the PCF Stage 2 assessments and reporting were not complete at the time of the PRD.

27.1.6 Where assessments were incomplete at the time of PRD, assessments were supplemented with PCF Stage 1 assessment information and/or qualitative assessments. At the PRD the limitations and risks of making an early decision based on the available information were highlighted to the PRD meeting to allow an informed decision to be made.

27.2 Preferred Route Decision Meeting

27.2.1 The Preferred Route Decision (PRD) Workshop took place on 15 June 2017. This was attended by senior representatives from Highways England, Amey and MMS.

27.2.2 The minutes of the PRD meeting are included in Appendix O. The following assessments were presented to the PRD meeting:

- Strategic Outcomes
- Transport Economics and Environmental Assessments via Appraisal Summary Table (AST)
- PIE Summary
- Buildability Analysis
- Key Risks & Opportunities
- Cost

27.3 Strategic Outcomes

27.3.1 The strategic outcomes assessed in PCF Stage 1, see section 10.3 were re assessed for the 4 options the results were as highlighted in **Table 27-1** below.

Table 27-1 High Level Strategic Outcomes Assessment

Option	Fit with wider transport and government objectives							
	Managing the network safer	Improving user satisfaction	Supporting the Smooth Flow of Traffic	Encouraging Economic Growth	Delivering better environmental outcomes	Helping cyclists, walkers and other vulnerable users	Achieving real efficiency	Keeping the Network in Good Condition
1	4	4	5	3	3	3	3	4
2	4	4	5	3	4	3	3	4
3	4	4	5	3	3	3	3	4
4	4	4	5	3	3	3	3	4

27.4 Traffic Assessment and Economics Assessment at PRD

27.4.1 The NATS transportation model update (as outlined in section 13) was not complete for PRD, although the model had been validated and do-minimum (do-min) scenarios were being run. There were no forecasting results for the 4 options and the BCRs which were reported to the PRD meeting were derived from PCF Stage 1 transportation assessments.

27.4.2 The 4 options all provide a dual carriageway replacing the length of single carriageway between North Tuddenham and Easton. From a transportation assessment all routes will predominantly perform in a similar way, the only real differentiating factor in terms of preliminary initial transportation assessment is the minor route length difference between the options. It was therefore considered that the transportation effects of the 4 options were not a significant differentiating factor for the preferred route decision.

27.5 Environmental Assessment pre PRD

27.5.1 A draft version of the Environmental Assessment Report (EAR) was prepared for PRD. It was based on information from PCF Stage 1 supplemented with available PCF Stage 2 surveys and assessments that had been completed up to PRD.

27.5.2 In the first instance the Environmental Assessments were used to complete the environmental sections of a Department of Transport WebTAG AST table. WebTAG assessment encompasses engineering, economic, accessibility and environmental; it utilises 8 environmental categories as listed below in Table 27.2. Each of the environmental categories were assessed based on an estimated impact based on a 7 point scale as follows:

- Large adverse
- Moderate adverse
- Slightly adverse
- Neutral
- Slightly beneficial
- Moderate beneficial
- Large beneficial

27.5.3 The results of the environmental assessment were R-A-G rated for presentation at the PRD the results are summarised in **Table 27-2** below:

Table 27-2 Environment Assessment Summary from AST table (7 point scale)

Scheme Options				
Environmental Category	Option 1 Assessment	Option 2 Assessment	Option 3 Assessment	Option 4 Assessment
Noise	Moderate adverse	Slight adverse	Slight adverse	Large adverse
Air	Moderate adverse	Slight adverse	Slight adverse	Moderate adverse
Greenhouse Gases	Neutral	Neutral	Neutral	Neutral
Landscape	Large adverse	Slight adverse	Large adverse	Large adverse
Townscape	Neutral	Neutral	Neutral	Neutral
Historic Environment	Moderate adverse	Slight adverse	Moderate adverse	Moderate adverse
Biodiversity	Large adverse	Slight adverse	Large adverse	Large adverse
Water	Moderate adverse	Slight adverse	Moderate adverse	Moderate adverse

27.5.4 The initial AST assessment presents Option 2 as the preferred environmental solution and Option 4 as the least preferred.

27.5.5 The AST used environmental topics from the Department of Transport guidance to provide the environmental input to the AST which includes engineering, economic and accessibility assessments. The DMRB topics are broader based for environmental assessment to capture topics not included in the TAG guidance.

27.5.6 The Environmental Assessment Report applies DMRB Chapter 11 guidance and the associated nine environmental topics listed in Table 27.3; these topics are broader and capture topics not included in the WebTAG guidance.

27.5.7 In addition to the AST, the Environmental Assessment Report utilising the environmental topics with the DMRB, also assessed and ranked each of the options per environmental topic and in conclusion comparatively ranked these to give a comparison between the options, which again was R-A-G rated - the results are summarised in Table 27-3.

Table 27-3 Environment Assessment Summary (based on Rankings)

	Scheme Options			
Environmental Category	Option 1 Assessment	Option 2 Assessment	Option 3 Assessment	Option 4 Assessment
Air Quality				
Cultural Heritage				
Landscape and Visual				
Biodiversity				
Noise and Vibration				
Road drainage and water				
People and communities				
Geology and soils				
Materials				

27.5.8 Utilising the environmental topics contained within the DRMB, the assessment completed within the Draft Environmental Assessment Report also identified, in greater detail, that Option 2 was the preferred environmental solution and Option 4 was the least preferred.

27.5.9 Following discussion during the PRD meeting it was agreed that the Environmental Assessment summary based on the rankings within the Environmental Assessment Report were a better way of comparing the options for the PRD.

27.5.10 The following sections give a brief overview of the environmental assessments completed and briefly highlights any additional baseline information and any data limitations. For more detailed information the Draft Environmental Assessment Report (A47IMPS2-AMY-TE-ZZ-DO-J0024) should be referenced.

Air Quality

Methodology and Limitations

27.5.11 Due to a lack of traffic data the methodology used for the draft report only partially followed the ‘simple‘ assessment level described in HA207/07. This was combined with the application of professional judgement to evaluate the pros and cons to determine an option ranking.

27.5.12 Ongoing air quality monitoring was undertaken in the areas of Hockering, Honingham and Easton. The results between January 2017 and March 2017 were used for the assessment within the draft EAR.

Baseline update

27.5.13 Air quality monitoring results reveal that background and roadside concentrations for the A47 between North Tuddenham to Easton are all under the annual mean NO2 objective of 40µg/m3. The results are illustrated in the table 27.4.

27.5.14 The study area was refined from Stage 1 and according to DMRB HA207/07 and encompasses only those receptors within 200m of the affected roads. Table 27.3 below shows the air quality receptor counts used in the assessment for the existing and proposed alignments.

Table 27.4 Receptor counts

Receptor Type	Quantity			
	0-50m	50-100m	100-150m	150-200m
Residential	84	72	87	99
Community	1	2	4	1
Commercial	2	4	3	4
Total	87	78	94	104

27.5.15 No concentrations have been monitored in excess of 60 µg/m^3, therefore exceedances of the 1-hour NO2 objective are unlikely.

Options Review and Preference

27.5.16 Option 3 is considered to be the preferred option. Option 4 is the least preferred option as it will expose some of the most vulnerable people in the local area, such as Earthsea House residents, to a deterioration in air quality. The overall ranking from an air quality perspective is as follows;

- Option 3
- Option 2
- Option 1
- Option 4

Cultural Heritage

Methodology and Limitations

27.5.17 The methodology adopted was in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 2 'Cultural Heritage', HA 208/07 (Ref 7.1) and hence examined archaeological remains, historic buildings and historic landscapes.

27.5.18 Walkover surveys were completed in March 2017 to confirm and update the baseline information obtained at PCF Stage 1. The surveys confirmed the nature and locations of the historic assets and assessed the conditions of the visible cultural heritage resources.

Baseline update

27.5.19 Approximately 113 archaeological records are located within the study area in the Norfolk County Council Historic Environmental Records (HER). The records range from prehistoric artefacts to post medieval finds. Of such records, approximately 54 lie within the vicinity of the route options. Eighteen of these HERs are undesignated historic buildings and structures.

27.5.20 The historic character of the study area is typical of the wider landscape and comprises of small villages and farms in low, rolling fields linked by a network of small lanes which have their origins in the medieval period.

Options Review and Preference

27.5.21 Option 2 is the preferred option as the route runs online and has limited impacts upon the historic environment. Option 1 and Option 3 are identified as having the greatest overall impacts on the historic environment, due to their impact on Honingham Hall and its associated designated and undesignated heritage assets. It is possible that Option 4 will require the demolition of one listed building; Grade II listed Ice House (Berry's Lane), however this cannot be confirmed at this stage of assessment. The overall ranking from a cultural heritage perspective is as follows;

- Option 2
- Option 4
- Option 1 and Option 3 (equally)

Landscape and Visual

Methodology and Limitations

27.5.22 The description of the baseline and the assignment of sensitivities follow the headings and tables of IAN 135/10.

27.5.23 A winter landscape survey was undertaken in March 2017 to gain better understanding of the landscape character and to assess viewpoints. No summer survey had been completed at the time of the draft EAR.

Baseline update

27.5.24 Land cover consists mainly of medium scale fields, some of them arable and many others turned over to pig rearing and sheep grazing, interspersed with patches of mixed woodland. Most of the fields are bounded by clipped hedgerows, which together with the woodland copses create a very structured landscape fabric.

27.5.25 Identified visual receptors include;

- Residential properties; Hockering, Honingham and Easton
- Businesses; farmsteads
- PRoWs
- Recreational destinations
- Road receptors
- Listed buildings

Options Review and Preference

27.5.26 Option 2 is the preferred option as it impacts the fewest receptors and will require the least amount of woodland/vegetation clearance. Option 4 impacts the greatest number of receptors and is considered the least favoured option. The overall ranking from a landscape and visual perspective is as follows;

- Option 2
- Option 3
- Option 1
- Option 4

Nature Conservation and Biodiversity

Methodology and Limitations

27.5.27 A desktop study and extensive field surveys were completed during Stage 2 to inform the preferred route assessment. Planned surveys included; Phase 1, botany and protected/notable species, White clawed crayfish, Badgers, Bats, Great crested newts, Otter, Water vole and Wintering birds.

Baseline update

27.5.28 The key survey findings are;

- **Badger**; Identification of a further six outlier setts (five active), one subsidiary sett, three annex setts, and two main setts (one active, one abandoned). Further field signs were identified including potential footprints and hair.
- **Bat**; Building scoping was undertaken in January 2017 to identify the potential for significant bat roosts within the zone of influence. A total of ten buildings were scoped, of which nine were identified as confirmed bat roosts.
- **Bullhead**; Bullhead were caught and identified as part of the aquatic invertebrate survey. The five specimens caught were of varying sized indicating a breeding population within the River Tud.
- **Great crested newt**; Sixteen ponds were surveyed to ascertain the presence of GCNs and establish population sizes. Six ponds were found to host populations of GCNs.
- **Otter**; Several Otter tracks and signs and potential holts were identified within 250m of the route options, some of which were located in close proximity to potential watercourse crossing points.
- **Water vole**; Water vole signs were identified along the River Tud including latrines, pathways, feeding remains and burrows.
- **Wintering birds**; Three wintering bird surveys were undertaken in January, February and March 2017. These surveys recorded a number of protected bird species.

Options Review and Preference

27.5.29 Option 2 is considered the preferred option from an ecological perspective. The long term impact on the River Wensum is assessed to be neutral as no new crossing of the Tud is required. Impacts on priority habitats are also reduced in comparison to the other three options. Option 1 is considered the least preferred option as the alignment has potentially significant impacts on designated sites of international and county importance.

27.5.30 The overall ranking from a nature and biodiversity perspective is as follows;

- Option 2
- Option 4
- Option 3
- Option 1

Noise and Vibration

Methodology and Limitations

27.5.31 As traffic data was not available, the methodology applied utilised guidance, professional judgement and the information currently available. Potential changes in noise levels were estimated at representative receptors as either beneficial, no perceptible change or adverse.

27.5.32 Noise surveys were undertaken in April 2017 to update the baseline information obtained at PCF Stage 1. Noise surveys of 24 hours duration and 3 hours duration were undertaken. The 24 noise surveys were used to obtain the $L_{A10,18h}$ and the L_{night} noise levels. The 3-hour noise measurements were undertaken in accordance with the CRTN (Calculation of Road Traffic Noise) shortened measurement procedure.

Baseline update

27.5.33 Noise sensitive receptors typically include dwellings, hospitals, community facilities and designated areas. Table 27.5 shows the noise sensitive receptors in distance bands up to 600m from each of the options.

Table 27.5 Noise sensitive receptors

Layout	Band						Total
	0-50m	50-100m	100-150m	150-200m	200-300m	300-600m	
Existing	97	126	131	147	284	376	1161
Option 1	14	36	57	71	159	479	816
Option 2	14	45	64	93	186	439	841
Option 3	16	29	52	52	192	463	804
Option 4	16	19	42	66	118	454	715

Options Review and Preference

27.5.34 Due to the lack of traffic data to allow noise modelling to be completed, the four options were ranked in order of preferred route based on a qualitative assumption of the number of properties identified in each Significant Observed Adverse Effect Level (SOAEL) buffer. Option 3 is considered to be the preferred route while option 4 is considered the least favoured route; primarily due to the isolated receptors along this route including Ailwyn Care Home and Earthsea School. The overall ranking from a noise and vibration perspective is illustrated below;

- Option 3
- Option 2
- Option 1
- Option 4

Road drainage and Water

Methodology and Limitations

27.5.35 The assessment was undertaken in line with HD 45/09 – Road Drainage and the Water Environment and included a desk study and a site walkover in March 2017. Due to lack of traffic data, the HAWRAT assessments as recommended within DMRB were not completed.

Baseline update

27.5.36 The River Tud is the only major watercourse which flows throughout the study area and is ecologically connected to the River Wensum which is designated as a SAC and SSSI. The most recent cycle of the 2015 Anglian River Basin Management Plan (RBMP) classifies the river as having an overall status of moderate, an ecological potential of moderate and a chemical status of good. There is a vast number of drainage ditches and ponds which lie sporadically in the countryside surrounding the existing A47.

27.5.37 The study area is ecologically diverse and contains a range of wildlife species which are likely dependant on the water environment. The River Tud is classified as having ecological potential of moderate, yet it is ecologically connected to the River Wensum which as discussed, is designated as a SAC and SSSI due to the presence of species such as White-clawed crayfish Austropotamobius pallipes, Desmoulin's whorl snail Vertigo moulinsiana, Brook lamprey Lamptera planeri, and Bullhead Cottus gobio.

27.5.38 A number of ponds within the study area have also been identified as breeding ponds for Great crested newt Triturus cristatus. Several of the ponds have been confirmed to contain low populations of this species.

27.5.39 Flood risk within the area is highest around the River Tud. The floodplain immediately adjacent to the river is designated as flood zone 2 and flood zone 3. The remainder of the study area is predominantly flood zone 1.

Options Review and Preference

27.5.40 Option 2 is considered to be the preferred option as the route runs predominantly online, resulting in fewer adverse impacts on the water environment. The option requires no new bridge structure to be built over the River Tud. Option 1 is considered the least preferred option as this route intercepts the most water features and will require at least one new bridge structure over the River Tud. The overall ranking from a road drainage and water environment perspective is as follows;

- Option 2
- Option 3
- Option 4
- Option 1

People and Communities

Methodology and Limitations

27.5.41 The assessment was undertaken in line with DMRB Volume 11, Section 3, Part 6; Land Use, and DMRB Volume 11, Section 3, Part 8; Pedestrians, Cyclists, Equestrians and Community Effects.

27.5.42 Walkover surveys were undertaken in March 2017 in order to gain an insight into specific land use within the study area and to gain a better understanding of NMU movements. Six 3-hour NMU counts were also conducted at three locations within the study area.

