A27 Arundel Bypass Scheme Assessment Report

October 2020

CONTENTS

This Scheme Assessment Report (SAR), presents the information from the 2019 Interim SAR with the 2019 and 2020 errata corrections and adds chapters 16 – Summary of Public Consultation, 17 – Identification of Preferred Route and 18 – Conclusion.

A27 Arundel Bypass Scheme Assessment Report

Chapter 1 - Introduction

October 2020

CONTENTS

LIST OF FIGURES

1 INTRODUCTION

1.1 Background

1.1.1.1 In May 2018 a Scheme Assessment Report[1] (SAR) on the A27 Arundel Bypass scheme (the Scheme) was published. This report summarised the technical appraisal of several alternative options for the Scheme and the findings of a non-statutory public consultation which was held between 22 August 2017 and 16 October 2017 (the 2017 Public Consultation). A Preferred Route (PR) for the Scheme was then announced in May 2018[2] (the 2018 Preferred Route Announcement (PRA)). In October 2018 Highways England announced a further non-statutory public consultation on route options[3] (the Further Consultation). This decision was informed by development of the Preferred Route since its announcement and to ensure continued engagement on project planning and development.

[1] Highways England, "A27 Arundel Bypass Scheme Assessment Report," May 2018. [Online]. Available: https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/sarv1forpublishing.pdf [Accessed 20 June 2019

[2] Highways England, "A27 Arundel Bypass Preferred Route Announcement," Spring 2018. [Online]. Available: https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/a27arundelbypassprabrochure-webversion-final-100518.pdf [Accessed 20 June 2019]

[3] Highways England, Press Release, "Arundel bypass – further consultation next spring," October 2018. [Online]. Available: https://www.gov.uk/government/news/arundel-bypass-further-consultation-next-spring [Accessed 20 June 2019

1.1.1.2 An Interim Scheme Assessment Report was published in August 2019[4]. This formed part of the consultation documents for the further non-statutory public consultation, which was held between 30th August 2019 to 24th October 2019. It reported on the Scheme's history, existing conditions, the development of route options and the appraisal of the short-listed options. Errata documents were published in September 2019[5] and February 2020[6] correcting errors in the Interim SAR. This SAR updates the Interim Scheme Assessment report, providing a summary of the consultation and recommends Highways England's Preferred Route.

1.1.1.3 A decision on whether or not to approve the preferred option will be made by the relevant Highways England investment decision committee (IDC). The decision would be made public in a new PRA.

1.1.1.4 Highways England would then develop the PR and the Scheme would undergo additional public consultation, including a period of statutory consultation, before submission of a Development Consent Order (DCO) application. The DCO application would be examined by Appointed Persons' called the Examining Authority who would then make a recommendation on the application scheme, after which the Secretary of State (SoS) would decide on whether to make or refuse development consent. Once a decision is made there is a period to challenge. Once an Order is made the development can commence in accordance with the terms of the DCO and certified documents.

[4] Highways England "Interim Scheme Assessment Report," August 2019 [online]. Available https://highwaysengland.citizenspace.com/he/a27-arundel-bypass-further-consultation/supporting_documents/A27%20Arundel%20Bypass%20%20Scheme%20Assessment%20Report%202019%20%20Final.pdf. (Accessed, February 2020)

[5] Highways England "Interim Scheme Assessment Report Errata", September 2019 [online]. Available https://highwaysengland.citizenspace.com/he/a27-arundel-bypass-further-consultation/supporting_documents/Interim%20Scheme%20Assessment%20Report%20Errata%2016%20September%202019%20.pdf. (Accessed, February 2020)

[6] Highways England "Interim Scheme Assessment Report Errata", February 2020 [online]. Available https://highwaysengland.citizenspace.com/he/a27-arundel-2019-further-consultation-corrections/supporting_documents/A27%20Arundel%20Bypass%20Further%20Consultation%20%20Scheme%20Assessment%20Report%20Errata%203%20February%202020.pdf, (accessed, February 2020)

1.2 Scheme Context

1.2.1.1 The A27 is the only east-west trunk road south of the M25 (Figure 1-1). It links many of the towns and cities along the south coast, including Portsmouth, Havant, Chichester, Arundel, Worthing, Adur, Brighton and Hove, Lewes, and Eastbourne serving a combined population of around 1.2 million people[7], as well as a large number of businesses. The A27 also provides access to the wider Strategic Road Network (SRN) and is therefore an important corridor for both longer distance travel (67%) and local traffic (33%)[8]. West Sussex also attracts, on average, 17 million visitor days per year, contributing over £500 million to the local economy[9].

1.2.1.2 The A27 through Arundel is currently operating at over 100% of capacity.

1.2.1.3 Population estimates from the Office for National Statistics (ONS) show that Arun is the most populous district in West Sussex, and it represents 19% of the county's population. Arun has one of the highest new housing targets in West Sussex, with the target of an additional 20,000 new residential dwellings by 2031[10]. The existing journey to work information for West Sussex and Arun District indicates that a high proportion of working age residents moving into these new dwellings are likely to commute to their place of work by car, adding to the pressure on the road network.

1.2.1.4 On either side of Arundel, the A27 is a dual carriageway which has the capacity to carry existing traffic flows and can cope with future traffic growth. However, the single carriageway section and junctions through Arundel do not cope with the existing traffic during peak periods, particularly on the section to the west of Crossbush where the Average Annual Daily traffic (AADT) is over 32,000 vehicles per day[11]. This often results in long queues of traffic approaching Arundel.

[7] Nomis. Official labour market statistics. Available at: https://www.nomisweb.co.uk [Accessed August 2019]

[8] A27 Arundel Bypass Highways England PCF Stage 2 Further consultation strategic model (2015 base). Local traffic is defined as having an origin or destination within Arundel. Through-traffic has an origin and a destination outside of Arundel

[9] The GB Day Visitor Statistics 2015, Visit Britain (https://www.visitbritain.org/sites/default/files/vb-corporate/Documents-Library/documents/England-documents/gbdvs_annual_report_2015_13.06.16.pdf)

[10] Arun Local Plan 2011-2031 (Adopted July 2018)

[11] A27 Arundel Bypass Highways England PCF Stage 2 Further consultation strategic model (2015 base)

1.2.1.5 The congestion caused by the lack of capacity on the A27 through Arundel results in delays for traffic. This is demonstrated by comparing journey times in peak periods to off peak periods (see Chapter 5 and 9 for further details). The worst delays in the AM peak are in the westbound direction when journey times are up to 1 minute longer. This is forecast to increase by over 3 minutes by 2041. In the eastbound direction delays are worst in the PM period and these are forecast to remain over 6 minutes longer by 2041.

1.2.1.6 Operational assessments of the Ford Road roundabout and Crossbush junction has demonstrated that whilst Ford Road roundabout is operating at capacity in the AM peak, Crossbush junction is already operating over capacity during both the peak periods (see Chapter 5). Both junctions are predicted to operate over capacity in 2041 (see Chapter 8).

1.2.1.7 Due to congestion, some longer distance traffic subsequently diverts away from the A27 to alternative routes which are less suited to high volumes of traffic. To the north, this includes the B2139 through the South Downs National Park (SDNP) as well as local villages and towns (Houghton, Amberley and Storrington).

1.2.1.8 The main alternative route to the south is via the B2233, passing through the villages of Eastergate, Barnham, Yapton and Climping, which adversely affects people living alongside this route and for those walking, cycling and horse riding. These local roads, as discussed in the PCF Stage 2 (Option Selection) Combined Modelling and Appraisal Report (ComMA), are not designed for large volumes of traffic therefore safety of non-motorised road users is compromised.

1.2.1.9 As stated in Scheme Assessment Report: Chapter 3, the A27 currently has a poor safety record, with a higher than average accident rate for rural A-roads. In the last 5-year period, 1 January 2013 to 31 December 2017 there have been 81 personal injury collisions, resulting in 121 casualties, recorded between the A27 junction with the A29, to the west, and Crossbush junction to the east.

1.2.1.10 Without improvement, the congestion and delay on the A27 through Arundel will increase in the future. Even if greater reliance on public transport, walking and cycling could reduce some of the future demand for car travel, this is unlikely to solve the problems of queueing and congestion on the A27 through Arundel.