Baseline update

27.5.43 Land use within the study area is predominantly dominated by agriculture and specifically utilised for the cultivation of crops and cereals. Residential properties are scattered throughout the study area with main concentrations located within the villages of Hockering, Honingham and Easton. A number of community facilities are additionally present within these villages.

27.5.44 Thirteen public rights of way are identified within the study area and are utilised by a range of Non-Motorised-Users (NMUs).

Options Review and Preference

27.5.45 Option 2 is the preferred option from a people and communities perspective. Although this will result in the demolition of several residential properties, land-take impacts in general will be preferable to other options. From the perspective of pedestrians, cyclists and equestrians this option will leave most existing routes unaffected. Option 1 is the least preferred option; this option will result in large levels of land take, severance to agricultural land and community severance to parts of Hockering and will further disrupt many recreational routes for NMUs. The overall ranking from a people and communities perspective is as follows;

- Option 2
- Option 3
- Option 4
- Option 1

Geology and Soils

Methodology and Limitations

27.5.46 This assessment is undertaken in accordance with the Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 11 Geology and Soils, 1993 (Ref 13.1) methods for a Stage 2 assessment.

27.5.47 A site walkover survey was undertaken in March 2017 to determine the accuracy of desk study information and to assess the area for any additional sites worthy of further investigation or any potentially contaminated land sites not identified during the desk study.

Baseline update

27.5.48 From the site walkover, historical map review, public database searches and from consultations, it is possible to assemble a list of potential contamination sources within 300m of the study area. These include; brickworks, gravel pits, marl pits, sewage treatment works, industrial yards, timber yards and sand pits.

Options Review and Preference

27.5.49 Option 2 is the preferred option, primarily as the route passes through land which has been previously excavated. Option 1 is considered the least favoured option as the route passes through a number of potentiality contaminated land sites and requires the largest import of fill material. The overall ranking is as follows;

- Option 2
- Option 4
- Option 3
- Option 1

Materials

Methodology and Limitations

27.5.50 The assessment has been undertaken in accordance with the guidance set out in Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Environmental Assessment (Ref 14.1), in conjunction with Interim Advice Note (IAN) 153/11, Guidance on the Environmental Assessment of Material Resources.

27.5.51 As the design is ongoing, it is not possible to quantify the use of materials in absolute terms at this stage, for example, tonnes of primary aggregate, concrete or steel required for the scheme. Similarly, the projected volumes of waste, excavated material or potential reuse of materials cannot be quantified at this stage.

Baseline update

27.5.52 The route options will require the procurement of quantities of aggregates, pavement, concrete and steel. Given the high quantities of these materials on the UK market (i.e. low scarcity), the sensitivity of the material resources for this scheme are considered low.

27.5.53 As the design is ongoing, there is insufficient information at present to accurately forecast waste streams that will be produced on the site. Therefore, local landfill capacity as a whole has been reviewed. The nearest landfill to site lies approximately 5.1km away.

Options Review and Preference

27.5.54 As data relating to material use is limited, a full options comparison cannot be undertaken. Using the expected earthworks quantities, option 2 is the preferred option and option 1 is the least favoured option. The overall ranking from a materials perspective is;

- Option 2
- Option 4
- Option 3
- Option 1

Overall Environment Ranking

27.5.55 The options ranked from most to least preferred based on environmental effects considered within the Draft Environmental Assessment Report are as follows:

- Option 2 is the environmentally preferred option;
- Option 3 is the second preferred option;
- Option 1 is the third preferred option; and
- Option 4 is the least preferred option.

27.6 Non Statutory Public Consultation Summary

27.6.1 The Public Consultation results as described in section 25

27.7 Buildability Analysis

27.7.1 A buildability contractor had been asked to make some preliminary assessments of construction durations. The timescales proposed by the buildability contractor were generally longer than those assumed in the cost estimates.

27.7.2 As a result only Option 4 is anticipated to reduce in costs with Options 1, 2 and 3 costs are anticipated to increase due to the longer programmes. Buildability Contractors programme figures are indicators to show the scheme costs may vary. It was agreed that there was more risk with online scheme costs increasing than those offline.

27.7.3 While the PRD meeting could not quantify the difference in estimates, the additional time will have significant cost implications. Based on the assumption that project durations are still to be confirmed, it was agreed that the meeting should consider the costs presented see section 27.9 below.

27.7.4 The meeting thus agreed to proceed with the costs presented in section 6.2 and accepted the risks associated with the likely cost increases.

27.8 Key Risks & Opportunities

27.8.1 As explained in Section 27.4, it was assumed during the PRD discussions that as the routes are largely similar in length and all replace an existing single carriageway section of road with a dual carriageway section that from a traffic flow perspective there will be no discernable difference between the 4 options in terms of volumes of traffic movements and the way the options perform in terms of flow of traffic.

27.8.2 It was agreed that traffic flow should not be a differentiating factor between the options for the PRD.

27.8.3 The limitations of the information presented to the PRD were noted in the meeting, the limitations of the information, assessments and the Stage 2 PCF Products prepared to the date of the PRD were highlighted in a table see Appendix P.

27.9 Cost

27.9.1 The options estimates detailed in section 26 were presented to the PRD meeting

27.10 Overall Assessment Summary for PRD

27.10.1 A discussion regarding the way in which the assessments and information presented could now be combined and used to best make an overall assessment was held.

27.10.2 The assessments overall were discussed and the following were agreed in the room:

Alignment to Strategic Objectives

27.10.3 The high level strategic assessment of KPIs aligned to the Delivery Plan showed little if no difference as all options were likely to meet the KPIs in a similar way (Option 2 had a very slight higher scoring than the other options which all scored equally).

AST comparison

27.10.4 The only real differentiation from the AST was within the environmental section, the AST RAG showed that Option 2 is likely to have the least Environmental Impact. Although it is clear from the RAG table that Option 2 and 3 have less impact

27.10.5 In terms of Environmental ranking the options ranked 2-3-1-4 in order of preference option 2 being the best

- Option 2 is the environmentally preferred option;
- Option 3 is the second preferred option;
- Option 1 is the third preferred option; and
- Option 4 is the least preferred option.

Consultation Feed back

27.10.6 The overall impression from the consultation feedback with regard to route preference was that the options ranked 2-3-1-4, with Option 2 being favoured by more responses and having fewer responses against:

- Option 2 is the preferred option based on consultation feedback;
- Option 3 is the second preferred option;
- Option 1 is the third preferred option; and
- Option 4 is the least preferred option.

27.11 PRD Discussion and Deliberation

27.11.1 The following is a summary of the discussion at the PRD

27.11.2 It was discussed and agreed that Option 1 and Option 4 should not be taken forward due to the way they ranked on environmental grounds and the high impacts on the environment and the local community.

27.11.3 Option 1 - the route was discounted - the western end of the route has large impacts as the route passes through the north of the village of Hockering, severing part of the village and passing through the now consented housing development land, local sports facilities and fishing lakes. The east of the route has large impacts on areas of woodland and on Easton estates.

27.11.4 Option 4 – the route was discounted – it passes close to the River Tud and creates a new crossing of the river in the west. There are large impacts on East Tuddenham, Honingham, Earthsea House School, Ailwyn Hall and the wood to the north of it (Warren Plantation). There are also impacts on the Icehouse listed building as well as the high risks associated with ground conditions and proximity to the river Tud.

Option 2 and 3 Comparison

27.11.5 A comparison of the remaining options, options 2 and 3 was made.

- Option 2 scores very slightly better than Option 3 in the alignment to strategic outcomes assessment.
- Due to it being online, Option 2 is predicted to take longer to construct (30 months rather than the 21 months included in the estimates) than Option 3.
- Option 2 is predicted to cost more (£138.80M compared to £133.16M) than Option 3.
- Option 2 has less environmental impact than Option 3.
- Option 2 is more favoured by the respondents to consultation than Option 3.

27.12 Preferred Route Decision

27.12.1 Although there were pros and cons of both Option 2 and 3 the PRD meeting felt that the higher environmental impact of Option 3 coupled with the higher public consultation preference for Option 2 outweighed the higher cost and longer programme and it was agreed that Option 2 should be taken forward in principle.

27.12.2 The meeting agreed that Route Option 2 should be taken forward as the preferred route option.

27.13 Preferred Route Viability

27.13.1 Option 2 was chosen as the preferred route option and there was a discussion regarding whether it is possible to develop Option 2 to overcome any of the likely issues with it. As Option 2 and Option 3 were close in overall terms, a discussion was held as to the viability of developing Option 2 in places along its route to remove or reduce some of the potential issues associated with it.

27.13.2 It was agreed that the route could be developed.

27.13.3 Option 2 is described in the consultation document as follows:

"Option 2 proposes dualling of the existing A47.

- The new dual carriageway follows an alignment running as close as possible to the existing A47.
- Improvements to the existing alignment will be needed to bring the route up to dual carriageway standards. In places this will deviate from the existing alignment.
- Land would need to be acquired in order to widen the current route to a dual carriageway and accommodate the improvements."

27.13.4 The meeting discussed and concluded that the route description gave sufficient scope to enable the route to be developed where necessary to an alignment that followed the current route corridor as close as possible but where beneficial to the scheme to meet

current alignment standards, to maintain local access and to locally avoid key constraints along the existing road the route alignment could be alongside the existing or diverge slightly from the existing road.

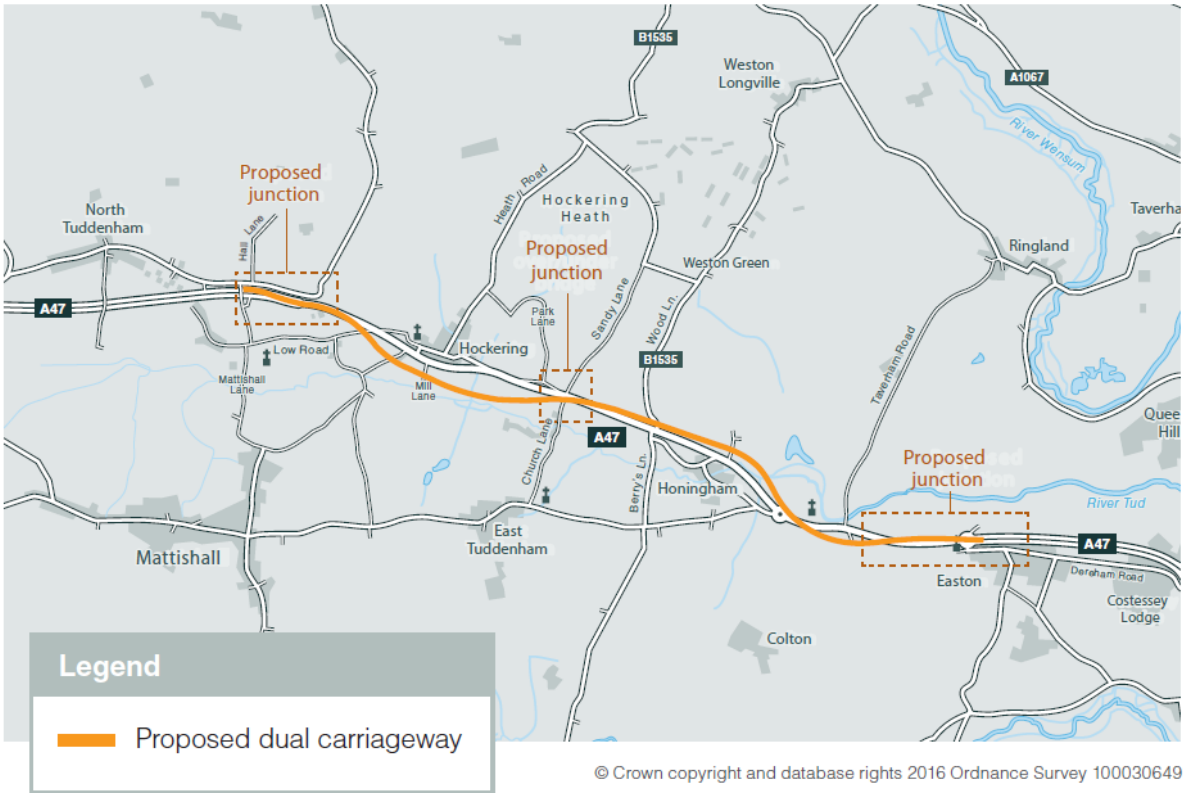
27.13.5 The areas which were identified as potential for developing option 2 were:

- minimising the impact at the western end on Oak Farm
- minimising the impact on the existing properties on Matishall Lane
- minimising the impact on the properties on Gypsy Lane
- minimising the impact of the crossing of the River Tud
- keeping the route to the north side of the corridor as it passes Honingham to achieve noise and air quality benefits
- keeping the route to the north at the tie in at Easton to maximise the chance of the local road reconnection being alongside and to the north of the church at Easton

27.13.6 The meeting discussed that these developments would potentially make the route easier to construct and that some of the existing route would then be able to be retained for local access. It was felt that this would lead to a reduction in the construction period that was advised by the buildability contractor.

27.13.7 It was agreed that, prior to announcing the preferred route, the alignment of route Option 2 was to be reviewed and developed in order that the route announcement would be able to give the public a better understanding of which sections of the route would be built over the existing road and which sections would deviate from the existing roadway.

27.13.8 The initial preferred route was reviewed at the project progress meeting held on the 22 June 2017 and it was agreed that the route as shown below should be taken forward as the preferred route. (The announced Option is shown below.)



27.14 Interim Stage Gate Review 2

27.14.1 Following the PRD meeting an Interim Stage Gate Review was held to confirm the status of the scheme.

27.14.2 The Interim SGAR acknowledged the risk of making PRA prior to the completion of the assessment work but concluded that the level of risk was acceptable and risk was sufficiently mitigated by the initial assessments made.

27.14.3 It was confirmed that the PCF Stage 2 Reporting should be concluded along side the PCF Stage 3 supplier commencing developing the scheme based on the PRA. Highways England confirmed that PCF Stage 2 environmental, transport and economic assessments should be completed where they were time limited for PRD and written up within transportation, economics and environmental reports, and that these should be summarised within the Scheme Assessment Report to verify the PRA decision. These completed assessments are presented in the following chapters:

- Chapter 28 Traffic Analysis PCF Stage 2
- Chapter 29 Economic Assessment PCF Stage 2
- Chapter 30 Environmental Assessment PCF Stage 2
- Chapter 31 Additional Assessment of Public Consultation
- Chapter 32 Appraisal Summary Tables

27.14.4 The above completed assessments would then be used to confirm and validate the assessments prepared for PRD.

28 Traffic Analysis PCF Stage 2

28.1 Introduction

28.1.1 As explained in Chapter 12, the traffic analysis of the scheme has been undertaken using an updated and revalidated version of the NATS model.

28.1.2 The detailed methodology to update the NATS model has been developed through PCF Stage 1 and 2 following detailed dialogue with Highways England. The detail of the methodology and revalidation of the model is contained in the "Local Model Validation Report" (A47 IMPS2-AMY-NA-ZZ-DO-J-0031).

28.1.3 Following validation of the updated NATS model, the model has been used as a base for traffic forecasting. The methodology and results of the traffic forecasting are contained within the "Traffic Forecasting Report" (A47 IMPS2-AMY-TE-DO-J0029).

28.1.4 The Local Model Validation Report and the Traffic Forecasting Report have been reviewed by Highways England Transport Planning Group to ensure the modelling and forecasting work is suitable to provide a robust analysis of the proposed scheme and suitable to make appropriate assessments of the scheme options during PCF Stage 2.