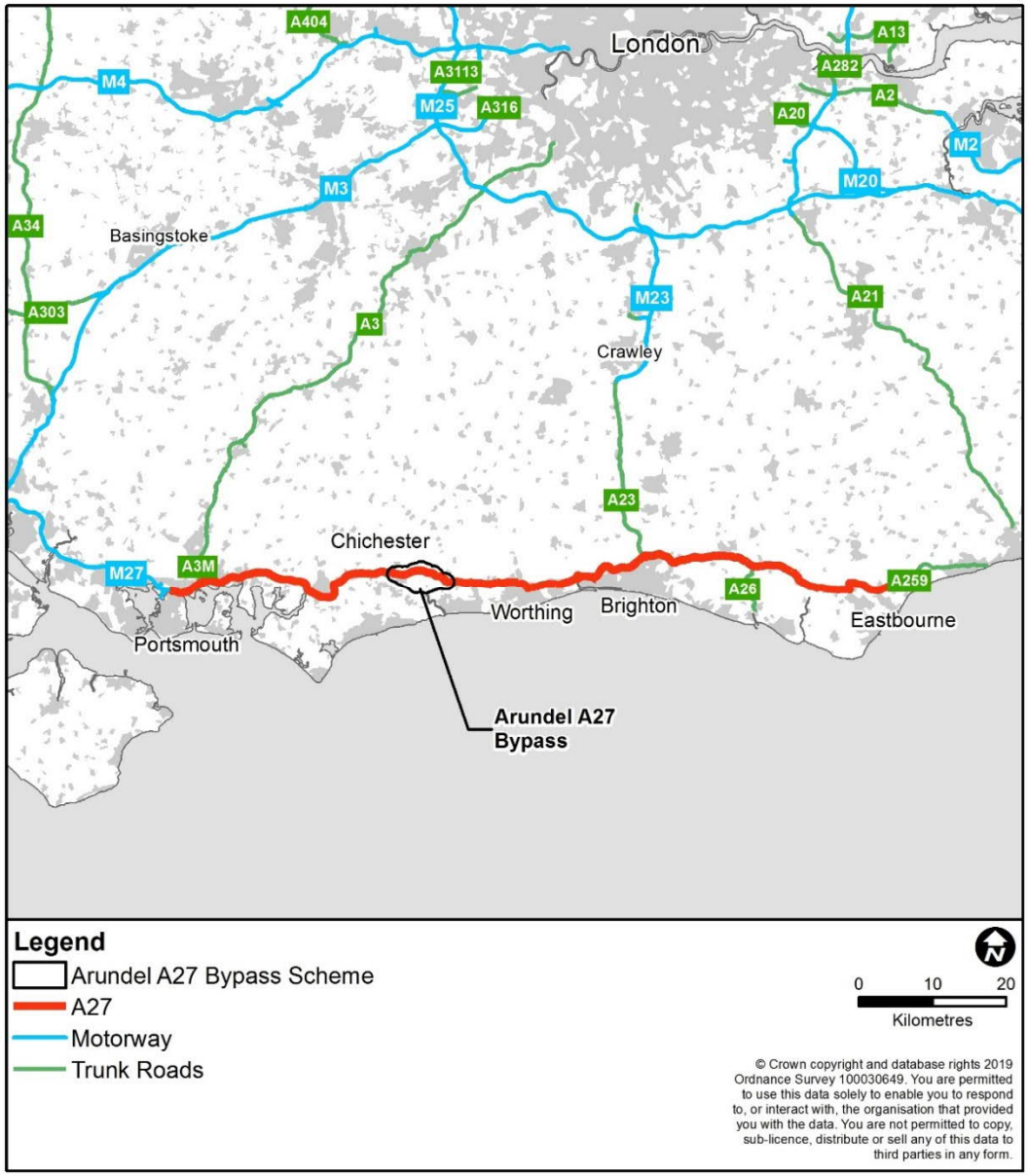


Figure 1-1 - A27 Corridor

1.3 Scheme Description

1.3.1.1 The proposed scheme will replace the existing single carriageway section of the A27 at Arundel with a 2-lane all-purpose dual carriageway. It will include a grade separated junction with the A284 to replace the existing at grade A27 / A284 Crossbush Junction. Six Options have been developed and these are detailed in Chapter 8.

1.3.1.2 Throughout the SAR the proposed options are referred to by the following reference names:

- Option 1V5

- Option 1V9
- Option 3V1
- Option 4/5AV1
- Option 4/5AV2
- Option 5BV1

1.3.1.3 For the Further Public Consultation, the proposed options have also been identified by colour to ease recognition:

- Option 1V5 - Cyan
- Option 1V9 - Beige
- Option 3V1 - Crimson
- Option 4/5AV1 - Magenta
- Option 4/5AV2 - Amber
- Option 5BV1 - Grey

1.4 Scheme History

1.4.1.1 Proposals for the improvement of the A27 at Arundel have been the subject of extensive study and consultation for many years and a number of routes for a bypass have been proposed. These are illustrated in Figure 1-2. The main events providing background to the current Scheme are as follows.

- 1987 First public consultation on three routes termed the Orange, Red and Purple routes was carried out. A modified Orange route was proposed during the consultation.
- 1989 The Orange route was selected as the PR.
- 1991 A second public consultation was held on the Orange route with an alternative route at the eastern end called the Blue route and an alternative route at the western end termed the Brown route.
- The Pink route was proposed during the consultation as an alternative to the Brown route.
- 1993 During a further consultation period three alternative routes for the western end were proposed. These were called the Green routes.
- 1993 A combination of the Pink and Blue routes was selected as the PR. The Pink route was identified as the least environmentally damaging compared to the green routes for the western end.
- There was then no further progress as a series of Government reviews of the roads programme and transport strategy resulted in the proposals for a bypass being placed in a long-term category.
- 2002 – 2003 The South Coast Multi Modal Study (SoCoMMS) carried out for the Government as part of a review of transport

provision[12] recommended a new bypass at Arundel based on the Pink/Blue route. The recommendation was rejected by the SoS for Transport due to its environmental impact and further investigation of less environmentally damaging options was requested.

- 2005 – 2006 Further investigation of options was carried out by the Highways Agency focusing on less environmentally damaging solutions. This included a modified, less environmentally damaging, version of the Pink/Blue route.
- 2014 – 2015 The A27 Feasibility Study[13] considered 7 route options developed as part of the further investigations undertaken after SoCoMMS and 3 sustainable transport options. Following a sifting of options two bypass options to the south of the existing A27, including the modified Pink/Blue route and an option which avoided ancient woodland, were selected for an investment case assessment. The sustainable transport measures were assumed would be provided alongside each option. The two dual carriageway bypass options were evaluated and it was concluded that an investment case existed for a dual carriageway bypass at Arundel.

[12] The Multi-Modal Study programme was an outcome of the Government's strategic review of the roads programme, as described in "A New Deal for Trunk Roads", published by DETR (now DfT) in July 1998. This review was done in the context of the Government's White Paper "A New Deal for Transport – Better for Everyone", published earlier that year.

[13] Highways Agency, "A27 Corridor Feasibility Study," February 2015. [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/409062/a27-report-3-inv-cases-report.pdf. [Accessed 20 June 2019].

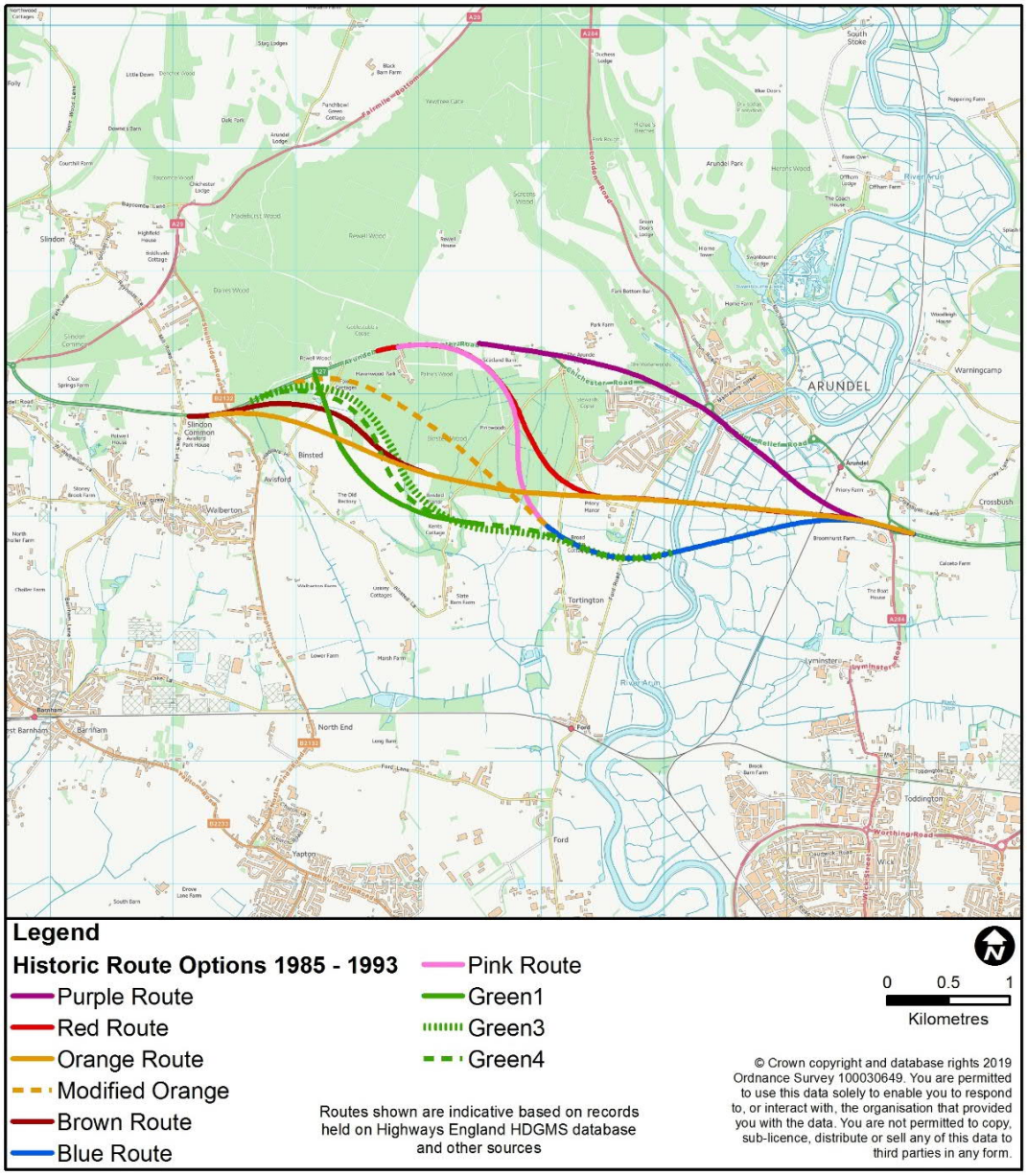


Figure 1-2 - Historic Options 1987 to 1993

1.4.1.2 The A27 Feasibility Study also informed the Pre-project Strategy, Shaping and Prioritisation of the Scheme, at the start of Highways England's Project Control Framework (PCF) illustrated in Figure 1-3. The PCF Stage 0 was completed at the end of 2015 by WSP, which recommended consideration of seven options at the start of the Options Phase.