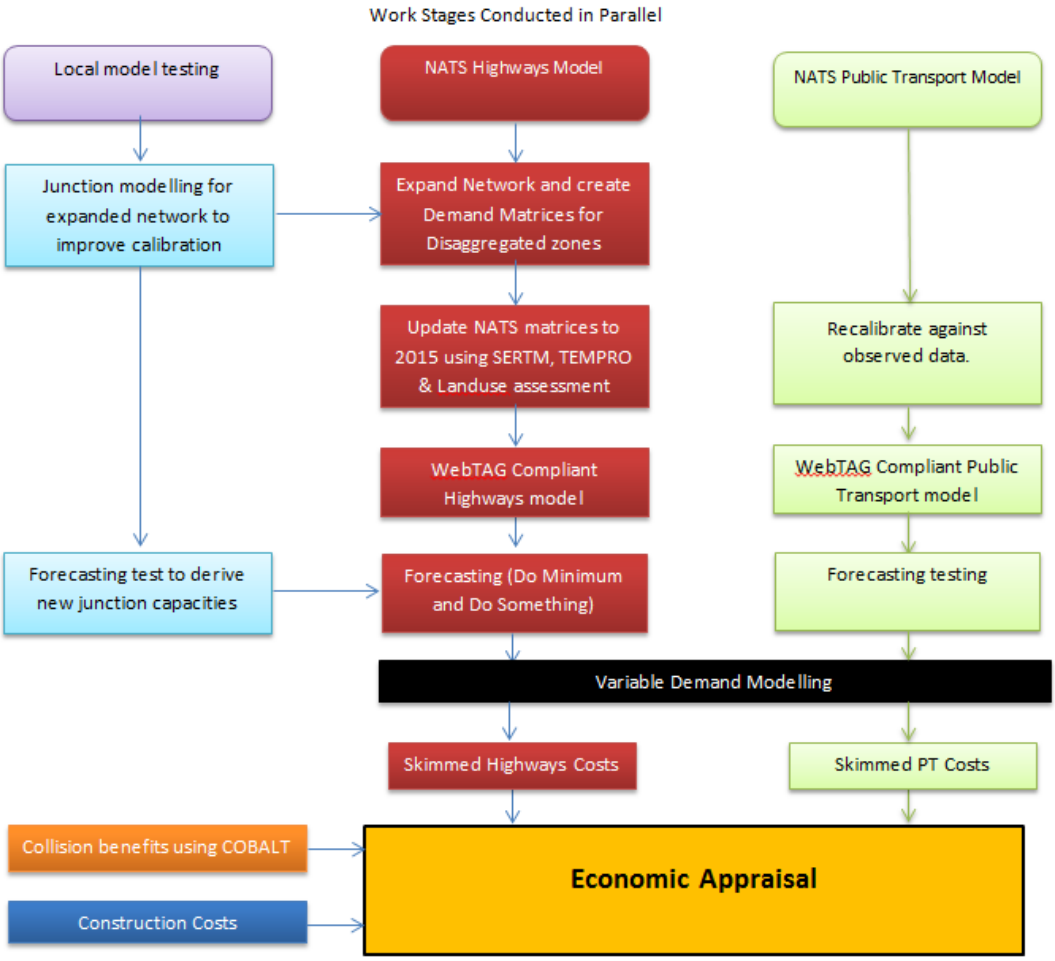
28.1.5 The following sections give a brief overview of the method in summary form and a brief overview of the process to update and revalidate the NATS model and the methodology and results of the traffic forecasting undertaken using the model. The results and outputs of the forecasting have been used to provide an economic assessment of the scheme (see Chapter 29) and to inform the traffic based environmental assessments of noise and air quality (see Chapter 30).

28.2 Outline methodology

28.2.1 The traffic assessment will focus on the scheme location and local roads that are likely to be affected by any change in connectivity with the A47. The assessment of each of the scheme options will be based on a revision of the existing NATS model. The outline approach is presented in Figure 28-1 below.

28.2.2 The junction modelling will be used to establish junction capacities in the expanded area of NATS model. This junction modelling will also be used in the operational assessment stage to test future traffic flows on the junctions.

Figure 28-1 : Scheme appraisal - PCF Stage 1/2 Programme Outline



28.3 Norwich Area Transport Strategy (NATS)

28.3.1 The Norwich Area Transport Strategy (NATS) Model consists of three main elements:

- A highway assignment model developed in SATURN
- A public transport model developed in VISUM
- A demand model using the DIADEM software

28.3.2 The original NATS base model was developed in 2002 and re-validated using 2006 flows in April 2011. This highway assignment base model was again calibrated using 2012 traffic flows to test the Northern DistributorRoad (NDR) DCO process. The LMVR for the calibration using 2012 flows was issued in January 2014 and states that the model is WebTAG complaint.

28.3.3 The NATS model matrix development for the 2012 model was rebased using the 2006 NATS synthetic matrices. For private vehicles only the 2006 tripends have been retained and factored by purpose using NTEM 6.2 to give 2012 tripends. For goods vehicles the previous matrices have been used as a basis from which to prepare the 2012 trip matrices.

28.3.4 The current NATS model was updated to support the DCO application of the Norwich Northern Distributor Road (NDR). The NDR will be a 20km long dual carriageway road connecting the A47 from Postwick to A1067 Fakenham Road, as shown in Figure 5. The NDR scheme work started in December 2015 and is expected to be completed in 2017.

28.3.5 The NATS highway and public transport assignment models have been developed for AM Peak (08:00 to 09:00), average Inter-peak hour (10:00 to 16:00) and PM Peak hour (17:00 to 18:00).

28.4 Use of NATS Model

28.4.1 It is intended that the scheme options will be tested in a revised expanded NATS highways model, not a cordon model. Full details of the existing model extents and areas of coverage and the increased model coverage from the updates proposed are included in the Appraisal Specification Report. The model will also include expansion on the eastern and western sides of Norwich to facilitate the assessment of the Blofield to North Burlingham and Thickthorn schemes.

Update to NATS Model Detail

28.4.2 The local road network in the vicinity of the scheme area has not been modelled in detail in the current NATS base year model.

28.4.3 Part of the scheme lies in the fully modelled area but outside the area of detailed modelling (the non-detailed area), while the remaining part lies in the buffer area. The proposed A47 scheme requires expansion of the NATS model especially in the region of the scheme.

28.4.4 There is a portion of the scheme which falls outside of the area of detailed NATS modelling that has also been modelled. Junctions in this area have been coded with less detail than those within the area of detailed modelling. As such amendments to junctions, saturation flows and signal timings are required to increase the detail of the junctions in this area.

28.4.5 The local road network within the scheme influenced area is not included in the current NATS model. New nodes and links will be added to the NATS model so the impact on the local road network can be assessed. A refinement of zones in the area is also required.

Modify zones and matrices

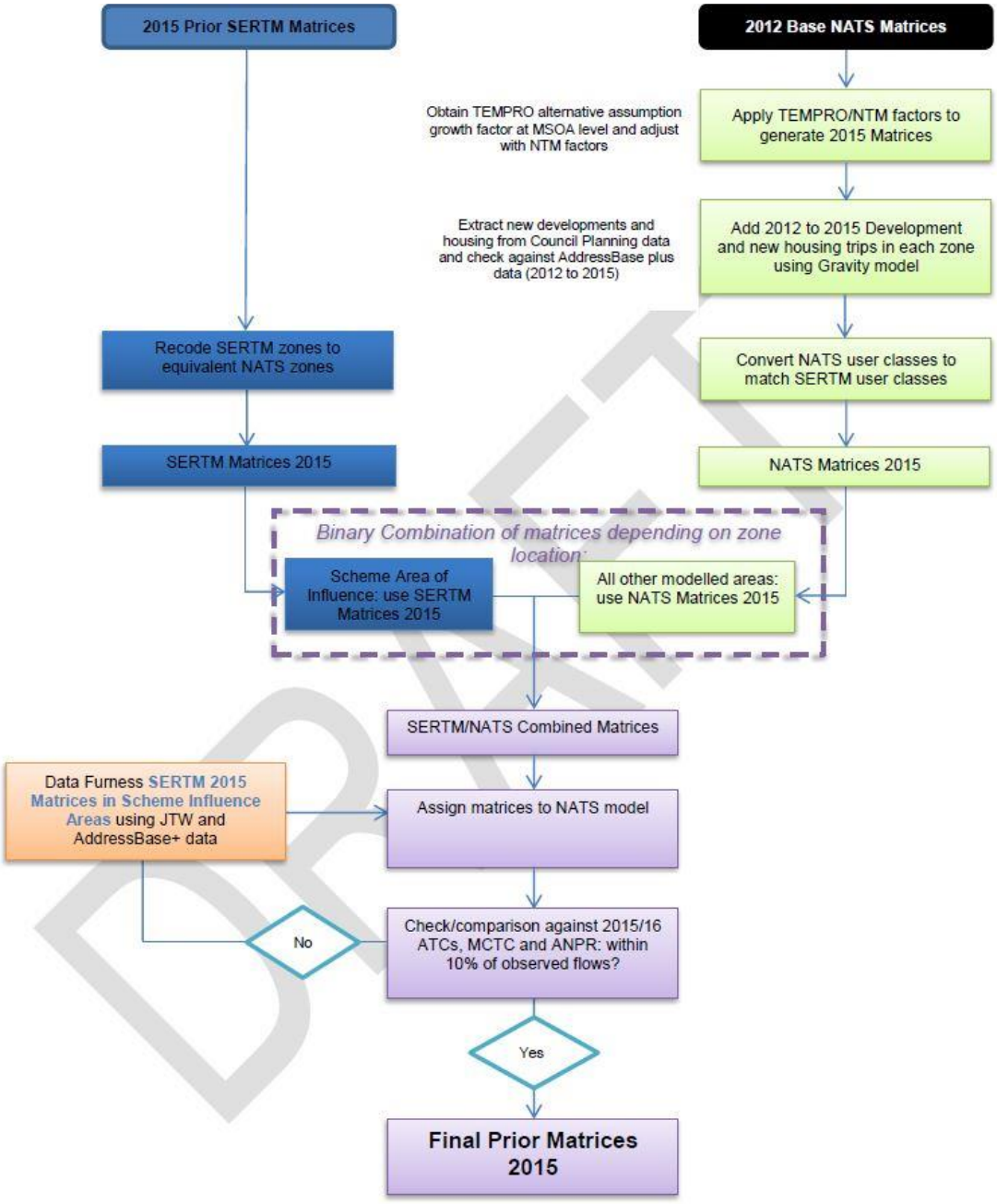
28.4.6 The current NATS model zones in the scheme influenced simulated area will be disaggregated to a level to match the new links. Figure 12 shows the proposed new zoning within the scheme influenced area. The zone boundaries correspond with existing ward boundaries.

28.4.7 Land–use data for the disaggregated zones, including main land-use types, density/scale of activities and dominant trip purposes, will be derived from aerial photos, maps, plan data and 2011 census journey to work data. This will be then be used to construct the demand matrix for the disaggregated zones.

28.4.8 As part of the model updates the modelled zones within the model and the matrices used within the model will be updated using information from the Strategic Eastern Regional Model which has been developed by Highways England.

28.4.9 The process for matrix update is shown in Figure 28.2 below.

Figure 28-2 Process for Matrix upgrade



Calibrate and validate

28.4.10 The model recalibration and revalidation process of the 2012 base year NATS model was carried out in accordance with WebTAG M3.1. The process was undertaken using the calibration and validation of the models from an iterative process to achieve a robust platform for option testing.

28.4.11 The model calibration process will be carried out to ensure that the model assignments are appropriate and representative. Calibration is an iterative process in which the model is continually revised to ensure that:

- Traffic patterns throughout junctions are modelled accurately, including vehicle turning proportions;
- Traffic journey time on all the major routes is accurate, which is inclusive delays and queues.
- Junctions are modelled accurately in terms of vehicle behaviour, especially at stop lines and lane changing; and
- Traffic volumes through the junction are modelled accurately.

28.4.12 In order to achieve matrix calibration in the scheme area new screenlines will be introduced at the matrix build stage.

28.5 Forecast Approach

28.5.1 The current NATS model is based on 2012 flows. Any new (2015 or 2016) data obtained to expand the current NATS model in the vicinity of the scheme will also be factored back to 2012 by using NTM growth factors.

Demand Forecasting

28.5.2 All forecasts were completed in line with the WebTAG guidance on uncertainty given in Unit M4 'Forecasting and Uncertainty'. Local development information was collected and classified according to the certainty that the development is likely to come forward. Only 'near certain' and 'more than likely' developments will be included in the core scenario.

Supply Forecasting

28.5.3 As with the demand forecasts, all transport improvements which are either 'certain' or 'more than likely' to come forward will be included in the core scenario network for the without scheme and with scheme scenario.

Income and fuel costs

28.5.4 Forecast Values of Time and Vehicle Operating Costs will be taken from the WebTAG data book.

Variable demand modelling

28.5.5 Variable demand modelling will be carried out as per WebTAG guidance to make sure that correct trip frequency and trip distribution is produced by the model. The convergence will also be checked against WebTAG to make sure that equilibrium has been achieved. The existing mode choice model will be kept and used in the analysis as it is expected that mode choice will not be affected by this scheme.

Realism Testing

28.5.6 Demand Model Realism testing will be undertaken on the base-year demand model in accordance with WebTAG M2.

Western Link Road

28.5.7 Also under consideration is the Western Link Road (WLR) route which runs from the A47 to the A1067 (see section 7.2). This route was originally part of the NDR route but was removed due to environmental constraints. Further work was carried out in September 2014 using the NATS model to evaluate potential route options. It is

expected a WLR route would generate additional traffic on the A47 as it will connect through traffic from the A47 East as well as attracting other traffic to the route.

28.5.8 The current uncommitted status of the Western Link Road means that it will not be included in the modelling for this scheme in the current PCF Stage, but sensitivity testing is likely to be required during junction and side road strategy and in future PCF Stage assessments to understand the potential influence of the route on the proposals.

28.6 Model Calibration, Validation and Convergence Results

28.6.1 As noted in the introduction (section 28.1), the NATS model update and validation results are discussed in detail in the Local Model Validation Report (LMVR)

Model Calibration

28.6.2 Each base year time period model was successfully calibrated against reference data, in respect of: network and zone configurations; Origin/Destination travel demands and segmentation; journey routes chosen; and network operational performance under trip matrix assignment.

Model Validation

28.6.3 The reliability of the calibrated base year models was also satisfactorily verified against separate reference data and TAG criteria. The models were shown to achieve acceptable levels of 'validation' with regard to: Origin/Destination trip changes during ME; individual link and junction flows; 'pragmatic' aggregated screen-line movements; and route journey times.

Model Convergence

28.6.4 It was confirmed that each base year time period model had been run to an appropriately 'converged' steady-state of assignment 'equilibrium', such that the outcomes extracted from the models were dependable and would not change under further assignment iterations. Satisfactory convergence was checked in respect of achieving: 'proximity' to the minimised travel-cost objective; and 'stability' between the ultimate assignment iterations, in terms of traffic flows and network delays.

Variable Demand Travel Responses

28.6.5 DIADEM has been satisfactorily configured and tested for 'realism' and integrated with the hybrid SATURN model, as a tool for predicting 'variable demand', or people's changing travel decisions, in response to changing travel costs. This enables a realistic picture of how travellers may change trip frequency, change travel mode, change trip destination, or change highway route, as generalised travel costs (time and distance) rise and fall.

28.6.6 This VDM aspect of the A47 hybrid model is important, as it could have a considerable influence on the outcomes and reliability of the forecast A47 scheme appraisals.

Overall Conclusion

28.6.7 The LMVR reporting lists the model strengths and weaknesses and concludes that *"it is judged that the A47 hybrid 2015 base year model gives a sufficiently accurate overall representation of true highway conditions to provide a reliable foundation from which to develop scheme forecasts. It should therefore be accepted as such."*

28.7 Forecasting Results Traffic Flows

28.7.1 As noted in the introduction (section 28.1) the traffic flows taken from the forecasting results are discussed and presented in the Traffic Forecasting Report.

28.7.2 Model outputs extracted from the Traffic Forecasting Report for the comparative 2-way AADT flows on the A47 with and without the scheme in the core scenario are summarised in Table 28-3.