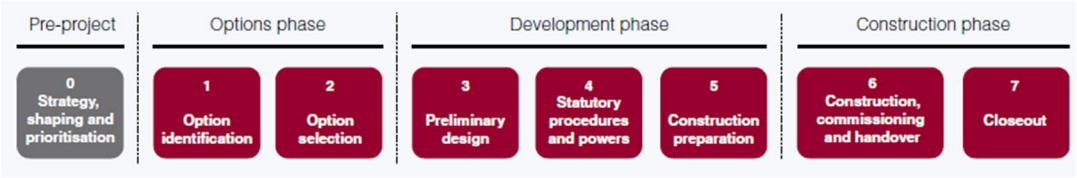


Figure 1-3 - Highways England Project Control Framework

1.4.1.3 Highways England then commissioned WSP in 2016 to undertake the Options Phase for the scheme (PCF Stages 1 and 2). A non-statutory public consultation was held between August and October 2017 on three route options following which a PRA was made in May 2018.

1.4.1.4 Following the PRA, Highways England began carrying out further studies and surveys of the then preferred route and surrounding area to progress preliminary design for the Scheme.

1.4.1.5 In October 2018, Highways England announced that a further, non-statutory public consultation would be undertaken on the Scheme (the Further Consultation) and that the Scheme would return to PCF Stage 2 (Option Selection).

1.4.1.6 Through the additional studies and surveys mentioned in paragraph 1.4.1.4 above, Highways England came across new and important information. Highways England wished to ensure that the decision on the PR is made taking this new information into account and that consultees are given a fair opportunity to comment on the options on the basis of the information available and to ensure continued engagement on project planning and development.

1.5 Purpose and Structure of the Report

1.5.1.1 The purpose of the SAR is to:

- Bring together the traffic, economic, safety, operational, technical, maintenance and environmental assessments undertaken during the further PCF Stage 2, for the six route options presented at the Further Consultation
- Provide a summary of the Report for the Further Consultation
- Set out the conclusions from this work and recommend a preferred Option.

1.5.1.2 The Interim SAR is structured into the following chapters:

- Chapter 1 – Introduction
- Chapter 2 – Planning Factors and Brief
- Chapter 3 – Existing Conditions

- Chapter 4 – Environmental Status
- Chapter 5 – Do Minimum Scenario
- Chapter 6 – Alternative Options
- Chapter 7 – Further Alternative Options
- Chapter 8 – Description of Options
- Chapter 9 – Summary of Traffic Appraisal
- Chapter 10 – Summary of Economic Appraisal
- Chapter 11 – Summary of Social and Distributional Appraisal
- Chapter 12 – Summary of Environmental Assessment
- Chapter 13 - Safety Assessment
- Chapter 14 - Operational, Technology and Maintenance Assessments
- Chapter 15 - Appraisal Summary
- Chapter 16 – Summary of Public Consultation
- Chapter 17 – Identification of Preferred Route
- Chapter 18 - Conclusion

Abbreviations

Abbreviations	Explanation
DCO	Development Consent Order
IDC	Investment Decision Committee
PCF	Project Control Framework
PR	Preferred Route
PRA	Preferred Route Announcement
NPA	National Park Authority
RIS	Road Investment Strategy
SAR	Scheme Assessment Report
SoS	Secretary of State
SoCoMMS	South Coast Multi Modal Study

Glossary

Term	Definition
Development Consent Order	The means of applying for consent to undertake a Nationally Significant Infrastructure Project (NSIP). NSIPs include, for example, major energy and transport project and requires development consent to be granted by the relevant Secretary of State, as defined by the Planning Act 2008.
Dual Carriageway	A road that has two separated carriageways for travel in opposite directions.
Dual 2 lane Carriageway	A road that has two separated carriageways for travel in opposite directions with 2 lanes in each direction
Grade Separated Junction	A Grade Separated Junction is a junction where the intersecting roads are separated at different heights, usually be a bridge, so that traffic flows do not intersect one another. For the A27 Arundel Bypass only traffic on the proposed A27 would be free flowing.
Multi Modal Study	The Multi-Modal Study programme was an outcome of the Government's strategic review of the roads programme, as described in "A New Deal for Trunk Roads", published by DETR (now DfT) in July 1998. This review was done in the context of the Government's White Paper "A New Deal for Transport – Better for Everyone", published earlier that year.

Term	Definition
Project Control Framework	A joint Department for Transport and Highways England approach to managing major projects. The Framework comprises a standard project lifecycle; standard project deliverables; project control processes and governance arrangements
The Scheme	The A27 Arundel Bypass
Road Investment Strategy	The long-term strategy to improve England's motorways and major A roads. The first RIS (known as RIS1) was published in 2014 and covers the period 2015-2020. A second RIS (RIS2) was published in 2015, and covers the post-2020 period.

A27 Arundel Bypass Scheme Assessment Report

Chapter 2 – Planning Factors and Brief

October 2020

CONTENTS

2 Planning Factors

2.1 Introduction

2.1.1 Background

2.1.1.1 The Scheme is defined as a Nationally Significant Infrastructure Project (NSIP) and will seek development consent under the provisions of the Planning Act 2008 (as amended) ('PA2008'). The Scheme involves the construction, improvement or alteration of a highway as per section 14(1)(h) of PA2008 (which are the responsibility of the Secretary of State, via Highways England, as the Strategic Highways Company). The Scheme lies wholly within England and will exceed the qualifying thresholds set out in section 22(2) and (4) of the PA2008, and hence would likely meet the definition of an NSIP.

2.1.1.2 This chapter provides an overview of the legislation and planning policy which is the starting point for consideration of a national network transport project and other relevant policy to the scheme. Relevant European Directives, UK legislation and national policy that will need to be complied with as part of an application for development consent is set out.

2.1.1.3 The Department for Transport's requirements for the A27 Arundel Bypass scheme is set out in the Client Scheme Requirements (CSRs). They cover a high-level definition of the transport challenges and issues, objectives, project outputs and value for the scheme.

2.2 Planning Brief

2.2.1 Client Scheme Requirements (CSRs)

2.2.1.1 The objectives of the scheme are defined in the seven CSRs and detailed objectives as follows:

High Level Objectives

- Improve the safety of travellers along the A27 and consequently the wider local road network.
- Ensure that customers and communities are fully considered throughout the design and delivery stages.
- Improve capacity of the A27 whilst supporting local planning authorities to manage the impact of planned economic growth.
- Reduce congestion, reduce travel time and improve journey time reliability along the A27.

- Improve accessibility for all users to local services and facilities.
- Deliver a scheme that minimises environmental impact and seeks to protect and enhance the quality of the surrounding environment through its high-quality design.
- Respect the South Downs National Park and its special qualities in our decision-making.

Detailed Objectives

1. Improve the safety of travellers along the A27 and consequently the wider local road network:

- Along the Arundel section of the A27 route. The A27 through Arundel has a higher than average accident rate due to its single carriageway component and multiple junctions.
- On the wider local road network caused by longer distance traffic avoiding congestion on the A27.

2. Throughout the design and delivery stages, the scheme should ensure that customers and communities are fully considered. Specifically, this should include:

- Understanding the needs and views of all segments of customers (including vulnerable users), stakeholders and partners
- Responding to those needs and views such that the end product delivers an improved customer experience
- Assessing the impact of works on road users and communities, minimising disruption and delivering appropriate mitigation measure. The assessment should look at issues through customers' eyes.

3. Improve capacity of the A27 whilst supporting local planning authorities to manage the impact of planned economic growth:

- Improve regional connectivity, taking into account all modes of transport, and the resilience provided by the A27 route within the West Sussex coastal region in order to contribute positively to the economy of the Arun area.
- Facilitate the delivery of housing allocations within the Local Plans.

4. Reduce congestion, reduce travel time and improve journey time reliability along the A27.

5. To reduce the community severance caused by the A27 through Arundel by improving the links between local communities, to provide improved accessibility to local services and facilities, particularly for tourism and access to railway stations and bus services.

6. To deliver a design that reflects the quality of the landscape and setting of Arundel that takes advantage of opportunities to minimise the adverse environmental impact of new construction, including habitat loss and takes into account the following objectives:

- plan for climate change;
- work in harmony with the environment to conserve natural resources and encourage bio-diversity;
- protect and enhance countryside and historic and archaeological environments; and
- reduce air and noise pollution.

7. Respect the South Downs National Park and its special qualities in our decision-making. Recognising that any improvements would have a significant impact on the SDNP, and therefore to have regard in designing and evaluating improvement options to the National Park purposes and special qualities the SDNPA is seeking to preserve in addition to the specific requirements of the NN NPS (see page 5.150 to 5.154) and other applicable legislation in regard to National Parks.

2.3 UK Legislation and European Directives

2.3.1 Planning Act 2008 (PA2008)

2.3.1.1 As mentioned in paragraph 1.1.1.1, the Scheme is defined as an NSIP and will seek development consent under the provisions of the PA2008. This means the Scheme requires a Development Consent Order (DCO) to be granted by the Secretary of State, following a recommendation by the appointed Examining Authority.

2.3.1.2 The PA2008 under sections 42, 47 and 48 sets out the pre-application process for the consideration of applications for development consent. It requires the developer to carry out consultation before making an application. Once an application is made, there are statutory time limits placed on most stages of its consideration.

2.3.1.3 Section 104 of PA2008 prescribes that a decision on whether or not to grant consent must have regard to:

- Any National Policy Statement (NPS) which has effect in relation to the type of development.
- Any marine policy documents (if relevant).
- Any local impact reports.
- Any matters prescribed in relation to the type of development.
- Any other matters which are important and relevant.

2.3.1.4 In the case of highways, the Secretary of State must decide the application in accordance with any relevant national policy statement (in this case the National Policy Statement for National Networks[1] (NN NPS)), except to the extent that one or more of subsections (4) to (8) of section 104 PA2008 applies:

- (4) would lead to the United Kingdom being in breach of any of its international obligations
- (5) would lead to the Secretary of State being in breach of any duty imposed on the Secretary of State by or under any enactment (6) would be unlawful by virtue of any enactment (7) the adverse impact of the proposed development would outweigh its benefits (8) any condition prescribed for deciding an application otherwise than in accordance with a national policy statement is met.

2.3.2 Habitats Directive and Habitats Regulations

2.3.2.1 The Habitats Directive (92/43/EEC) and Wild Birds Directive (2009/147/EC) conserve particular habitats and species across the European Union by protecting a network of functionally linked sites. These are known as the Natura 2000 network. The UK is also obligated to protect these sites by virtue of a number of international agreements such as The Convention on Wetlands of International Importance, called the Ramsar convention.

2.3.2.2 The Conservation of Habitats and Species Regulations 2017 (Habitats Regulations) transpose into UK law the requirements of the Habitats and Wild Bird Directives. Habitats Regulations set out the iterative process by which plans, projects or programmes should be assessed by a "Competent Authority" (the Secretary of State for Transport in this case) as defined under section 7 of the Habitats Regulations, in order to ensure they do not have an adverse effect on the integrity of a European designated site. European sites include Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Wetlands of International Importance (Ramsar sites).

2.3.2.3 The stages of Habitat Regulations Assessment (HRA) process are:

1. **Stage 1 – Screening**: To test whether a plan or project either alone or in combination with other plans and projects is likely to have a significant effect on a European site;

[1] Department for Transport (December 2014) “National Policy Statement for National Networks.” Available [Online] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387223/npsnn-web.pdf [Accessed August 2019]

2. **Stage 2 – Appropriate Assessment**: To determine whether it can be ascertained, in view of the conservation objectives, that the plan or project (either alone or in combination with other projects and plans) would have no adverse effect on the integrity of a European site. If the potential for adverse effects on the integrity of a European site cannot be avoided, potential mitigation measures to alleviate those adverse effects should be proposed and assessed;

3. **Stage 3 – Assessment of alternative solutions**: Where it is not possible to ascertain no adverse effect on the integrity of a European site, but a decision maker is minded to proceed, notwithstanding the negative outcome to an appropriate assessment, it is first necessary to establish the absence of alternative solutions (e.g. alternative locations and designs of development); and,

4. **Stage 4 – Assessment of imperative reasons of overriding public interest** (**IROPI)**: Where no alternative solutions can be identified and where reasonable scientific doubt remains as to the absence of adverse effects on site integrity, authorisation may be granted in exceptional circumstances.

5. **Stage 5 – Compensatory measures**: These must be put in place to ensure the overall coherence of the network is protected.

2.3.2.4 The HRA will have to be provided as part of an application for development consent. Natural England is the statutory nature conservation body who will inform the Planning Inspectorate, regarding impacts on European designated sites. The Planning Inspectorate will report and make a recommendation on the HRA in order that the Competent Authority (Secretary of Statement for Transport, in this instance) can assess whether there would be a 'likely significant effect' as a result of the Scheme n any European sites as required by Regulation 63 of the Habitats Regulations.

2.3.3 Environmental Impact Assessment

2.3.3.1 The Environmental Impact Assessment (EIA) Regulations (The Infrastructure Planning (EIA) Regulations 2017) set out the process of environmental impact assessment for nationally significant schemes. This includes that the applicant may request a Scoping Opinion from the Planning Inspectorate, who will consult with a number of statutory consultees on the proposed scope of the assessment. The regulations also stipulate that scheme promoters of NSIPs must state in their Statement of Community Consultation how they will consult on Preliminary Environmental Information.

2.3.3.2 Schedule 4, Part 1 of the Regulations states the information which should be included in an environmental statement, principally:

- Description of the development.
- An outline of the alternatives studied.
- Description of the aspects of the environment likely to be affected.

- Description of the likely significant effects of the environment.
- Measures to reduce prevent and offset these effects.
- A non-technical summary.

2.3.3.3 The EIA Directive (2014/52/EU) was transposed into UK law on 16 May 2017.

2.4 National Policy

2.4.1 National Policy Statement for National Networks (NN NPS)

2.4.1.1 The NN NPS sets out Government policy for the need for, and delivery of, nationally significant road and rail projects. The NN NPS in chapter 2 states that the Government will deliver national networks that meet the long-term needs of the country and support a thriving and prosperous economy.

2.4.1.2 Chapter 2 of the NN NPS sets out the following strategic objectives:

- Networks with the capacity and connectivity and resilience to support national and local economic activity and facilitate growth and create jobs.
- Networks which support and improve journey quality, reliability and safety.
- Networks which support the delivery of environmental goals and the move to a low carbon economy.
- Networks which join up our communities and link effectively to each other.

2.4.1.3 It states a critical need to improve the road network to address congestion, providing safe, resilient and expeditious networks which support social and economic activity. These improvements may also address impacts of networks on quality of life and the environment (NN NPS paragraph 2.2). A well-functioning road network is stated as critical to supporting national and regional economies (NN NPS paragraph 2.13).

2.4.1.4 The Government's policy to address this need is to bring forward enhancements and improvements to the existing network. This includes improvements to trunk roads, in particular dualling of single carriageway strategic trunk roads to increase capacity and improve, safety, performance and resilience.

2.4.1.5 Chapter 3 of NN NPS sets the need for improvements to the road network in the context of wider Government policies. These include:

- Environment and social impacts: networks should be designed to minimise social and environmental impacts and improve quality of life; the principles of the National Planning Policy Framework (NPPF) and

Planning Practice Guidance, as well detailed policy set out in Chapter 5 of the NN NPS should be followed to mitigate effects.

- Emissions: the Government supports the switch to Ultra Low Emission Vehicles, and predicts that increases to emissions as a result of improvements to the road network will be very small as a result of current and future commitments to meet legally binding targets.
- Safety: the Government intends to remain a world leader in road safety, and scheme promoters are expected to take opportunities to improve road safety, employing the most modern and effective safety measures where proportionate.
- Technology: innovative technologies will be monitored for their benefits and risks, but are not expected to alleviate the need to address current congestion problems or negate the need for improvements to the road network.
- Sustainable transport: the Government expects applicants to use reasonable endeavours to address the needs of pedestrians and cyclists. This includes investing in locations where the national road network severs communities and acts as a barrier to cycling and walking by addressing historic problems, retrofitting solutions, and ensuring safety for cyclists on junctions.
- Accessibility: applicants should improve access wherever possible through delivering schemes which take all opportunities for improvements in accessibility for all users, including disabled users, of the strategic road network.
- Road tolling and charging: the Government's policy is not to introduce road pricing for key trunk roads on the strategic road network.

2.4.1.6 Chapter 4 sets out the assessment principles for the consideration of highway schemes. In particular, it states that subject to the detailed policies and protections in this NN NPS, and the legal constraints set out in PA2008, that there is a presumption in favour of granting development consent for NSIP projects, such as the proposed scheme.

2.4.1.7 When considering an application for development consent, the Secretary of State will consider its benefits including for economic growth, job creation, and environmental improvement. This will be considered against adverse impacts of the scheme including long-term cumulative impacts. Such applications are required to be supported by a business case prepared in accordance with the principles in The Green Book Central Government Guidance on Appraisal and Evaluation 2018.

2.4.1.8 NSIP projects subject to The Infrastructure Planning EIA Regulations 2017 should include an environmental statement with the application. As part of this, the impacts from reasonably foreseeable schemes should be considered in the assessment. The maximum extent of the project's possible impact should be assessed where there are details which are yet to be finalised. The policy also sets out that the application should provide sufficient information for the carrying out of an appropriate assessment by the Secretary of State for Transport, where proposals are likely to have a significant effect on a European designated site.

2.4.1.9 The NN NPS at paragraph 4.27 states that all projects should be subject to an options appraisal which should consider viable modal alternatives and other options.

2.4.1.10 The policy requires principles of good design to inform projects from their inception (NN NPS paragraph 4.28). The design should work to mitigate the impact of the project in terms of the environment, safety and sustaining operational efficiency. Proposed schemes which are fit for purpose and sustainable can contribute towards the area in which they are located; applicants should demonstrate how the design process has contributed to these aims.

2.4.1.11 Applicants must consider climate change adaptation in the siting, location, design, construction and operation of proposed schemes (NN NPS paragraphs 4.36 to 4.47). This includes demonstrating that there are no critical features that will be affected by the effects of climate change in the long term; this is to be based on the Government's climate change risk assessment and consultation with statutory bodies. The policy also sets out that pollution control, nuisance and statutory nuisance, safety, security, and health should be considered by applicants in the design of their schemes.