28.7.3

Table 28-3 Forecast 2-Way AADT Flows on the A47 at 2021 and 2036, Core Scenario

Link	Year	DM	DS1	DS2	DS3	DS4
Modelled Flow (AADT)						
A47 at North Tuddenham	2021	27774	33576	33146	32683	32166
	2036	33083	42452	41883	41884	41070
A47 at Hockering	2021	26656	36724	36258	35452	33418
	2036	31659	46137	45953	45022	43420
A47 at Easton	2021	31153	38341	39234	37958	38697
	2036	36652	48653	49582	48442	49689
Flow Change from Do Minimum (%)						
A47 at North Tuddenham	2021	-	21%	19%	18%	16%
	2036	-	28%	27%	27%	24%
A47 at Hockering	2021	-	38%	36%	33%	25%
	2036	-	46%	45%	42%	37%
A47 at Easton	2021	-	23%	26%	22%	24%
	2036	-	33%	35%	32%	36%

28.7.4 The comparison in Table 28-3 demonstrates that the proposed capacity improvements between North Tuddenham and Easton bring about significant increases in traffic flow in all options. Some of the key outcomes are as follows:

- Do Something 1 attracts the largest number of users out of the four options to the A47 at North Tuddenham;
- Do Something 1 attracts the largest number of users out of the four options to the A47 at Hockering;
- Do Something 2 attracts the largest number of users out of the four options to the A47 Easton;
- There is little difference between the various options, however, on balance Do Something 1 (Building a new dual carriageway to the north of the existing A47) and Do Something 2 (Dualling the existing A47) have greater throughput flows; and
- Across the different scheme options and sections, traffic flow on the A47 increases by around 25% (averaged over all options/sections) at 2021 and 34% at 2036 with the introduction of the scheme.

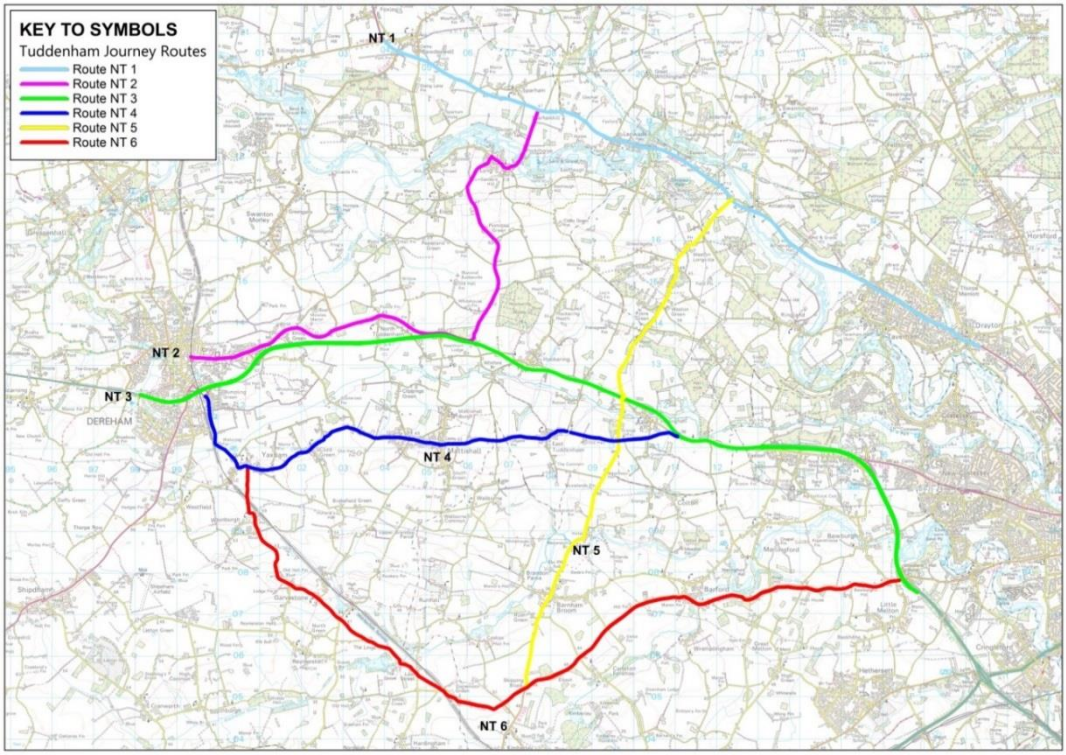
28.8 Forecasting Results Journey Times

28.8.1 As noted in the introduction (section 28.1), the forecasted changes in journey times taken from the forecasting results are discussed and presented in the Traffic Forecasting Report.

28.8.2 The report compares the journey times between fixed points across the Area of Interest on the existing A47, parallel routes and others that pass through the area for the forecast year do minimum and do something scenarios. The six routes are shown in Figure 28-1 below.

28.8.3 All the network changes for do something scenarios occur along Route NT3 and beyond this route the networks are the same for all options.

Figure 28-1 Network Routes



28.8.4 The journey times for each route are presented in the forecasting report. Tables 28.4 and 28.5 below present a summary for the 2036 modelled journey times to show a comparison between the Do-minimum and the 4 scheme options for the core scenario. Results for other modelled years and inter-peak periods can be found in the Traffic Forecasting Report.

Table 28.4 AM Peak Journey Time Comparison (2036 Core Scenario)

Route	Direction	DM	DS1	DS2	DS3	DS4
Modelled Journey Times (min:sec)						
NT1	EB	17:34	17:07	17:13	17:11	17:03
	WB	18:39	17:52	17:53	17:56	17:49
NT2	EB	13:10	13:12	13:26	13:28	13:28

	WB	14:52	14:48	14:59	15:05	15:09
NT3	EB	19:59	13:39	13:46	13:52	13:57
	WB	16:52	13:08	13:15	13:14	13:14
NT4	EB	12:42	10:20	10:52	10:04	11:25
	WB	12:39	10:18	09:38	09:55	13:10
NT5	NB	17:43	16:23	16:09	13:29	15:45
	SB	15:58	17:55	16:45	14:57	18:07
NT6	EB	22:40	21:04	21:13	21:14	21:15
	WB	20:28	20:15	20:14	20:17	20:15
Change from Do Minimum (min:sec)						
NT1	EB	-	-00:27	-00:21	-00:23	-00:31
	WB	-	-00:46	-00:46	-00:42	-00:50
NT2	EB	-	00:02	00:16	00:18	00:18
	WB	-	-00:04	00:07	00:13	00:17
NT3	EB	-	-06:20	-06:13	-06:07	-06:02
	WB	-	-03:44	-03:37	-03:38	-03:38
NT4	EB	-	-02:21	-01:49	-02:37	-01:17
	WB	-	-02:21	-03:01	-02:44	00:58
NT5	NB	-	-01:20	-01:34	-00:48	-01:58
	SB	-	01:57	00:48	01:43	02:09
NT6	EB	-	-01:36	-01:28	-01:26	-01:25
	WB	-	-00:13	-00:14	-00:11	-00:13

Table 28.5 PM Peak Journey Time Comparison (2036 Core Scenario)

Route	Direction	DM	DS1	DS2	DS3	DS4
Modelled Journey Times (min:sec)						
NT1	EB	17:35	17:01	17:07	17:08	17:07
	WB	18:41	17:49	17:25	17:46	17:53
NT2	EB	13:25	13:38	13:53	13:55	13:53
	WB	14:55	15:38	15:51	15:42	15:37
NT3	EB	19:21	13:31	13:41	13:46	13:46
	WB	18:02	13:56	13:36	13:58	13:55
NT4	EB	13:21	10:20	12:49	10:04	12:05
	WB	13:33	11:16	11:10	11:34	11:29
NT5	NB	19:07	17:49	18:12	14:36	17:57
	SB	15:11	17:44	16:49	15:03	16:20
NT6	EB	22:13	20:36	20:40	20:46	20:39
	WB	20:27	20:11	20:12	20:13	20:15
Change from Do Minimum (min:sec)						

NT1	EB	-	-00:34	-00:28	-00:27	-00:29
	WB	-	-00:52	-01:16	-00:55	-00:48
NT2	EB	-	00:13	00:29	00:31	00:28
	WB	-	00:43	00:56	00:47	00:42
NT3	EB	-	-05:50	-05:40	-05:35	-05:35
	WB	-	-04:05	-04:25	-04:03	-04:06
NT4	EB	-	-03:01	-00:32	-03:17	-01:16
	WB	-	-02:17	-02:23	-01:59	-01:33
NT5	NB	-	-01:18	-00:54	-00:10	-01:10
	SB	-	02:33	01:37	02:26	01:08
NT6	EB	-	-01:37	-01:33	-01:27	-01:35
	WB	-	-00:16	-00:15	-00:14	-00:12

28.8.5 The comparison of scheme options against the do minimum journey times shows there is little difference between the various options with only routes NT3 (A47) and NT4 (B1135) being affected significantly. The following describes some of the key impacts:

- Travel times eastbound along the A47 (route NT3) are around 30% quicker (around 4 mins) in 2021 and around 40% (around 5 mins) in 2036 in the do something when compared to the do minimum;
- Travel times westbound along the A47 (route NT3) are around 25% quicker (around 3 mins) in 2021 and around 30% (around 4 mins) in 2036 in the do something when compared to the do minimum;
- Travel times eastbound along the B1135 (route NT4) are around 15% quicker (around 1.5 mins) in 2021 and around 25% (around 2.5 mins) in 2036 in the do something when compared to the do minimum; and
- Travel times westbound along the B1135 (route NT4) are around 15% quicker (around 1.5 mins) in 2021 and around 20% (around 2 mins) in 2036 in the do something when compared to the do minimum.

28.9 Forecasting Results for Environmental Assessment

28.9.1 Peak hour flows, AADT flows, 24hr and 18hr AAWT flows and speeds have been calculated using the model outputs and have been made available to the highway design and environmental noise and air quality modelling teams as part of the design development and environmental assessments processes.

28.10 Assignment Results for Operational Performance Assessment

28.10.1 Operational assessment has not been undertaken at this stage of the PCF process. It has been assumed that the junctions will be designed with sufficient capacity and the design is not yet at a standard where assessing the operational capacity of the junctions would add anything to scheme assessment.

28.10.2 A uniform junction strategy has been applied across the four options so that the only difference between options is the alignment. This allows the selection of the best route without any potentially misleading effects arising from the influence of various junction layouts.

29 Economic Assessment PCF Stage 2

29.1 Introduction

29.1.1 This section summaries the methodology and results of the Economic Assessment of the four options undertaken in PCF Stage 2. The transportation modelling and forecasting assessment detailed in Chapter 28 provides the input to the Economic assessment detailed in this Chapter.

29.2 Economic Assessment Methodology

29.2.1 The methodology of the economic assessment is broadly similar to that undertaken in PCF Stage 1 and detailed in Chapter 18. The user benefits of the scheme have been assessed using TUBA 1.9.7, with costs provided by the Highways England Commercial team.

29.2.2 Accident benefits were calculated using COBALT version 2013.02.

29.2.3 The economic appraisal process follows WebTAG guidance and assumptions, where practical, for the assessment.

29.2.4 Traffic volumes and journey times have been taken from the modelling undertaken. The distances of each do-something option have been taken from the long section plans produced by the engineering team. Default journey purposes and vehicle split/user classes from WebTAG have been used.

29.3 Travel Time and Vehicle Operating Costs

29.3.1 The user benefits of the scheme are the savings in travel time and vehicle operating cost, accrued over 60 years following the assumed opening of the scheme in 2024 Journey time savings and changes in vehicle operating costs have been calculated for the representative scheme, compared to the Do-Nothing, using TUBA 1.9.7.

29.3.2 The User Benefits to travel time and vehicle operating costs, in present values discounted to 2010, in 2010 prices, are shown in the Economics Summary tables below.

29.4 Accidents

29.4.1 The benefit from a reduction in collisions has been calculated using Cobalt v2013_02. Collisions have been assessed using a combined link and junction based assessment. In the Do Minimum, link type 8 has been assumed which represents a single carriageway A road designed to modern standards. In the Do Something, link type 10 has been assumed which represents a dual carriageway with two lanes in each direction designed to modern standards.

29.4.2 The results are included in the AMCB table which is included in the Economic Assessment Report (A47 IMPS2-AMY-TE-ZZ-DO-J-0039) section 5.12.

29.5 Assumptions

29.5.1 A number of assumptions have been performed in the construction of economic analysis, and these must be considered in the context of the assessment as a whole:

- The assessment at this point does not consider construction delays, the impact of accidents or noise and air quality;
- Journey purpose splits and vehicle occupancies do not utilise local data and are instead based entirely on national averages from the WebTAG Data Book;
- The model outputs represent the average of a full peak hour; no profiling or shoulder peaks have been modelled and annualisation has been used to provide a best estimate of how benefits rise and fall over the full day;
- Only basic greenhouse gas emissions data from TUBA has been used to generate quantitative environmental impact.

29.6 Journey Time Reliability

29.6.1 Journey time reliability is typically impacted by two main sources: incidents and congestion. Incidents are those which reduce or stop carriageway capacity, typically accidents or vehicle breakdowns. Congestion effects journey time reliability when the flow exceeds capacity and a break down in the flow occurs. Anecdotal evidence suggests that journey time reliability on the A47 is also affected by the presence of agricultural vehicles and limited safe overtaking opportunities.

29.6.2 Dualling the A47 would address the two main typical sources impacting journey time reliability; the A47 would be more resilient to incidents and the increased capacity would reduce the incidence of congestion causing a break down in flow. The effect of the presence of agricultural vehicles would be reduced by providing a second lane which other vehicles could use to overtake.

29.7 Option Estimate

29.7.1 The Options estimates used in the PCF Stage 2 economic assessment are described in section 26.

29.8 Economic Summary Tables

Transport Economic Efficiency

29.8.1 The Transport Economic Efficiency (TEE) table for each option is shown in Table 29-1. User charges, private sector provider impacts and developer contributions are omitted from this table as they do not apply to this scheme, and maintenance delays have not been assessed, as is explained in section 5.10 of the Economic Appraisal Report.

Table 29-1 Transport Economic Efficiency

Option	User type	Benefit type	Benefits by journey type			
			Road Personal	Road Freight	Bus Personal	Total
Option 1	Commuting	Journey time	52885	-	-	52885
		VOCs	-6826	-	-	-6826
	Other	Journey time	77907	-	-	77907

Option	User type	Benefit type	Benefits by journey type			
			Road Personal	Road Freight	Bus Personal	Total
		VOCs	-22484	-	-	-22484
	Business	Journey time	28198	43967	-	72165
		VOCs	2540	5780	-	8320
	Present Value of Transport Economic Efficiency Benefits					181967
Option 2	Commuting	Journey time	48621	-	-	48621
		VOCs	-7923	-	-	-7923
	Other	Journey time	66779	-	-	66779
		VOCs	-24660	-	-	-24660
	Business	Journey time	25556	40196	-	65752
		VOCs	1415	2400	-	3815
	Present Value of Transport Economic Efficiency Benefits					152384
Option 3	Commuting	Journey time	48933	-	-	48933
		VOCs	-7945	-	-	-7945
	Other	Journey time	68648	-	-	68648
		VOCs	-23758	-	-	-23758
	Business	Journey time	25862	41182	-	67044
		VOCs	1550	2021	-	3571
	Present Value of Transport Economic Efficiency Benefits					156493
Option 4	Commuting	Journey time	45892	-	-	45892
		VOCs	-8280	-	-	-8280
	Other	Journey time	60215	-	-	60215
		VOCs	-24612	-	-	-24612
	Business	Journey time	23280	37857	-	61137
		VOCs	349	718	-	1067
	Present Value of Transport Economic Efficiency Benefits					135419

29.8.2 The scheme is predicted to deliver TEE benefits ranging between £135m and £182m. Business users are predicted to benefit from vehicle operating costs whilst commuters and other users will see a disbenefit. All users will have significant benefits associated with improvements in journey times with all options. Personal travel accounts for over 70% of benefits in all options with freight less than 30%.

Public Accounts

29.8.3 An abridged Public Accounts (PA) table for each option is shown in Table 29-7. In the absence of any revenue, operating cost data, developer contributions and grants/subsidies, only the cost to central government and the changes in indirect tax revenues are non-zero for this scheme.