2.4.1.12 Chapter 5 of the NN NPS sets out the assessment framework against which the application will be considered. The contents of this chapter will be used by the decision maker to establish whether the applicant has considered the necessary areas of assessment. The areas which must be considered are outlined below:

- Air quality.
- Carbon emissions.
- Biodiversity.
- Waste management.
- Civil and military aviation and defence interests.
- Coastal change.
- Dust, odour, artificial light, smoke, steam.

- Flood risk.
- Land instability.
- The historic environment
- Land use including open space, green infrastructure, and greenbelt.
- Noise and vibration.
- Impacts on transport networks.
- Water quality and resources.

2.5 Other Relevant Policy and Strategy

2.5.1.1 In addition to the NN NPS, other documents which may be considered important and relevant to the scheme are summarised below.

2.5.2 National Planning Policy Framework (NPPF) (February 2019)

2.5.2.1 The NPPF provides a framework for the designation of local plans by local authorities and for the consideration of planning applications in England. The policy puts a presumption in favour of sustainable development at the heart of decision making for planning applications made to the local authority.

2.5.2.2 Paragraph 5 of the NPPF confirms that the framework does not contain any specific policies for nationally significant infrastructure projects. These are determined in accordance with the decision-making framework in the PA2008 and relevant national policy statements for major infrastructure, as well as any other matters that are relevant, which may include the NPPF. The NN NPS at paragraph 1.17 states that the overall strategic aims of the NPPF and the NN NPS are consistent, however, the two have differing but equally important roles to play. However, paragraph 3.3 of NN NPS expects applicants to avoid and mitigate environmental and social impacts of schemes in line with the principles set out in the NPPF and the Government's planning guidance.

2.5.3 Highways England Licence

2.5.3.1 The Highways England Licence[2], sets out the Secretary of State's statutory directions and guidance to Highways England. Sections 5.23 and 5.24 of the Highways England Licence set out the environmental conditions of the licence:

[2] Department for Transport (2015). Highways England Licence. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/431389/strategic-highways-licence.pdf [Accessed April 2019]

"*5.23 In complying with 4.2(g) and its general duty under section 5(2) of the Infrastructure Act 2015 to have regard to the environment, the Licence holder should:*

a. *Ensure that protecting and enhancing the environment is embedded into its business decision-making processes and is considered at all levels of operations;*
b. *Ensure the best practicable environmental outcomes across its activities, while working in the context of sustainable development and delivering value for money;*
c. *Consider the cumulative environmental impact of its activities across its network and identify holistic approaches to mitigate such impacts and improve environmental performance;*
d. *Where appropriate, work with others to develop solutions that can provide increased environmental benefits over those that the Licence holder can achieve alone, where this delivers value for money;*
e. *Calculate and consider the carbon impact of road projects and factor carbon into design decisions, and seek to minimise carbon emissions and other greenhouse gases from its operations;*
f. *Adapt its network to operate in a changing climate, including assessing, managing and mitigating the potential risks posed by climate change to the operation, maintenance and improvement of the network;*
g. *Develop approaches to the construction, maintenance and operation of the Licence holder's network that are consistent with the government's plans for a low carbon future;*
h. *Take opportunities to influence road users to reduce the greenhouse gas emissions from their journey choices.*

2.5.3.2 *5.24 The Licence holder must develop and implement strategic plans that demonstrate how it aims to meet its legal duties and other obligations with regard to the environment, including the requirements of 5.23, to be published to timescales specified in the Licence holder's Delivery Plan.*"

2.5.4 Road Investment Strategy (2015-2020)

2.5.4.1 The Road Investment Strategy (RIS) is a suite of documents prepared by the Department of Transport and Highways England which outlines a long-term programme to improve England's strategic road network. It outlines how opportunities to improve and transform the road network can be met, alongside addressing strategic imperatives such as economic growth and climate change. Fundamentally, the documents outline the vision for smooth, safe and reliable monitoring, sustainable roads and methods for fostering cutting edge technologies.

2.5.4.2 The RIS sets out eight 'performance areas' for improved performance. These form the basis of the Performance Specification, setting out specific expectations for the strategic road network over the period to 2020 (chapter 7). Performance areas relevant to the scheme include:

- Making 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 of the network.

2.5.5 Highways England Delivery Plan (2015-2020)

2.5.5.1 The Delivery Plan sets out how Highways England will deliver the five key strategic outcomes, measure success and identify goals and plans to keep improving customers' experience.

2.5.5.2 The Delivery Plan is committed to taking forward and developing solutions to the issues investigated in the feasibility studies undertaken in 2014, which included the A27 Feasibility Study. These studies examined some of the most notorious and long-standing congestion hotspots in the country, and sought to identify ways in which these could be tackled. With regards to A27 Arundel Bypass, the Plan states the intention to engage more widely with local stakeholders on the A27 bypass at Arundel. The Plan provides substantial investment to start tackling some long-standing environmental issues which include a bypass and junction improvements on the A27, whilst also developing sustainable transport measures at Arundel.

2.5.6 Defra, English National Parks and the Broads UK Government Vision and Circular (2010)

2.5.6.1 The guidance states:

‘there is a strong presumption against any significant road widening or the building of new roads through a (National) Park unless it can be shown there are compelling reasons for the new or enhanced capacity and with any benefits outweighing the costs significantly. Any investment in trunk roads should be directed to developing routes for long distance traffic which avoids the Parks’.

2.5.6.2 The above guidance is reiterated in the NN NPS at paragraph 5.152. The NN NPS at paragraph 5.148 also refers to this Defra guidance and that for significant road widening or building roads in National Parks and the Broads applicants are required to fulfil the requirements set out in the Defra guidance or successor documents.

2.5.7 South East LEP Strategic Economic Plan

2.5.7.1 The Strategic Economic Plan (SEP) published in March 2014 identifies key objectives that transport interventions can help to achieve. The A27 corridor is integral to the area's connectivity with the A23/M23 corridor and London. Specific mention is made of the A22/A27 Junction improvement need at Polegate and that the A27 is:

'not fit for purpose for carrying long distance strategic traffic, nor providing journey time reliability which is important in terms of the movement of people and good and is inhibiting potential growth.'

2.5.7.2 The SEP identifies the A22/A27 Growth Corridor as directly creating 1,400 jobs by 2020/21 and a further 800 by 2021/25. It will also directly deliver 725 homes by 2020/21 with a further 575 by 2020/25. Transport schemes will facilitate 9,240 jobs and 17,800 homes by 2020/21.

2.6 Sub-Regional and Local Planning Policy

2.6.1 West Sussex County Council Transport Plan 2011 -2026

2.6.1.1 West Sussex County Council (WSCC) published the third West Sussex Transport Plan for the years 2011 to 2026 in February 2011. The Plan provides the strategic direction for transport within West Sussex and aligns itself closely with other strategies.

2.6.1.2 The main objectives of the Transport Plan are to:

- promote economic growth
- tackling climate change
- provide access to services, employment and housing; and
- improve safety, security and health.

2.6.1.3 One of the highest priorities stated under section 1.2 of the Transport Plan is to improve the A27 trunk road and complementary public transport improvements to bottlenecks at Chichester, Arundel and Worthing to increase capacity, improve reliability, safety and increase the competitiveness of local businesses and attract investment.

2.6.1.4 The Transport Plan in section 1.4.1 notes that the A27 at Arundel *"experiences congestion during peak hours on weekdays and is a honey-pot destination at weekends, causing off-peak congestion on the edge of the SDNP. The unimproved section of the road was designed to be used by around a third of current traffic flows, the majority of which is through traffic. In addition to causing significant congestion at Arundel, this also leads to heavy traffic flows through nearby villages as vehicles divert to avoid the queues. The town is severed by the alignment of the A27 which passes through the south of the town with few crossing points. This has led to a number of casualties, including some killed or seriously injured, which have contributed to a poor safety record on this section."*

2.6.1.5 WSCC seek to tackle issues along the Strategic Road Network, including developing options (in conjunction with Highways England) to address key issues for Coastal and Rural West Sussex through dealing with congestion on the A27 at Chichester, Arundel and Worthing.

2.6.1.6 WSCC's Implementation Plan for Arun in section 2.2.1 of the Transport Plan is to tackle identified transport issues as and when funding becomes available and to ensure that regeneration aspirations of the coastal plain are delivered. WSCC will ensure that all new schemes and developments contribute and support increasing use of sustainable modes of transport; improve network efficiency in order to improve journey time and air quality; improve safety for all road users; discourage HGVs from using unsuitable roads and improving accessibility between communities within Arun District.

2.6.1.7 The Implementation Plan in section 2.2.2 of the Transport Plan states that major improvements to the A27 at Arundel, such as a bypass, to reduce congestion and rat-running, and to improve the safety record and community cohesion is a key priority.

2.6.1.8 The principle of major improvements to the A27 at Arundel is clearly supported in The West Sussex Transport Plan. The Plan identifies network efficiency, capacity, and safety concerns and seeks to work with Highways England to develop options to address the key issues for Arundel and the wider area whilst supporting economic development and growth. The Transport Plan does not state any preference for route options. There is therefore County level policy support for the principle and benefits of the Scheme.

2.6.2 South Downs National Park (SDNP) South Downs Local Plan (Adopted 2 July 2019)

2.6.2.1 The South Downs National Park Authority Local Plan was formally adopted on 2 July 2019. The adopted Local Plan replaces all existing planning policies across the National Park.