29.8.4 The PA is reported as a cost table, so the signs are inverted from the other tables in this section; costs appear as positive numbers while benefits appear negative.

Table 29-7: PA table

All figures in £1000s at 2010 prices and values

Option	Central Government	Wider Public

	Broad Transport Budget	Finances
Option 1	99276	-20646
Option 2	89836	-21442
Option 3	87435	-21622
Option 4	86245	-20952

29.8.5 The present year costs (discounted to 2010, in 2010 prices) associated with each option range from £86million (Option 4) to £99million (Option 1).

Cost Benefit Analysis

29.8.6 The cost-benefit analysis for each option is summarised in the Analysis of Monetised Costs and Benefits (AMCB) table shown in Table 29-8. The AMCB is constructed from the TEE and PA tables, and allows for the effects of construction delays, accidents and greenhouse gas emissions.

Table 29-8: Core scenario AMCB table

All figures in £1000s at 2010 prices and values

Category	Benefit			
	Option 1	Option 2	Option 3	Option 4
Construction delays	Not Assessed			
Accidents	Not Complete			
Greenhouse gas emissions	-8916	-9326	-9424	-9225
Noise impacts	Not Complete			
Air quality impacts				
Commuter travel time benefits	46495	41165	41421	37949
Other user travel time benefits	55882	42064	45465	35988
Business user travel time benefits	80535	69587	70519	62182
Indirect taxation revenues	20646	21442	21622	20952
Present Value of Benefits (PVB)	194642	164932	169603	147846
Present Value of Costs (PVC)	99276	89836	87435	86245
Net Present Value (NPV) = PVB - PVC	95366	75096	82168	61601
Benefit to Cost Ratio (BCR) = PVB ÷ PVC	**1.961**	**1.836**	**1.940**	**1.714**

29.8.7 Present Value Benefits (PVB) for the different options range between £148million (Option 4) and £195million (Option 1) with Present Value of Costs ranging between £86million and £99million. Table 29-8 indicates that in all options, the scheme delivers significant benefits over and above its cost and is likely to repay the central government investment over the scheme appraisal period.

29.9 Non-Monetised Benefits

29.9.1 Other benefits such as regeneration effects have not been monetised at this stage, relying on the regional growth scenario to determine the level of regeneration expected

for the scheme. It is recognised that there is the potential for benefits to be derived from the scheme, including:

- Expected journey time benefits for business users will help support planned residential and employment regeneration in the Norwich area;
- Improvements in journey times will improve access to services in Norwich from the areas local to the scheme; and
- Benefits in journey time savings will improve resilience and reliability which directly affect journey quality, predominantly associated with traveller stress.

29.9.2 There are a number of local development projects which have been put forward to local planning authorities via Local Development Order (LDO) applications and responses to call for sites from Breckland, Broadland and South Norfolk District Councils, which are likely to positively impact the economic scheme. In particular Breckland District Council are currently considering an LDO application for a 10ha. Food Hub site to the west of Easton adjacent to the A47. The LDO is likely to be determined early in early 2017. Breckland and the developer involved have indicated that the LDO application is phase 1 of a much wider Food Hub and extensive residential proposal for the surrounding area.

29.10 Economic Summary

29.10.1 Value for Money assessments are produced to support scheme and programme decisions, whereby the performance of the scheme, utilising the BCR can be appraised on a common scale. A Value for Money (VfM) category is defined for each option's BCR as described in the DfT's "Value for Money Assessment: Advice Note for Local Transport Decision Makers". The VfM categories are shown in Table 29-4.

29.10.2 The scale is defined as follows:

Table 29-4 Value for Money Categories

Rating	BCR
Poor	< 1.0
Low	> 1.0 and < 1.5
Medium	> 1.5 and < 2.0
High	> 2.0 and < 4.0
Very High	> 4.0

29.10.3 Option 1 is observed to have the highest Benefit to Cost Ratio (BCR) at 1.961 with Option 3 having a BCR of 1.94. Option 4 which is the cheapest option has the lowest BCR (1.714) but is still considered value for money. Option 2 sits in between these options having the third highest BCR (1.836) of the four options.

29.10.4 It can be observed that all options provide a positive BCR in the MEDIUM VfM category.

30 Environmental Assessment PCF Stage 2

30.1 Introduction

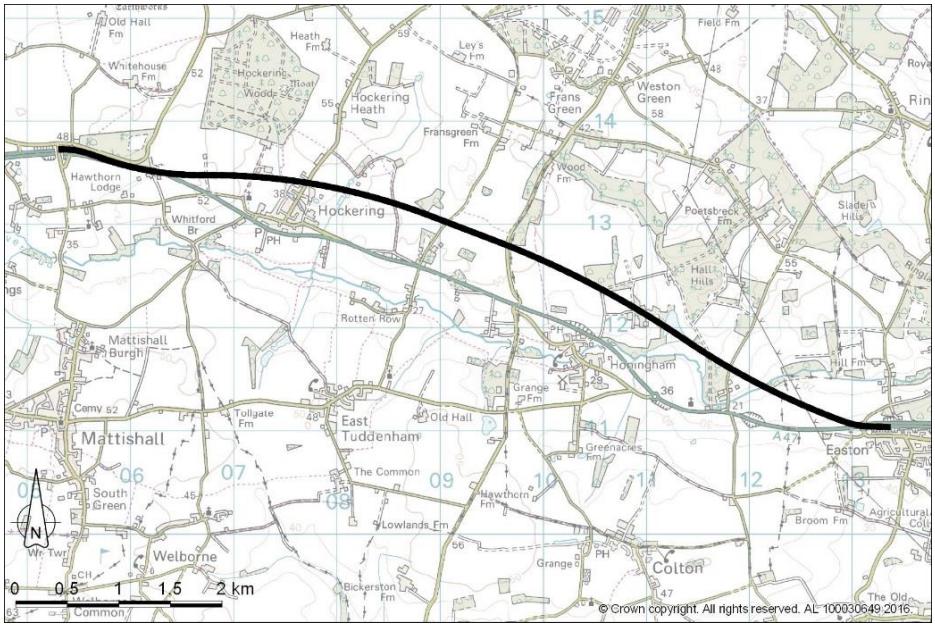
30.1.1 The purpose of this section is to provide a summary of the environmental assessment undertaken during the PCF Stage 2 process. The PCF Stage 2 Environmental Assessment Report (EAR) is a standalone document which provides a detailed assessment of the environmental effects of the proposed options for the A47 North Tuddenham to Easton dualling scheme.

30.2 Options considered

Option 1

30.2.1 Option 1 is an offline dualling to the north of the existing A47 route as shown in Figure 30.1. The single carriageway section of the A47 between North Tuddenham and Easton would be improved to dual carriageway standard by the construction of a new section of offline dual carriageway with appropriate junction improvements. At the western end of the scheme the alignment passes to the south of Hockering Wood and to the north of Hockering. The remainder of the route passes through open farmland and woodland habitat before crossing the River Tud.

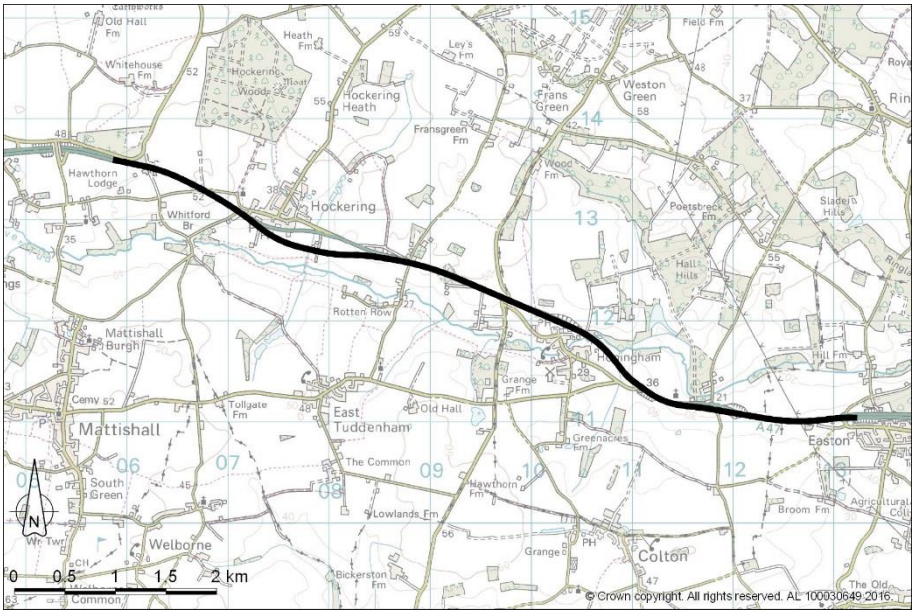
Figure 30.1 : Option 1 alignment



Option 2

30.2.2 Option 2 is an online dualling following the existing A47 route, as shown in Figure 30.2. This consists of improvement to the existing alignment to bring the route up to modern standards. The practicalities and safety of construction will make it necessary for the alignment in some sections to deviate from the existing highway corridor, particularly as the route passes to the south of the village of Hockering.

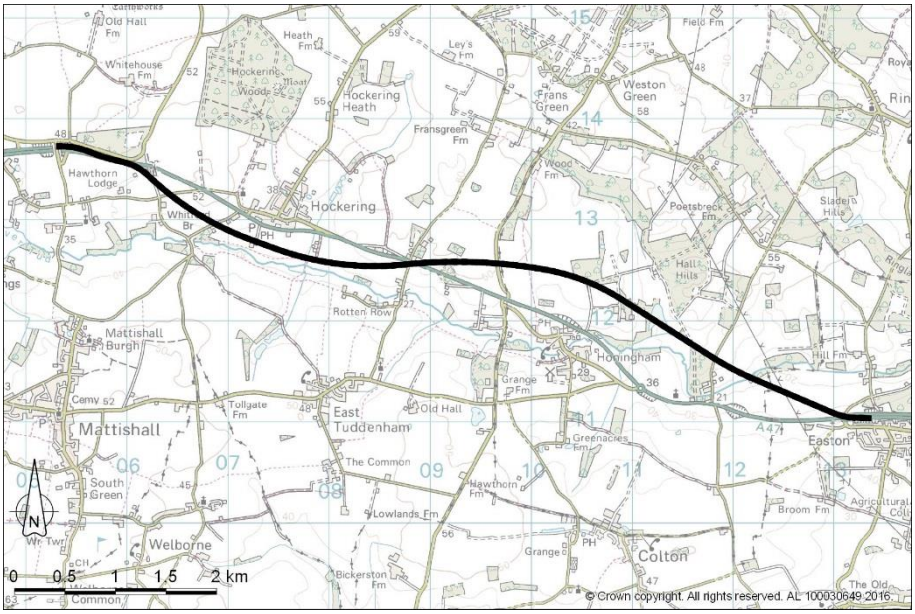
Figure 30.2 Option 2 alignment



Option 3

30.2.3 Option 3 is an offline dualling to the south of the existing A47 at the western extent of the route, and to the north of the existing A47 at the eastern extent of the route. The alignment passes through open farmland and woodland habitat and crosses the River Tud at the eastern end of the study area. The alignment is shown in Figure 30.3.

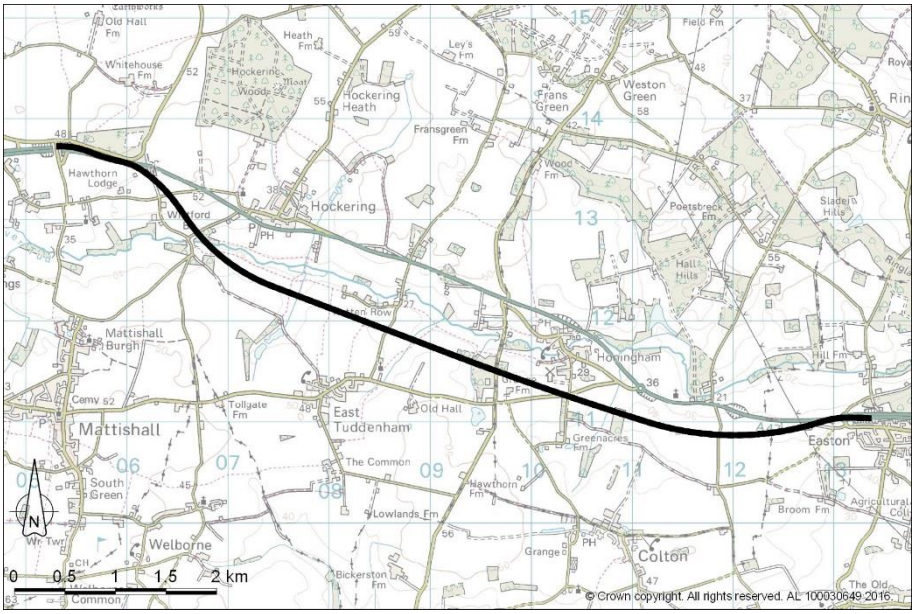
Figure 30.3 Option 3 alignment



Option 4

30.2.4 Option 4 is an offline dualling south of the existing A47, as shown in Figure 30.4. The route runs predominantly through arable farmland and semi-improved grassland. The alignment crosses the River Tud at the western extent of the route.

Figure 30.4 Option 4 alignment



30.3 Assessment methodology

30.3.1 The environmental assessment followed, where possible, The Design Manual for Roads and Bridges (DMRB) Volume 11, Environmental Assessment. Any limitations to the environmental assessment are set out in each environmental topic section within Chapters 6 to 14 of the PCF Stage 2 EAR. For each environmental topic, a study area was identified, within each study area the baseline conditions relevant to the scheme were determined by both desk study and field study.

30.4 Environmental assessment of proposed options

Introduction

30.4.1 The following section summarises the baseline information on all environmental topics and provides a summary of the potential impacts on receptors and features of each topic from the proposed options. The environmental assessment is considered in more detail in the PCF Stage 2 EAR.

Air Quality

Baseline conditions

30.4.2 There are no Air Quality Management Areas within the study area used for assessing air quality impacts. Background air quality data from Department for Environment Food and Rural Affairs (DEFRA) reveals that air quality in the area is generally good. Average nitrogen dioxide (NO_2) and nitrogen oxide (NO_x) concentrations are raised slightly in the vicinity of the urban areas. Levels of particulate matter are likely to be affected by arable agriculture on the land surrounding the A47. The majority of receptors in the area are residential.

30.4.3 A programme of air quality monitoring was undertaken in the areas of Hockering, Honingham and Easton between January 2017 and August 2017. The results reveal that

background and roadside site concentrations do not exceed the annual mean NO_2 objective and the 1-hour NO_2 objective as set out within the UK Air Quality Strategy.

Impacts

30.4.4 All construction activities hold the potential to increase levels of dust and particulate matter within the study area. It is determined that with suitable mitigation in place during construction adverse impacts on receptors will be limited.

Option 1

30.4.5 Option 1 will result in a reduction in the total number of receptors impacted by air pollutants from A47 traffic. Forty-two receptors lie within 50m of the option alignment. Modelling results for the representative receptors for NO_2 and PM_{10} show that the predicted levels of NO_2 and PM_{10} do not exceed the annual AQS objectives. There will be an increase of approximately 203,502tCO_{2e} as a result of the option over a sixty-year assessment period. Approximately 247 receptors will experience a deterioration in air quality, while 5 will experience an improvement.

Option 2

30.4.6 Option 2 will result in a reduction in the total number of receptors impacted by air pollutants from A47 traffic. Thirty-one receptors lie within 50m of the option alignment. The model results for the representative receptors for NO_2 and PM_{10} show that predicted levels of NO_2 and PM_{10} do not exceed the annual objective. There will be an increase of approximately 185,422tCO_{2e} as a result of the option over a sixty-year assessment period. A total of 192 receptors will experience a decrease in air quality as a result of the scheme, while 67 will experience an improvement.