2.6.2.2 The South Downs Local Plan (SDLP) sets out how the National Park Authority will manage development over the next 15 years (SDLP paragraph 1.7). This is based on the statutory purposes and duty for national parks as specified in the Environment Act 1995: The National Park purposes are:

- To conserve and enhance the natural beauty, wildlife and cultural heritage of the area
- To promote opportunities for the understanding and enjoyment of the special qualities of the National Park by the public.

2.6.2.3 The National Park Authority also has a duty when carrying out the purposes:

- To seek to foster the economic and social well-being of the local communities within the National Park

2.6.2.4 Working in partnership with other Local Authorities (LAs) and other organisations, it also seeks to foster the economic and social well-being of local communities within the SDNP.

2.6.2.5 The SDLP notes at paragraph 1.10 that landscape is the key to all of the special qualities. The South Downs was designated as a National Park in recognition of its exceptional natural beauty, for the opportunities to learn about and appreciate its special qualities, and as a landscape of national importance.

2.6.2.6 The SDLP is ‘landscape-led’ rather than ‘development-led’ reflecting South Downs National Park Authority’s (SDNPA) remit of nurturing and protecting the SDNP’s special qualities. The emphasis placed on landscape needs also to be considered in the context of the NN NPS Section 5 noted above, which articulates the landscape importance of National Parks.

South Downs National Park Authority Position Statement on A27 route corridor

2.6.2.7 The Position Statement sets out the Authority's position in the case of any future transport infrastructure projects. In considering proposals the SDNPA will be *"mindful that the current state of congestion on the A27 can create secondary impacts within the National Park"* (paragraph 6 of the Position Statement). Where feasible, the primary impacts of any new schemes must be objectively assessed alongside potential secondary impacts. In assessing the specific impacts of any detailed options, the SDNPA (paragraph 7 of the Position Statement) will ask Highways England to use the framework of the seven Special Qualities (SQ)3 of the National Park. These are:

- Diverse, inspirational landscapes and breath-taking views
- Tranquil and unspoilt places
- A rich variety of wildlife and habitats including rare and internationally important species
- An environment shaped by centuries of farming and embracing new enterprise
- Great opportunities for recreational activities and learning experiences
- Well-conserved historical features and a rich cultural heritage
- Distinctive towns and villages, and communities with real pride in their area.

2.6.2.8 The SDNPA expects that any schemes which are ultimately proposed will (paragraph 8 of the Position Statement):

- Demonstrate that there is no alternative which would have avoided or had a lesser impact on the seven Special Qualities for which the National Park is nationally designated.
- Set out clearly, based on robust evidence, the nature and scale of these impacts.
- Demonstrate how these impacts would be mitigated or compensated for, bearing in mind that a National Park landscape is of national importance.

[3] All National Park Authorities are required by Defra to set out and describe the Special Qualities (SQs) for which the particular National Park landscape was designated and given national protected status. In the South Downs National Park these SQs were published in and formed the basis for the State of the National Park report 2012, informed the Partnership Management Plan 2014 and are informing the development of the Local Plan.

Roads in the South Downs - Enhancing the safety and quality of roads and places in the national park (2015)

2.6.2.9 The guide looks to raise awareness of best practice for rural road design and management for highway authorities, the SDNPA and local communities. It is intended to influence decision-making, training and investment and raise awareness of opportunities and challenges in reconciling traffic movement with the inherent qualities and purposes of the National Park.

2.6.2.10 The guide highlights the role of roads in forming the immediate foreground for most visitors to the Park, and the influence of legislation, duties and policies for road design in determining expectations, driver behaviour and values.

2.6.2.11 It is recognised that busy transport highways remain part of the SDNP, but that their design and treatment must take account of the Park purposes. Single purpose transport corridors offer opportunities to enhance the SDNP with practical measures to minimise the impact of such routes through quieter road surfaces, careful siting of signs, low-level lighting and drainage capable of encouraging wildlife through reed beds and holding ponds.

2.6.3 Arun District Council Local Plan

2.6.3.1 The Arun Local Plan 2011-2031 was adopted on 18th July 2018 and replaces the Arun Local Plan 2003 and any saved policies. The Arun Local Plan 2011-2031 sets out the Council's vision for the development of Arun up to 2031.

2.6.3.2 Key strategic objectives of the Arun Local Plan are (Arun Local Plan Table 4.1 Strategic Objectives):

- To strengthen Arun's economic base and provide local job opportunities by increasing, diversifying and improving the quality of employment through the provision of appropriate employment sites, better infrastructure including road access.
- To reduce the need to travel and promote sustainable forms of transport.
- To plan for climate change and work in harmony with the environment to conserve natural resources and increase biodiversity.
- To plan and deliver a range of housing mix and types in locations with good access to employment, services and facilities to meet the District's housing requirements and the need of Arun's residents and communities both urban and rural.
- To protect and enhance Arun's outstanding landscape, countryside, coastline, historic, built and archaeological environment, as well as the

setting of the South Downs National Park, thereby reinforcing local character and identity.

- To create vibrant, attractive, safe and accessible towns and villages that build upon their unique characters to provide a wide range of uses.
- To promote strong, well-integrated and cohesive communities, through the promotion of healthy lifestyles, provision of good quality accessible community facilities and a safe environment, which delivers an enhanced quality of life to all.

Abbreviations

Abbreviation	Explanation
CSR	Client Scheme Requirements
DCO	Development Consent Order
EIA	Environmental Impact Assessment
HRA	Habitat Regulations Assessment
IROPI	Imperative reasons of overriding public interest
LA	Local Authorities
NN NPS	National Policy Statement for National Network
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
PA2008	Planning Act 2008
RIS	Road Investment Strategy
SAC	Special Areas of Conservation
SEP	Strategic Economic Plan
SDLP	South Downs Local Plan
SDNP	South Downs National Park
SDNPA	South Downs National Park Authority
SPA	Special Protection Areas
SQ	Special Qualities
WSCC	West Sussex County Council

Glossary

Term	Explanation
The Scheme	The A27 Arundel Bypass

A27 Arundel Bypass Scheme Assessment Report

Chapter 3 – Existing Conditions

October 2020

CONTENTS

LIST OF TABLES

LIST OF FIGURES

3 Existing Conditions

3.1 Introduction

3.1.1.1 This Chapter describes existing[1] transport conditions related to the Scheme. Chapter 4 describes existing environmental conditions.

3.1.1.2 The current extent of the Scheme and the Scheme Study Area is shown in Figure 3-1. This is the area within which all the Scheme options described in Chapter 8 are located. Further details of the coverage of the A27 transport model is provided within the A27 Arundel PCF Stage 2 Further Consultation Combined Modelling and Appraisal Report[2].

3.1.1.3 The Scheme is located in Arun District within West Sussex on the south coast of England. The Scheme is primarily within the parishes of Walberton and Arundel but extends into the neighbouring parishes of Slindon and Crossbush and Lyminster. The northern half of Arun District falls within the South Downs National Park (SDNP). The SDNP Authority is the planning authority for the SDNP.

3.2 Locality

3.2.1.1 The small historic market town of Arundel is located within the Arun District of West Sussex in the South of England. The town is positioned in a steep valley on the border of the SDNP. The SDNP covers an area of 1600km^2, extending from Winchester in the west to Eastbourne in the east[3]. The location of Arundel in a wider south-east England geographical context is presented in Figure 3-2.

3.2.1.2 The largest population centre in the surrounding region is the city of Brighton and Hove, located approximately 29km to the east of Arundel, with a population of over 270,000[4]. Other nearby major urban areas include Littlehampton to the South, Worthing to the East, Bognor Regis to the south-west and Portsmouth and Chichester to the west.

[1] Unless otherwise specified, the baseline information relating to transport conditions is based on the year 2015

[2] HE551523-WSP-GEN-SWI-RP-TR-00017-P03 – A27 Arundel Bypass, PCF Stage 2 Further Consultation Combined Modelling and Appraisal Report (August 2019)

[3] https://www.southdowns.gov.uk

[4] https://www.nomisweb.co.uk (based on 2011 census)