Option 3

30.4.7 Option 3 will result a reduction in the total number of receptors impacted by air pollutants from A47 traffic. Forty-one receptors lie within 50m of the option alignment. Representative receptors for NO_2 and PM_{10} show that predicated levels of annual NO_2 and PM_{10} do not exceed annual AQS objectives. There will be an increase of approximately 174,547tCO_{2e} as a result of the scheme over a sixty-year assessment period. Approximately 180 receptors will experience a deterioration in air quality as a result of the scheme, while 14 will experience an improvement.

Option 4

30.4.8 Option 4 will result a reduction in the total number of receptors impacted by air pollutants from A47 traffic. Fifteen receptors lie within 50m of the option alignment. Representative receptors for NO_2 and PM_{10} show that predicated levels of annual NO2 and PM10 do not exceed annual objectives. There will be an increase of approximately 184,833tCO_{2e} as a result of the option over a sixty-year assessment period. Approximately 156 receptors will experience a deterioration in air quality as a result of the scheme, while four will experience an improvement.

Option Ranking

30.4.9 Option 4 is the preferable option with respect to local air quality primarily because the carriageway is the most remote of the options and provides the fewest new receptor exposures. However, due to the proximity of particularly sensitive receptors along the route (Earthsea House and Ailwyn Hall) the assessment discounts option 4 as the preferred option, and considers option 2 the preferred route. The overall ranking from an air quality perspective is as follows:

- Option 2 (preferred)
- Option 3
- Option 1
- Option 4 (least preferred)

Cultural Heritage

Baseline conditions

30.4.10 There are numerous archaeological sites, monuments and find spots located across the study area. There is little evidence for human activity in the prehistoric, Neolithic, Bronze Age and Iron Age periods, yet greater evidence of Roman presence, particularly due to the number of Roman artefacts which are spread out across the study area. There are also finds of medieval and post medieval origin.

30.4.11 Twenty one listed buildings lie within the study area; the majority of which are churches and Grade II listed farmhouses and their ancillary buildings which date from the 17th Century. Key listed buildings include; St Andrew's Church, St Peter's Church, St Michael's Church, Church Farmhouse, Ice House (Berry's Lane) and Honingham Hall Estate Stables and Coach House. A further twenty undesignated historic buildings and structures also lie within the study area.

30.4.12 The historic character of the study area is typical of the wider landscape comprising of small villages and farms in low, rolling fields linked by a network of small lanes which has origins in the medieval period. The historic field pattern survives although in some areas there has been a degree of field amalgamation.

30.4.13 The historic landscape character of the area reveals a rural environment, which reflects the intensification of agriculture in the late 20th century. Large estates and parkland are also typical of the wider landscape. To the north of the A47 lies Honingham Park, an undesignated landscape park.

Impacts

Option 1

30.4.14 During construction, option 1 will impact several sites which host archaeological remains, including the site of a Roman Settlement and the earthworks interpreted as former medieval settlement. In addition, the option will result in the demolition of the undesignated walled garden in Honingham Hall.

30.4.15 During operation, option 1 will sever the historical relationship between St Andrew's Church and the historic landscape park. The realignment of the road will also potentially diminish the dominance of the church within the landscape when viewed from the south and alter the integrity of the Honingham Hall Park through the severance of historic plantations and carriageways.

Option 2

30.4.16 During construction, the option will intersect multiple archaeological remains from the Roman period. It is also likely that the option will require the demolition of the undesignated gate lodge to Honingham Park.

30.4.17 During operation, the option is not expected to result in any significant adverse impacts on any archaeological remains or listed buildings/historic structures. An adverse impact is

expected on the historic landscape of Honingham Hall Park due to the proposed addition of a link road to the landscape.

Option 3

30.4.18 During construction, option 3 will result in the demolition of the undesignated walled garden in Honingham Hall. Construction clearance within Honingham Park will also lead to adverse impacts for this historic landscape.

30.4.19 During operation, the option will diminish the dominance of St Andrew's Church within the landscape. Adverse impacts are also determined for St Peter's Church due to the proximity of a new link road. The historic landscape of Honingham Hall Park will also be adversely impacted.

Option 4

30.4.20 During construction, the option will require the demolition of the Grade II listed Ice House.

30.4.21 During operation, minimal adverse impacts will occur as a result of the re-aligned A47 moving slightly closer to St Peters Church. The creation of embankments may adversely impact St Andrew's Church.

Option Ranking

30.4.22 The overall ranking from a cultural heritage perspective is as follows:

- Option 2
- Option 1 and Option 3 (equally)
- Option 4

Landscape and Visual

Baseline Conditions - Landscape

30.4.23 The study area is located within two National Character Areas; NCA 78 Central North Norfolk and NCA 84 Mid Norfolk. There are no national landscape designations or any designated Areas of Outstanding Natural Beauty (AONB).

30.4.24 Land cover consists predominantly of medium scale fields of mixed use. The majority of field boundaries consist of clipped hedgerows, which together with woodland copses, create a locally distinctive landscape structure. Significant landscape assets within the study area include the River Tud Valley, Hockering Wood, Honingham Mill, St Peter's Church and St Michael's Church.

Baseline Conditions- visual

30.4.25 The study area has a predominantly rural character with small villages and hamlets and a large proportion of woodland and trees that create framed views. Residential receptors within the study area consist often of isolated farms and small groups of properties. The village of Hockering lies to the north of the existing A47 in the west of the study area, while the village of Honingham lies to the south in the centre of the study area. Easton lies at the eastern extent of the study area.

30.4.26 Fifteen residential receptors are identified within the study area. These are a combination of single residential receptors and groups of residential receptors which hold similar views. In

addition to this, four institutional/business receptors are identified along with 14 recreational routes and a number of road receptors and viewpoints.

Impacts - Landscape

30.4.27 During construction, all four options will result in the removal of woodland and vegetation, affecting the landscape structure. The presence of construction compounds and haul roads will lead to adverse landscape impacts.

Option 1

30.4.28 The offline dualling will result in the loss of trees and hedgerows, impacting the landscape fabric, particularly in the north east of the study area where small fields and woodland are prominent features of the landscape. The construction of a new bridge structure in the east will also impact the landscape fabric.

Option 2

30.4.29 The widening of the carriageway and the small section of offline dualling will involve the loss of woodland and the loss of well-established vegetation. This will occur particularly around the verges of the existing A47 and through the area to the south of Hockering where the carriageway deviates from the existing alignment.

Option 3

30.4.30 Option 3 will result in large scale losses of woodland and vegetation in the north east of the study area. The construction of a new bridge over the River Tud will adversely impact the landscape fabric.

Option 4

30.4.31 This option will result in the removal of mature trees to the southwest and southeast of Honingham. A new river crossing will be required in the west of the study area where the river valley is smaller in scale and well wooded.

Impacts - visual

30.4.32 For all options construction impacts are temporary and associated with loss of vegetation for construction and adverse visual impacts from machinery and earthworks. Those visual receptors closest to the construction corridor for each options will experience the largest adverse impacts.

30.4.33 Once operational, all four options will affect the composition and quality of existing views within the study area. The majority of properties affected will be those in the wider countryside rather than properties within settlements. The exception being properties in the northwest of Hockering and on Heath Road which will experience adverse impacts from Option 1 only. Option 4 may give rise to impacts upon residents of properties in the southeast of Honingham. Residents of the majority of properties within Honingham will not experience impacts from any of the four options due to the presence of screening vegetation within the village and alongside the existing A47. Option 4 will give rise to the largest impacts on receptor groups.

Option Ranking

30.4.34 Option 2 is the preferred option as it results in the least disruption to landscape and visual receptors as the alignment runs predominantly online. The overall ranking from a landscape and visual perspective is as follows:

- Option 2
- Option 3
- Option 1
- Option 4

Nature Conservation and Biodiversity

Baseline conditions

30.4.35 Three statutory designated nature conservation sites are located within 2km of the project extents; Hockering Wood Site of Special Scientific Interest (SSSI), River Wensum Special Area of Conservation (SAC)/SSSI and Rosie Curston's Meadow SSSI. Online sources identify twenty one non-statutory designated sites; these include a number of County Wildlife Sites (CWS) and proposed CWS (pCWS). Six areas of ancient woodland are also present within the study area.

30.4.36 Online records and survey data indicate the presence of a number of species within the study area. These include; badger, bat, great crested newt, otter, water vole, white claw crayfish and a range of wintering birds. Further ecological surveys were completed in 2017 to confirm the presence of such species.

- **Badger**; A detailed survey identified six outlier setts (five active), one subsidiary sett, three annex setts and two main setts (one active, one abandoned).
- **Bat**; Aerial inspection surveys indicate that numerous trees within the area have high bat roost potential. Building scoping also identified ten buildings as confirmed bat roosts.
- **Great crested newt (GCN);** Sixteen ponds within the study were surveyed to ascertain the presence and population size of GCN. Six ponds are confirmed to have GCN present.
- **Otter/Water vole**; Several otter tracks and potential holts were identified within 250m of the route options. Water vole signs were also identified along the River Tud. This included latrines, pathways and feeding remains.
- **Wintering birds**; Three wintering bird surveys were completed in January, February and March 2017. Thirty-four protected species of wintering birds were identified during this time.

Impacts

30.4.37 Construction impacts will be similar for all options, with vegetation removal and disturbance to species being the key impacts. There is also potential for pollution of habitats although this will be controlled through adherence to best practice measures and pollution prevention. Tables 9.24 and 9.25 of the Environmental Assessment Report (A47IMPS2-AMY-TE-ZZ-DO-J0024) show the impacts on environmental receptors for each of the four options.

Option 1

30.4.38 Option 1 is considered to have adverse impacts on designated sites of international and county importance. The land-take required from CWS's is large and likely to impact the local biodiversity. The option may affect the River Wensum SAC by impacting the population and distribution of qualifying species inhabiting the River Tud. The option also

requires a considerable amount of land-take from priority habitats and will result in adverse impacts on associated biodiversity. Impacts on ten protected species of varying sensitivity have been identified.

Option 2

30.4.39 Option 2 is identified as the preferred option when considering impacts on ecological receptors. The long term impact on the River Wensum is assessed to be minimal due to the existing bridge being widened and no new bridge structure required. Impacts on priority habitats are reduced in comparison to the other three options, with two habitat categories affected. Where deciduous woodland is impacted, these woodland pockets are considered immature and are not a significant long-term loss. Impacts on two protected species have been identified.

Option 3

30.4.40 Option 3 has been identified to have a potentially large adverse impact on the River Wensum SAC by affecting the population and distribution of qualifying species inhabiting the River Tud. Adverse impacts such as this are anticipated as the option will require two new crossings of the River Tud. Land-take is required from areas of habitat suitable of CWS designation. This option also has considerable land-take from priority habitats and will result in a loss of biodiversity in the area. Impacts on nine protected species have also been identified.

Option 4

30.4.41 Option 4 is determined to have similar impacts to options 1 and 3. The option was found to have a potentially adverse impact on the River Wensum SAC by impacting the population and distribution of qualifying species inhabiting the River Tud. This option also requires significant land-take from priority habitats which is likely to impact local biodiversity. Impacts on eight protected species have also been identified.

Option Ranking

30.4.42 The overall ranking from a nature conservation and biodiversity perspective is as follows:

- Option 2
- Option 4
- Option 3
- Option 1

Noise and Vibration

Baseline conditions

30.4.43 The A47 within the study area between North Tuddenham and Easton is single carriageway with two roundabout junctions. The main source of noise within the study area is traffic from the existing A47. Receptors situated closest to the A47 experience the highest levels of traffic noise. Four Noise Important Areas (NIAs) are located within the study area.

30.4.44 Particularly sensitive receptors within the study area comprise of: Earthsea School; a specialist school for victims of severe childhood trauma; Earthsea House; a residential children's home offering therapeutic care and Ailwyn Hall; a residential care home.

Impacts

30.4.45 Construction will result in adverse noise and vibration impacts for the receptors closest to each option alignment. A lack of construction details however has prevented a full assessment on construction impacts.

Option 1

30.4.46 Fourteen Noise Sensitive Receptors (NSRs) lie within 50m of the option 1 alignment. Noise modelling reveals that approximately 397 dwellings will experience daytime noise increases from the alignment of option 1 in the short term, while 425 will experience a decrease. In the long term, 353 dwellings will experience an increase while 314 will experience a decrease.

Option 2

30.4.47 Fourteen NSRs lie within 50m of the option 2 alignment. In the short term approximately 536 dwellings will experience daytime noise increases, while 243 will experience a decrease. In the long term, approximately 451 dwellings will experience a day time increase, with 166 expected to experience a decrease.

Option 3

30.4.48 Sixteen NSRs lie within 50m of the option 3 alignment. Approximately 783 dwellings are expected to experience a daytime noise increase in the short term, while 97 will experience a decrease. In the long term, 381 dwellings are expected to experience a daytime increase while 220 will experience a decrease.

Option 4

30.4.49 Sixteen NSRs lie within 50m of the option 4 alignment. In the short term, approximately 277 dwellings will experience daytime noise increases as a result of option 4 while 559 are predicted to experience a decrease. In the long term, 204 dwellings will experience an increase while 528 will experience a decrease.

Option Ranking

30.4.50 The overall ranking from a noise and vibration perspective is as follows:

- Option 3
- Option 2
- Option 1
- Option 4

Road Drainage and the Water Environment

Baseline Conditions

30.4.51 The River Tud is the only major watercourse which flows throughout the study area. The River is ecologically connected to the River Wensum, which is designated as an SAC and SSSI. A vast number of drainage streams, ditches and ponds also lie within the study area, located sporadically within the countryside surrounding the A47.

30.4.52 The study area lies above a highly productive aquifer, which yields good quality water. A groundwater source protection zone is designated for a large section of the area; this

intersects the study area to the south west of Hockering and runs in a north easterly direction towards Easton.

30.4.53 Flood risk within the area is highest around the River Tud. The floodplain immediately adjacent to the river is designated as flood zone 2 and flood zone 3.

Impacts

30.4.54 During construction all options have potential to adversely impact the water environment through pollution and sediment runoff, however these will be controlled though best practice measures and adherence to pollution prevention.

Option 1

30.4.55 Option 1 will require one new bridge structure over the River Tud and will intersect approximately six drainage streams and six ponds. There is potential for spillages and road traffic collisions to adversely affect surface water features during operation. Flood risk may increase due to the loss of permeable farmland for the dual carriageway.

Option 2

30.4.56 Impacts on the water environment for option 2 will be limited as the route runs predominantly online. Disturbance to surface water features and groundwater will be limited. Flood risk may increase due to the widening of the carriageway creating a greater impermeable surface.

Option 3

30.4.57 Option 3 will require two new bridge structures over the River Tud and will intersect approximately four drainage streams and three ponds. The alignment will intersect the groundwater SPZ on two separate occasions. Similar to option 1, the loss of permeable farmland for the dual carriageway may increase flood risk within the area.

Option 4

30.4.58 Option 4 will require one new crossing of the River Tud and will further intersect approximately six drainage streams and involve the destruction of two ponds. Flood risk may be increased by the creation of the dual carriageway though farmland.

Options Ranking

30.4.59 Option 2 is the preferred option as the route runs online and its interaction with the water environment is limited. Option 1 is considered the least favoured option as the route intersects the most surface water features. The overall ranking from a road drainage and water environment perspective is as follows:

- Option 2
- Option 3
- Option 4
- Option 1

People and Communities

Baseline Conditions

30.4.60 Land use within the study area is predominantly dominated by agriculture and specifically utilised for the cultivation of crops and cereals. Residential properties are scattered throughout the study area with main concentrations located within the villages of Hockering, Honingham and Easton. A number of community facilities are additionally present within these villages.

30.4.61 Fourteen Public Rights of Way (PRoW) are present within the study area and are used by a variety of non-motorised users (NMUs).

30.4.62 There are small areas of land located within and around Hockering, Honingham and Easton which are designated for development, with proposals including housing and mixed use development.

Impacts

30.4.63 Due to a lack of construction data, a full assessment on construction impacts was not completed.

Option 1

30.4.64 Option 1 will result in large scale land take from agricultural land, specifically from the north of the existing A47. Residential properties, commercial land and development land will also be adversely impacted. Option 1 will require the largest land take out of all four options. The alignment of option 1 will additionally have adverse impacts on nine PRoWs. Open space located to the north of Hockering, as designated in the Breckland Local Plan, will also be lost to the option.

Option 2

30.4.65 Option 2 will result in land take from agricultural land, commercial land and residential properties which immediately bound the existing A47. The option will require the least amount of land take in comparison to the other options. One PRoW will be severed by the route.

Option 3

30.4.66 Option 3 will require land take from agricultural land, development land and residential properties. This will occur from both the north and south of the existing A47. The majority of land take will be from grade 3 agricultural land. Compared with the other options, this option will require the second largest land take. Seven PRoW will experience adverse impacts due to severance and a reduction to journey amenity.

Option 4

30.4.67 Option 4 will require land take from agricultural land, community land, development land and residential properties; all of which are from the south of the existing A47. Similar to other options, the majority of land take will be from agricultural land. Seventeen PRoW will experience adverse impacts due to severance and a reduction to journey amenity.

Option ranking

30.4.68 Option 2 is considered the preferred option. Land take impacts will be preferable when compared to the other options and there will be fewer impacts on PRoW. The overall ranking from a People and Communities perspective is as follows:

- Option 2
- Option 3
- Option 4
- Option 1

Geology and Soils

Baseline conditions

30.4.69 The bedrock underlying the study area is undifferentiated Upper Cretaceous White Chalk. Superficial deposits comprising; Alluvium, River Terrace Deposits, Sheringham Cliff Formation, Happisburgh Glacigenic Formation and Lowestoft Formation. Soil within the area comprises of Glacial Till, with Glaciofluvial deposits and Riverine Clay, River Terrance Sands and gravels and Floodplain sands and gravels along the River Tud.

30.4.70 The Natural England agricultural land classifications show much of the land within the study area to be Grade 3 (good to moderate) with land surrounding the River Tud to be Grade 4 (poor) and land north east of Easton to be non-agricultural. Land north of Hockering and east of North Tuddenham is indicated to be Grade 2 (very good).

30.4.71 The current agricultural, woodland and naturalised areas surrounding the options have a high potential for being able to store carbon.

30.4.72 Approximately 47 potentially contaminated sites have been identified within 300m of the project extents. These include brickworks, sand pits, gravel pits and industrial yards.

Impacts

30.4.73 All options have potential to result in pollution of underlying soils during construction, however these can be managed through best practice measures and adherence to pollution prevention. Adverse impacts on bedrock are expected for all options due to the excavation work required. The removal of woodland and vegetation will create adverse impacts on biomass production and climate change.

Option 1

30.4.74 Twenty one potentially contaminated sites are located within 300m of the option 1 alignment. Based on expected earthworks quantities, this option will require the greatest amount of imported fill material.

Option 2

30.4.75 Seventeen potentially contaminated sites are located within 300m of option 2 alignment. This option will require the least amount of imported fill material.

Option 3

30.4.76 Nineteen potentially contaminated sites are located within 300m of the option 3 alignment. This option will require the second greatest amount of imported fill material.

Option 4

30.4.77 Twenty three potentially contaminated sites are located within 300m of the option 4 alignment.

Option comparison

30.4.78 Option 2 is considered the preferred option as this alignment runs through land which has been previously excavated, the site also passes in the vicinity of the fewest contaminated land sites. The overall ranking from a geology and soils perspective is as follows:

- Option 2
- Option 1
- Option 3
- Option 4

Materials and Waste Management

Baseline conditions

30.4.79 The existing carriageway along the section proposed for improvement is single carriageway with associated drainage. There are a number of utilities present in the road verges including communications cables and a water mains. A high pressure gas main crosses the A47 close to Wood Lane. A number of waste facilities are present in the wider area and a number of landfill sites are located in and around Norwich.

Impacts

30.4.80 All options will result in the use of virgin or recycled materials and generate waste. Where possible existing materials will be reused and the amount of virgin materials used will be minimised.

Option comparison

30.4.81 As the design is ongoing, it is not possible to quantify the use of materials required for the scheme in absolute terms. An options comparison and ranking cannot be undertaken, with the exception of a comparison of the expected earthworks quantities required. This revealed option 2 as the preferred option and option 1 as the least favoured option. The overall ranking is summarised below:

- Option 2
- Option 4
- Option 3
- Option 1

Conclusions

30.4.82 The options were ranked using colour coding, with the preferred option ranked green and the lease preferred red and yellow second, orange third. The second preferred option is ranked yellow and the third preferred orange. Table 30.1 below summarises the environmental ranking of the options.

Table 30.1 Environmental Ranking

Environmental topic	Option 1	Option 2	Option 3	Option 4
Air Quality				
Cultural heritage				
Landscape and Visual				
Nature conservation and biodiversity				
Noise and vibration				
Road drainage and the water environment				
People and communities				
Geology and soils				
Materials				

30.4.83 The above table shows that option 2 is the environmentally preferred option, with option 3 second preferred. Options 1 and 4 are the least preferred.

30.5 Next Steps and Potential Mitigation

30.5.1 During PCF Stage 3 further detailed environmental surveys and assessment will be undertaken. A full environmental assessment and a formal Environmental Statement will be prepared as part of the application for development consent required for the scheme.

30.5.2 A summary of the mitigation measures for Option 2 is included in the paragraphs below. It should be noted that these mitigation measures will need to be developed, reviewed and updated once the preferred route has been developed. The measures set out below give an idea of the type of environmental mitigation measures which are likely to be considered during PCF Stage 3.

Mitigation measures for Option 2

Mitigation - Air Quality

30.5.3 Temporary construction phase effects can be controlled by the implementation of suitable mitigation measures in a Construction Environmental Management Plan (CEMP). Examples of likely control measures to minimise dust and plant emissions are outlined below.

- The wheels and bodies of site vehicles should be cleaned;
- Stockpiles should be watered and where necessary, they should be covered or enclosed to reduce windblown dust;
- Vehicles transporting earthworks materials to or from site should be covered;
- Vehicles should not be left idling; and
- Where possible, all non-road mobile machinery should use fuel equivalent to ultra-low sulphur diesel.

30.5.4 Permanent operational impacts can be controlled through a review of factors including;

- Route alignment; increasing the distance between the road and sensitive receptors can allow for significant localised benefits due to increased spatial dispersion of pollutants. The orientation of the road relative to locally prevailing winds can affect the overall dispersal of pollutants to or away from receptors. Placing the road in a cutting or embankment can increase the distance between receptors and vehicles which allows more time for dispersion.
- Landscape works; the use of bunds or screens can divert localised pollution away from localised receptors or increase the distance to receptors.
- Traffic management; measures include active traffic management, fixed and variable speed limits, dedicated lanes, hard shoulder running and ramp metering. Such measures can modify the traffic behaviour so that vehicles operate in a mode that produces lower emissions.

Mitigation - Cultural Heritage

30.5.5 Where impacts on below-ground archaeological remains cannot be avoided, a phase of archaeological evaluation will be required. Such evaluation will aim to understand the survival, nature, extent and significance of the heritage assets to be impacted and to refine further mitigation. Where upstanding earthworks are present, haul roads will be designed to avoid the earthworks and measures will be put in place to prevent tracking across the site.

30.5.6 Further mitigation strategies relating to impacts on the built environment and historic landscapes will be developed alongside the design process.

Mitigation - Landscape

30.5.7 During construction, the working corridor will be minimised to reduce vegetation removal and to minimise disturbance to existing ground and soil. Pre-construction tree surveys will be undertaken to identify key specimens or groups of trees to retain. Construction compounds will be sited and designed to minimise effects on vegetation, soil and visual receptors.

30.5.8 The primary means of landscape and visual mitigation is encompassed within the design of the road, including its horizontal and vertical alignment and the layout and design of junctions and side roads.

30.5.9 Mitigation planting will take place using a mixture of deciduous and evergreen species with local provenance. A mixture of trees and shrub planting with seasonal interest will also take place. Mitigation planting will be used selectively to reduce or avoid impacts on the residential properties which will experience large adverse impacts as a result of the scheme. The planting will avoid emphasising the scheme as a new linear feature visible in the landscape and will preserve key views across the landscape to include important features such as church towers and woodland.

Mitigation – Nature and conservation

30.5.10 Measures to mitigate any potential adverse effects on designated sites, and protected/notable habitats and species will be undertaken as the scheme evolves. Standard mitigation measures will be considered which include pollution prevention control measures, standard control measures to reduce dust from construction activities, and preconstruction surveys.

30.5.11 The following mitigation measures will be adopted where possible to reduce impacts on protected species

- **Badger**; creation of artificial setts, badger fencing and badger tunnels/underpasses where appropriate.
- **Bats**; creation, restoration and improvement of roosts and habitats (e.g. bat boxes, bat bricks in new or existing bridges).
- **Great crested newt**; restoration and creation of terrestrial habitats, creation of habitat corridors (e.g. green bridges/underpasses) to avoid fragmentation. Translocation and avoidance of newt trapping measures will additionally be in place.
- **Otter**; retention and enhancement of habitats, the construction of artificial holts and underpasses and the inclusion of mammal ledges on bridges.
- **Water vole**; incorporating suitable habitat into sustainable drainage schemes, ensuring a level of water retention in ditches/ drainage systems, the creation of banks suitable for burrowing and buffer zones around watercourses/wetland habitats to protect burrows.
- **White clawed crayfish**; retention and enhancement of habitat, inclusion of suitable inverts where new culverts/bridges are proposed and translocation within the catchment of River Tud/River Wensum.
- **Wintering birds**; retention of important habitats (e.g. open arable farmland) and the creation of lost habitats such as woodland and hedgerow. Further baseline surveys are required at PCF Stage 3 to fully inform mitigation proposals. Consultation will also be required with ecological stakeholders on the mitigation proposals.

Mitigation – Noise and Vibration

30.5.12 Mitigation measures that could be considered to reduce the impact of traffic noise on local receptors, if required, include:

- Maximising the distance between new/realigned sections of road and nearby receptors;
- Minimising changes in traffic on existing roads due to the scheme;
- Earth bunds/noise barriers to screen nearby receptors. Where there is sufficient land available, earth bunds/noise barriers can be designed in consultation with the

landscape design to help integrate the route of new/realigned sections of road into the surrounding area. This can also provide visual mitigation;

- Low noise surfacing, if traffic speeds are sufficient for a low noise surface to be effective. Current guidance in the DMRB advises that a noise benefit from a low noise surface should only be assumed at speeds of 75 km/hr or more; and
- Noise insulation of individual properties to protect the internal noise environment.

30.5.13 Construction works should be carried out in accordance with BS 5228-1 and -2 2009 plus amendments 'Noise Control on Construction and Open Sites' to mitigate temporary noise impacts.

Mitigation – Road drainage and Water Environment

30.5.14 Drainage systems will be in place to intercept surface water runoff from the carriageway and remove pollutants as near to the source before disposal to the on-site conveyance network. This network will comprise of components such as;

- Carrier and filter drains;
- Gullies;
- SuDS ponds for attenuation; and
- Culverts.

30.5.15 Where new road crossings increase the risk of flooding, flood prevention measures will be included within the design. Such measures include; flood walls, flood storage areas and SuDS ponds.

Mitigation – People and Communities

30.5.16 In the case of agricultural land, alternative means of access will be provided where existing access points will be disrupted. Hedgerows, field boundaries, water supplies and existing field drainage infrastructure will be re-instated where effects are sustained as a result of option construction.

30.5.17 Severance of PRoW will be reinstated where possible. There is also potential to introduce new cycleways and further pedestrian footpaths to improve accessibility around the local villages. Where new junctions or roundabouts are included as part of the design, suitable NMU infrastructure will be provided.

Mitigation – Geology Soils and Materials

30.5.18 To reduce the impact on geology and soils during construction the following mitigation measures will be implemented;

- Haul roads will be no wider than necessary to reduce compaction of superficial strata during construction.
- Where possible, all excavated earthwork should be re-used on site and works should be scheduled to allow for the maximum amount of excavated material to be reused.
- A Materials Management Plan (MMP) should be prepared to allow material to be excavated, treated and reused in the most efficient manner.
- All fuel and chemical storage areas should be sited on hard-standing and be bunded to prevent leaks escaping to the soils environment.
- Construction works will be in compliance with the guidance provided in DEFRA's 'Construction Code of Practice for the Sustainable Use of Soils on Construction Sites'.

30.5.19 The risks from contaminated land will be controlled through the following measures:

- Additional ground investigation including soils and groundwater sampling. Ground gas monitoring should also be completed at the detailed design stage.
- Appropriate health and safety and waste management procedures for working with potentially contaminated soils will be established.
- A 'watching brief' will be enforced during construction to identify any previously unidentified areas of contaminated land.

Mitigation – Materials and Waste Management

30.5.20 The flowing mitigation measures will be implemented where possible to reduce impacts on materials and waste management;

- Excavated materials will be reused on site in order to reduce the requirement for virgin materials. Where possible, existing infrastructure (e.g. light fixtures and drainage covers etc) may be able to be reused. Best practice will be followed at all times in order to reduce wastage and the reduce the quantity of raw materials required to construct and maintain the project.
- Any vegetation removal required by the options will be regarded as waste attributed to the construction of the option. Vegetation will be mulched, subject to regulatory permissions and used within new landscape areas.
- In order to maximise the reuse of existing materials, consideration will be given to the recycling of road planings to be used as aggregates in the sub-base layers.
- Following construction, the potential for further use of materials and possible wastage is focused on the maintenance and upkeep of the road. It is recommended that regular inspections of the road be made in order to reduce the need for major repairs.

31 Additional Assessment of Public Consultation

31.1 Introduction

As discussed in Section 24, the total number of respondents to the consultation was 529, which includes responses from stakeholders and members of the public. Therefore, the findings set out in the Report on Consultation (A47IMPS2-AMY-TE-ZZ-DR-J0007)

31.1.1 should be treated with caution and not be interpreted as representative of the views of the wider population of North Tuddenham to Easton and the surrounding area.

31.1.2 Section 24.2.5 to 24.2.9 explains the way in which the responses received from the consultation were coded for analysis.

31.1.3 As part of the PCF Stage 2 route selection analysis of the consultation comments the comments were filtered to identify where comments were specific to "route" comments. This was undertaken by filtering comments which had been coded as follows:

- "General" theme comments also coded as:
  - "Alternative suggestion"
  - "Alternative suggestion - consider future improvements to A47 / A141"
  - "Alternative suggestion - design / route"
  - "Alternative suggestion - traffic lights"
- "Option 1" theme comments also coded as:
  - "Design / route"
  - "Design / route - move further north"
- "Option 2" theme comments also coded as:
  - "Design / route"
- "Option 3" theme comments also coded as:
  - "Design / route"
- "Option 4" theme comments also coded as:
  - "Design / route"
  - "Design / route - river / valley"

31.2 Filtered "route" comments

31.2.1 The "route" comments identified by the filtering as explained in 31.1.3 are presented in the tables in Appendix Q.

31.3 Review of comments

31.3.1 The comments have been reviewed and a response has been added. The response seeks to either explain how the comment has been considered or addressed within the PCF Stage 2 work undertaken or indicates that the comment will be considered or addressed within following PCF Stages of the scheme.

31.3.2 As is noted in the tables in Appendix Q, the majority of the filtered comments refer to issues which will be addressed and used by the design teams to help shape the preliminary design as explained in the recommendations in the Report on Public Consultation:

> *"Going forward following Preferred Route Announcement, the responses and the information contained and appended to the responses, will be used by the design teams to help shape and develop the preliminary design of the preferred route into more detailed proposals. This will include consideration of comments and suggestions when developing proposals for junction, side road and non-motorised user strategies. They will also be used to inform analysis, assessment and potential mitigation proposals and considerations for accessibility, environmental, buildability, landscape, severance and interconnectivity, planning and engineering."*

31.3.3 The following headed sections discuss where the comments identified a potential alternative route option suggestion, and give a brief description of the option suggested and how these have been considered.