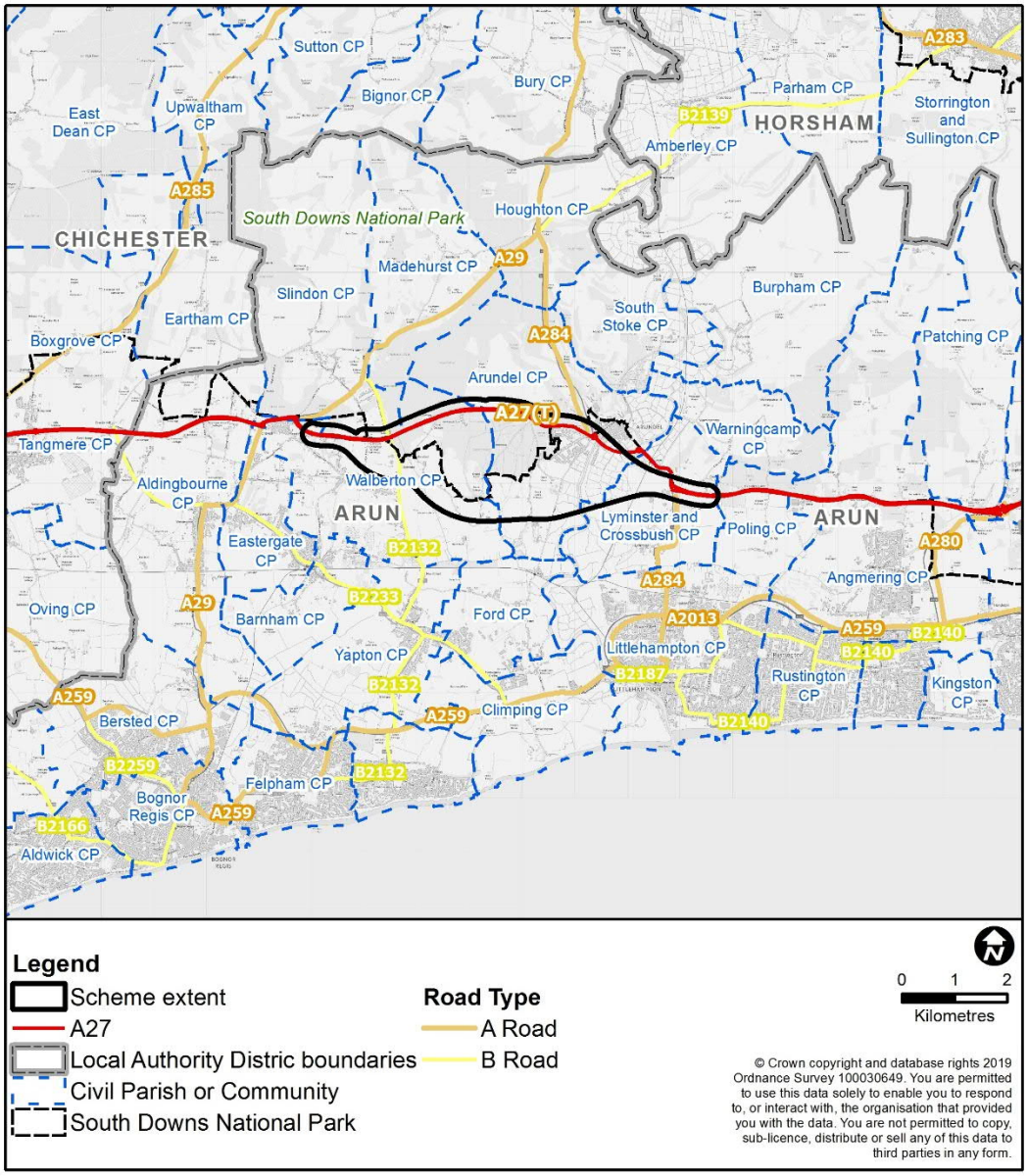


Figure 3-1 - Scheme Extents and General Scheme Study Area

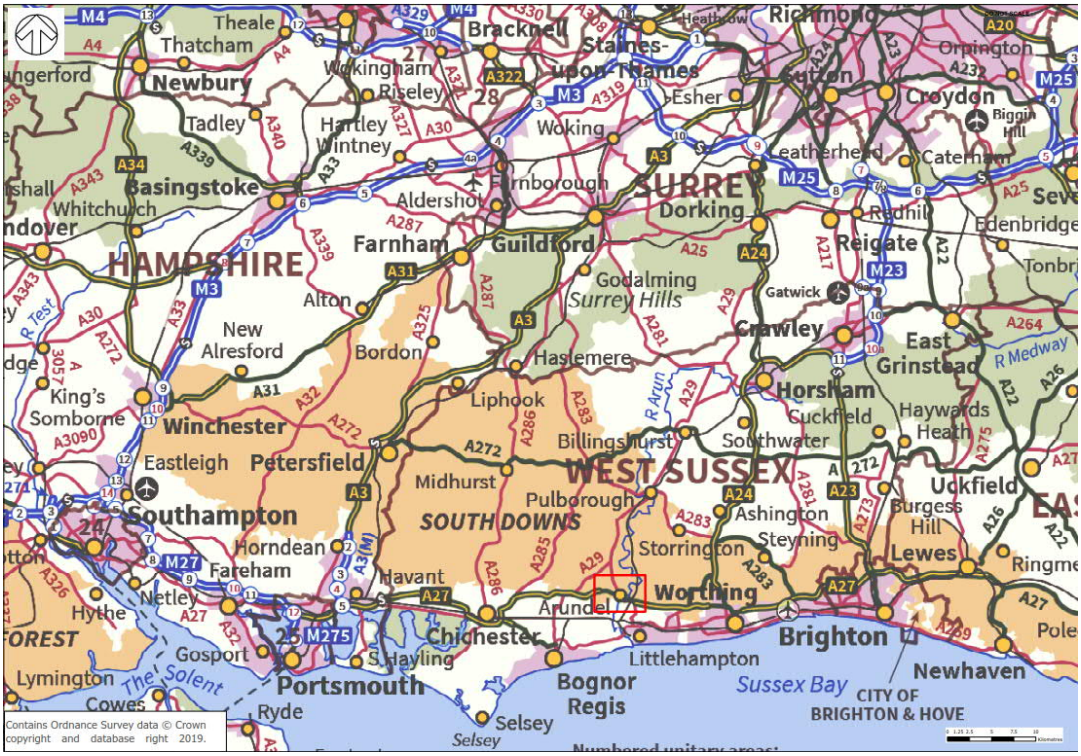


Figure 3-2 – Wider Geographical Context

3.2.1.3 There are a number of established major employment areas within the region, one of which is the Gatwick Diamond, a diamond-shaped geographical area, with Gatwick Airport at its centre, comprising around 45,000 businesses, many of which are global companies. The Gatwick Diamond contributes £24bn Gross Value Added (GVA[5]), to the UK economy and performs well above the national average on a range of different economic indicators, such as its levels of productivity, its share of high-skilled jobs, and its track record at attracting foreign investment[6]. The Gatwick Diamond has strong commuter links to towns along the south coast. Other major employment areas are situated in the cities of Portsmouth and Brighton and Hove for example, as well as the large town of Worthing.

3.2.1.4 Tourism is a key driver of the economic activity in the region, with West Sussex as a county receiving over 17 million visitor days per year. This contributes over £500 million to the local economy[7] .

[5] Regional Gross Value Added is the value generated by any unit engaged in the production of goods and services (https://www.ons.gov.uk/economy/grossvalueaddedgva)

[6] http://www.gatwickdiamond.co.uk/media/95386/Gatwick-Diamond-Business-Plan-2018-to-2021.pdf

[7] The GB Day Visitor Statistics 2015, Visit Britain

3.2.1.5 Pockets of deprivation are found within the county of West Sussex, especially in coastal areas. These areas suffer from a skills shortage and lack of accessibility to higher value employment sectors within the county. Some of the most deprived areas are the wards of River and Ham in Littlehampton, with three Lower Super Output Areas (LSOA's[8]) in these two wards falling within the UK's top 10% most deprived areas[9]. As a result of this, regeneration is underway, not just in Littlehampton, but in Bognor Regis, Shoreham and Newhaven. In Bognor Regis for example, there are proposals to develop a creative/digital hub through the implementation of 108,500m2 of employment space, generating over 4,000 jobs.

3.2.1.6 Arundel has a population of approximately 3,500 people, with an average age of 47.1 years[4]. The town is a popular tourist destination for its location on the border of the SDNP and for its heritage which includes three scheduled monuments, one of which is Arundel Castle and many listed buildings including Arundel Cathedral.

3.2.1.7 Employment within Arundel itself is focused on the tourism industry, with restaurants, shops, and a museum featuring alongside the historical attractions. Situated just outside of Arundel are a number of industrial areas. These include Ford Lane, Ford Road and Rudford Industrial Estates all of which are situated adjacent to Ford Road.

3.3 Existing Transport Network

3.3.1.1 This section describes the existing transport network within the wider region and the local area, including the provision for highway, public transport, and Walking, Cycling and Horse Riding (WCHR) users.

3.3.2 Highway network

3.3.2.1 The location of the scheme in the context of the wider strategic network is depicted in Figure 3-3.

[8] A geographical boundary used in the production of statistics collected via the UK census

[9] WSCC Public Health Research Unit - West Sussex Joint Strategic Needs Assessment Briefing - Indices of Deprivation 2015 (Arun) (https://jsna.westsussex.gov.uk/assets/core/Briefing-Indices-of-Deprivation-2015.pdf)