Option 1 moved further to the north around Hockering

31.3.4 During the public consultation, there was more than one comment querying the possibility of moving Option 1 further to the north to move the route further to the north of Hockering.

31.3.5 There is a residential development consented and under construction at the north of Hockering. In order to route the option to the north of the residential properties at the north of Hockering would introduce tighter alignment radi at the western tie in and would move the route closer to the SSSI Hockering Wood. It is considered that moving the alignment further to the north would create an unacceptable horizontal alignment and a route which was less environmentally acceptable due to proximity of Hockering wood than route Option 1 as currently shown.

No Dualling of the A47 with local improvement to junctions

31.3.6 During the public consultation, there were comments querying the possibility of leaving the section of the A47 between North Tuddenham and Easton as a single carriageway and locally improving the junctions along the route, rather than providing a dual carriageway.

31.3.7 As stated in Section 1.3, one of the key problems is defined in the A47/A12 Corridor Feasibility Study Stage 1: Review of Evidence and Identification of Problems along the Corridor (February 2015) for North Tuddenham to Easton as follows: *"It is predicted that the link stress on this link is currently an issue. In both peaks by 2021 there will be a link stress of over a 100% in both peaks".*

31.3.8 The RIS commitment made, see section 2.2, is, *"A47 North Tuddenham to Easton – dualling of the single carriageway section of the A47 between Norwich and Dereham, linking together two existing sections of dual carriageway."*

31.3.9 It is considered that improving the junctions locally and not upgrading the single carriageway to dual carriageway, would not solve the link stress issues with the single carriageway and would not alleviate the current issues with regard to poor horizontal alignment along the route nor would it meet the RIS commitments made to dual the section of the A47.

32 Other Relevant Factors considered in PCF Stage 2

32.1 Summary of Engagement with Public Bodies in PCF Stage 2

32.1.1 A number of formal and informal meetings and liaison with local councils with regard to planning the consultation events were held during the early part of 2017.

32.1.2 Chapter 24 details the non-statutory public consultation which was held in March and April 2017. Immediately prior to and following the announcement of the preferred route a number of meetings have been held with local authorities including but not limited to:

- Broadland District Council
- Breckland District Council
- South Norfolk District Council
- Norfolk County Council
- North Tuddenham Parish Council
- East Tuddenham Parish Council
- Hockering Parish Council
- Honingham Parish Council
- Easton Parish Council
- Lyng
- Marlingford & Colton
- Ringland
- Weston Longville
- Mattishall
- Morton

32.2 Assessment of Consenting Requirements

32.2.1 All of the options for the scheme would meet the criteria for a Nationally Significant Infrastructure Project and would therefore be subject to the DCO process due to the amount of land take required by the scheme.

32.3 Assessment of Options against Planning Policies

32.3.1 This section provides an update of the position of the scheme against the topics covered in Section 2 Planning Brief.

National Policy Statement for National Networks (NPSNN)

32.3.2 The NPSNN was reviewed and the relevant topics and impact on the options were summarised at a high level in the PCF Stage 2 product DCO Application - Planning Statement & National Policy Statement Accordance document.

32.3.3 As detailed in para 32.2.1 above the scheme would meet the criteria for a NSIP and would be subject to the DCO process. In this case, the development consent application will be judged primarily against the NPSNN, according to the decision-making framework set out in the Planning Act 2008.

Roads Investment Strategy (RIS)

32.3.4 The RIS described in Section 2 of this report is still applicable to the Scheme.

Highways England Strategic Business Plan (SBP) (2015-2020)

32.3.5 The SBP described in Section 2 is still current and relevant to this Scheme and has not been updated.

Highways England Delivery Plan (2015-2020)

32.3.6 The Delivery Plan described in Section 2 is still current but is subject to an annual review/update. The latest update, published in August 2017, details current progress on schemes and performance against Highways England's KPIs.

32.3.7 The objectives of the RIS including the KPIs from the SBP and the original Delivery Plan were used during the sifting of options described in Section 10 and in the Preferred Route Decision Review as described in Section 27.

32.3.8 The KPIs remain but the PIs within each KPI have been updated which will need further consideration during PCF Stage 3.

32.3.9 A supplementary Annex was published by Highways England in October 2017 which provides a further update on scheme delivery and performance against KPIs.

32.3.10 The Scheme is still listed in the latest update but now has the start of works as 2020/21 in the 'Updated Scheme Schedule 2015-20'. This represents a delay to the Scheme not previously identified and is as a result of concerns regarding phasing of the works along the A47 as a whole. The start on site date will be confirmed by Highways England in future stages.

32.3.11 Specifically, the update to the Delivery Plan describes the reason for delay as *'the route based review seeks to optimise the delivery programme of six projects along the A47 linking Peterborough and Norwich. All schemes within this study have been rescheduled to avoid potential impact of simultaneous roadworks and minimise delivery risk. The schedules for the two schemes around Peterborough enable a joint traffic management strategy to be developed for improved delivery efficiency.'*

Local Policy

32.3.12 Section 2.3 provides commentary on the local policy relevant to all of the four options for the scheme.

32.3.13 At the time of writing none of the options currently being developed have a negative impact on any of the plans described in Section 2 and all comply with the policies described.

Planning Applications

32.3.14 Section 7 references both the A47-A1067 Western Link Road and the Greater Norwich Food Enterprize Zone as developments in the immediate vicinity which could clearly have an influence on the scheme going forward.

A47-A1067 Western Link Road

32.3.15 At this stage the WLR is not committed development but due to its potential impact to transportation movements in the area of the scheme it may be necessary to undertake sensitivity testing during PCF Stage 3 when junction and side road arrangements are being developed to consider the impact of the WLR on the scheme.

Greater Norwich Food Enterprise Zone (GNFEZ) Local Development Order (LDO)

32.3.16 As of October 2017, the planning application for the Local Development Order has not yet been determined and the applications current status listed by BDC planning is “REGISTERED” indicating BDC are currently considering the application.

32.3.17 If the LDO application is approved the development will need to be considered within the transportation assessment as a committed development, and within the side road and junction strategy as it is developed in PCF Stage 3. Liaison with Broadland District Council planning officers with regard to the LDO and other planning issues will be ongoing through the future PCF Stages.

32.4 Conclusion

32.4.1 At the time of writing none of the options currently being developed have a negative impact on any of the committed plans described in Section 2, Section 7 and in this Section and all comply with the policies described.

32.4.2 The proposed developments described in section 32.3.18 are not yet committed, however they will need to be considered in further PCF Stages as the scheme progresses.

33 Appraisal Summary Table

33.1.1 The completed Appraisal Summary Table (AST), completed for each of the four options can be found in Appendix R. The AST includes the summary of the results of the economic assessment work and the environmental assessment work and includes results from the Distributional Impact Assessment (A47 IMPS2-AMY-TE-ZZ-DO-J-0063).

33.1.2 The purpose of the AST is to provide the project team with a concise, across-the-board overview of the impacts of a scheme option, taking account of all the economic, social, environmental and financial impacts of a proposed solution as set out in the Treasury Green Book. This enables an assessment to be made as to the overall value for money an option provides. Further information on the Distributional Impact Assessment can be found in the Distributional Impact Appraisal Report, which supports the AST.

34 Programme

34.1.1 A high-level programme for scheme delivery has been prepared in accordance with Highways England's PCF requirements. The current programme has been developed making an allowance for the DCO process to be followed.

Table 33-1: Summary of Key Milestones

PCF Stage	Delivery Item	Estimated project delivery date	Estimated project duration
PCF Stage 0	Strategy, Shaping and Prioritisation	Complete	Complete
PCF Stage 1	Option Identification	Complete	Complete
PCF Stage 2	Option Selection	Complete	Complete
PCF Stage 3	Preliminary Design	2017/2019	18 months
PCF Stage 4	Statutory Procedures and Powers	2019/2020	18 months
PCF Stage 5	Construction Preparation	2020/2021	6 months
PCF Stage 6	Construction, Commissioning and Handover	2021/2023	26 months
PCF Stage 7	Close Out	2023/2024	TBC

35 Validation of Preferred Route

35.1 Introduction

35.1.1 As highlighted in Section 27 the preferred route decision was made at the preferred route decision workshop based on the information and assessment work which had been undertaken at that point and which was available for consideration at the time.

35.1.2 The assessment work has now been completed and is reported in summary chapters 28, 29, 30, 31 and 32 and a series of other technical reports which describe the assessments in more detail. The key technical reports being the:

- Local Model Validation Report
- Traffic Forecasting Report
- Economic Assessment Report
- Appraisal Summary Table
- Environmental Assessment Report

35.1.3 The following sections highlight how the final PCF Stage 2 assessments undertaken since PRD compare to those undertaken prior to the PRD and the significance of these differences with regard to the decision on the preferred route.

35.2 Transportation

35.2.1 Prior to the PRD as highlighted in Section 27.4.2 the transportation assessment was not identified as a specific differentiating factor between the Options as the 4 options all provide a dual carriageway replacing the length of single carriageway between North Tuddenham and Easton. From a transportation assessment view, all routes will predominantly perform in a similar way, the only real differentiating factor in terms of preliminary initial transportation assessment is the minor route length difference between the options. It was therefore considered that the transportation effects of the 4 options were not a significant differentiating factor for the preferred route decision.

35.2.2 The transportation work completed following PRD has provided data for completing the economic assessment as detailed in Chapter 29 and into the final air quality and noise assessments as detailed in Chapter 30.

35.3 Economics and Cost

35.3.1 The estimated costs for the 4 Options as detailed in Chapter 26 were presented for consideration at the PRD, the estimates were complete prior to the PRD and the costs were considered in reaching the PRD decision.

35.3.2 The estimates have subsequently been used along with the results of the transportation assessment as the basis of the economic assessment as detailed in Chapter 29.

35.3.3 The economic assessment for the scheme shows that there is a range of BCRs from 1.714 to 1.961 for the four Options. The assessment shows that all of the Options

provide a positive BCR and all provide the same value for money category, all the BCRs being in the Medium VfM category.

35.4 Environmental

35.4.1 As detailed in Section 27 the environmental assessment completed at the time was presented to the PRD, each of the environmental topics were ranked and the results of these rankings are presented in Table 27-3. Following PRD the detailed environmental assessment was completed and is summarised in Section 30. The ranks were revisited for each environmental topic and the results of the final assessment are presented in Table 30-1 and in the Environmental Assessment Report.

35.4.2 Comparison of Tables 27-3 and 30-1 show the final assessment for the following environmental topics:

- Cultural Heritage
- Landscape and Visual
- Nature conservation and biodiversity
- Noise and Vibration
- Road Drainage and Water

The above list of topics gave the same assessment rankings as those presented at PRD. The other environmental topics show some differences in rankings between the assessment presented at PRD and the final environmental assessment these are listed in the sections below.

Air Quality

35.4.3 The ranking at PRD assessed the options in order of preference, Option 3 was most preferred.

35.4.4 The completed final assessment ranked Option 2 as most preferred with Option 3 second, rankings for Option 1 and 4 remained third and fourth.

People and Communities

35.4.5 The ranking at PRD assessed the options in order of preference, Option 2 was most preferred,

35.4.6 The completed final assessment ranked Option 2 as most preferred with Option 3 second, Option 4 third and Option 1 fourth and least preferred.

Geology and Soils.

35.4.7 The ranking at PRD assessed the options in order of preference, Option 2 was most preferred,

35.4.8 The completed final assessment ranked Option 2 as most preferred with Option 1 second, Option 3 third and Option 4 fourth and least preferred.

Materials

35.4.9 There were no ground investigations conducted to date to inform the PRD

35.4.10 The completed final assessment ranked Option 2 as most preferred with Option 4 second, Option 3 third and Option 1 fourth and least preferred.

Overall Environmental Assessment

35.4.11 The final overall environmental ranking prior to PRD (see section 27.5.55) when combining the environmental ranking was:

- Option 2
- Option 4
- Option 3
- Option 1

35.4.12 The completed assessment at the end of PCF Stage 2 reported in the Environmental Assessment Report and summarised in Chapter 30 gave the same overall environmental ranking as that considered at PRD. Option 2 being preferred environmentally for 7 out of the nine topics in the final assessment and ranked second on the other 2 topics.

35.5 Conclusion

35.5.1 The transportation, economic and environmental work that has been completed following PRD in PCF Stage 2 after the PRD, has confirmed that the assessment work considered at PRD although not complete at the time was sufficiently robust to give the correct consideration during the selection of the preferred route.

35.5.2 The final assessments have confirmed the information on which the preferred route decision was made was robust and consistent with the completed assessments at the end of PCF Stage 2.

36 Conclusion and Recommendation

36.1 Introduction

36.1.1 This sections concludes the work carried out in PCF Stage 2 and describes the PRA route.

36.2 Conclusion

36.2.1 A preferred route has now been announced taking into consideration the environmental sensitivities in the area and key concerns raised at public consultation.

36.2.2 The preferred route is an amendment to the original proposed Option 2.

36.3 Recommended Preferred Route

36.3.1 The preferred route was announced by Highways England on 14 August 2017. The PRA leaflet states:

> *Having reviewed the feedback following the consultation, and completed a number of other assessments, we are proceeding with an amended version of Option 2 presented at consultation.*
>
> *Option 2 was one of the two most favoured options and solves the traffic and safety problems. It also has the least impact on the environment. Key concerns raised by the public regarding Option 2 have influenced a realignment which means it can be built with less impact during construction and the existing road can remain for local traffic movements, pedestrians, cyclists and equestrians.*
>
> *The proposed Option 2 would benefit from deviating locally from the existing A47 route alignment, which would:*
>
> - *Reduce the impact at the western end on Oak Farm, minimising the impact on the existing properties on Mattishall Lane.*
> - *Minimise, where possible, the impact on properties close to the existing A47 at Hockering.*
> - *Reduce the impact of the road on the River Tud.*
> - *Keep the road widening to the north side of the corridor as it passes Honingham.*
> - *Keep route to the north at the existing junction at Easton to maximise the chance of the local road reconnection being alongside and to the north of the church at Easton.*
>
> *These elements will make the road easier to construct and will retain a significant amount of the existing A47 for local access, cycling and walking.*
>
> *This will now be developed further before statutory consultation.*

36.3.2 The preferred route announcement was accompanied by a drawing of the preferred route, a copy of the preferred route announcement leaflet is included in Appendix T.

36.4 PCF Stage 3

36.4.1 The PCF Stage 3 Consultants were engaged and commenced work on the preliminary design Stage of the scheme before the close out of PCF Stage 2. Some of the key areas that have been identified during PCF Stage 2 will need to be addressed in PCF Stage 3.

37 List of Appendices

Appendix A – Key Features of Existing A47 Route Drawings

Appendix B – Traffic Count Locations for NATS model update

Appendix C – Collision Data Plot

Appendix D – Geology and Flood Plans

Appendix E – Statutory Undertakers Plans

Appendix F – Environmental Study Area

Appendix G – Existing Area 6 Diversion Routes

Appendix H – Options 1-14 Route Layout Plans and Constraints Plans

Appendix I – East Assessment

Appendix J – Environmental and Engineering Ranking Tables

Appendix K – Option 6 with Option 15 Route Overlaid

Appendix L – Options 1, 3, 4 and 6 with Indicative Side Roads and Junctions

Appendix M - AST for Option 4 (PCF Stage 1)

Appendix N – Layouts Options 1-4 following Value Management Deep Dive Review

Appendix O - Minutes of the PRD meeting

Appendix P – Status of PCF Stage 2 Products prepared at the date of the PRD

Appendix Q – Comments table identified by the filtering (section 31.1.3)

Appendix R - AST for Options 1-4 (PCF Stage 2)

Appendix S – Preferred Route Announcement Leaflet