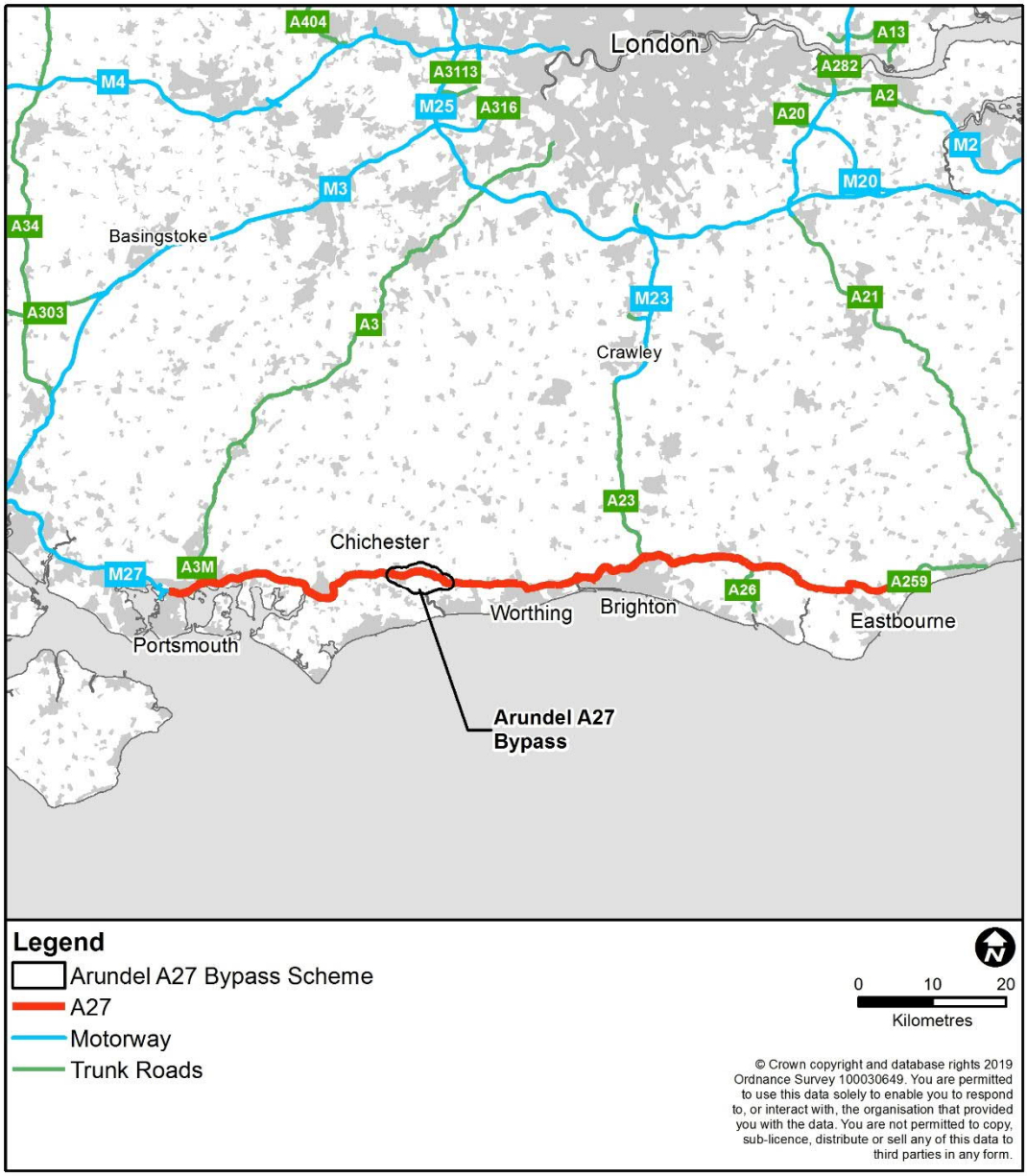


Figure 3-3 – A27 in the Context of the Wider Strategic Road Network

3.3.2.2 The A27 is the only east-west trunk road south of the M25. It links many of the towns and cities along the south coast, including Portsmouth, Havant, Chichester, Arundel, Worthing, Adur, Brighton and Hove, Lewes, and Eastbourne, serving a combined population of around 1.2 million people, as well as a large number of businesses. The A27 also provides access to the wider Strategic Road Network (SRN[10]) including the A3(M), M27 and A23 / M23. The A27 is therefore an important corridor for both longer distance travel and local traffic.

3.3.2.3 The A272 provides a single carriageway parallel route between Winchester and the Haywards Heath area along a similar east-west alignment, to the north of the A27. The route passes extensively through the SDNP. The A259 provides a predominantly urban route between Chichester and Brighton and Hove and continues to the east. Neither route is considered to offer a genuine alternative to the A27 as a strategic long-distance route.

3.3.2.4 Figure 3-4 presents the extent of the local road network within the influence of the A27 Arundel Bypass scheme extents.

3.3.2.5 Locally to Arundel, there are two east-west routes that are used as alternatives to particular sections of the A27. The first is located to the north, the A29 / B2139 / A283, which passes through the SDNP and the villages of Storrington and Steyning. To the south is the B2233 / A259 which runs through Eastergate, Barnham, Yapton and Climping, north of Littlehampton and then on to Goring-by-Sea and Worthing.

3.3.2.6 Other significant roads within the study area include the A29, which intersects with the A27 to the east of Fontwell, at an uncontrolled at-grade roundabout. The A284 connects with the A27 in two locations, at the Ford Road five-arm roundabout and at the Crossbush junction. It is the primary route used for those in Littlehampton, Wick and Lyminster to travel to and from locations to the north. Other local roads include the B2130 to the north of the town and the B2233 to the south.

[10] The Strategic Road Network is made up of motorways and trunk roads

3.3.2.7 The section of the A27 from Crossbush to Ford Road roundabout caters for both east-west movements on the A27 and north-south movements on the A284 which links Littlehampton with the A29 near Madehurst and provides a bypass to the historic town and former route of the A27. The town has since grown to the south-west along the A27 corridor between the A27 Chichester Road and the Ford Road and this residential area is severed from the town centre by the high traffic flows on this section of the A27 and by the lack of controlled pedestrian crossing facilities.

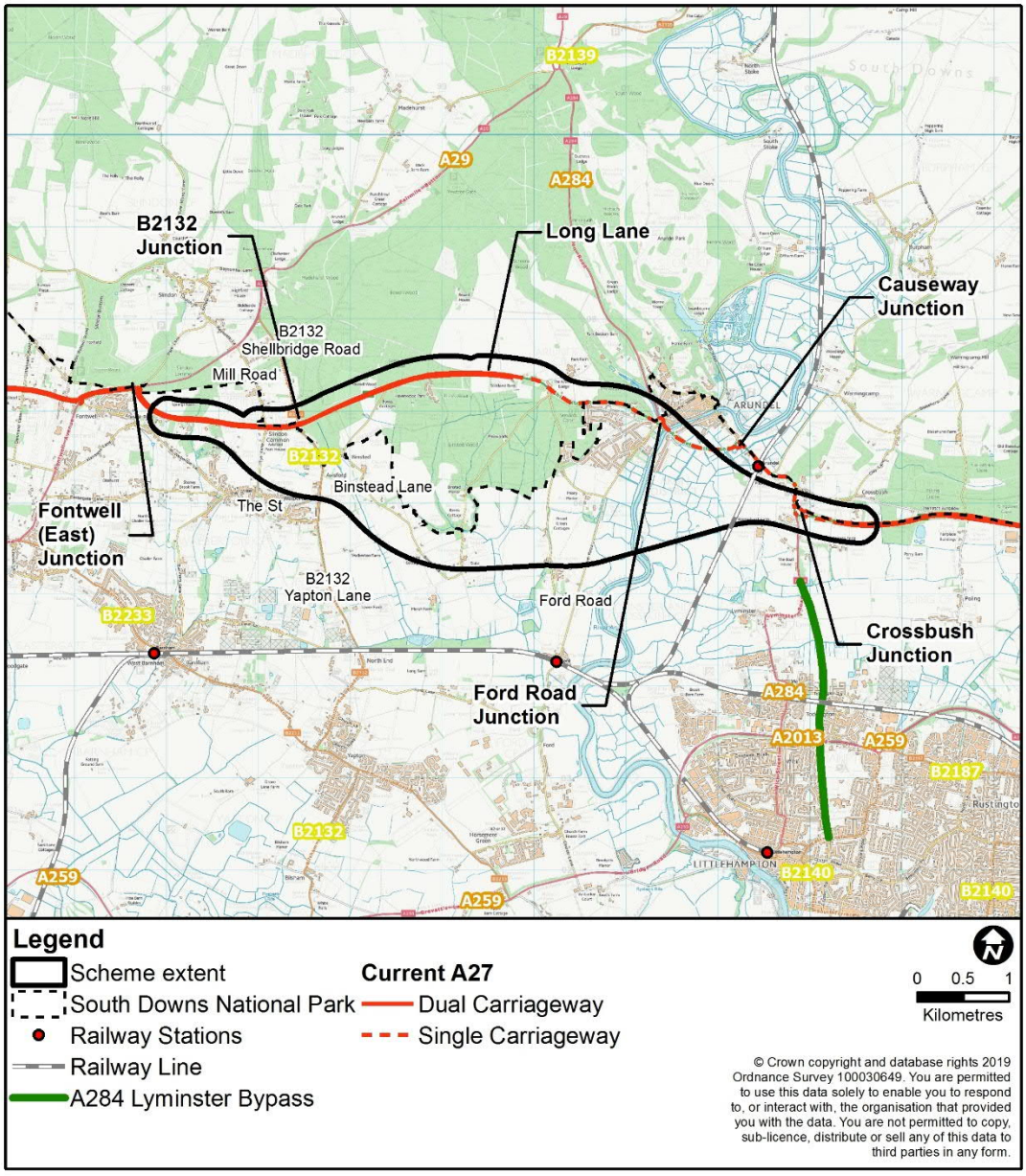


Figure 3-4 - Existing A27 within the Scheme Extents

3.3.3 Rail

3.3.3.1 Arundel railway station is located adjacent to the A27 to the south-east of the Causeway Roundabout, approximately a 13-minute walk from Arundel town centre. The station has pay and display car parking, along with two platforms and two entrances. The station is located on the Arun Valley railway line with the Southern Rail service operating between London and Bognor Regis. Trains travel approximately every half an hour to London Victoria and Gatwick Airport, taking between 60 and 90 minutes[11].

3.3.3.2 Other nearby rail stations are in Ford, Barnham, Littlehampton, Amberley and Angmering. Ford and Barnham stations, situated on the West Coast Railway line, are important interchanges for other destinations, including Portsmouth Harbour, Worthing and Brighton, with departures occurring approximately every 20 minutes.

3.4 Existing A27 Crossbush to Fontwell

3.4.1.1 Figure 3-4 shows the existing A27 within the Scheme extents at Arundel. It is approximately 8.5km in length, from the approach to the Crossbush junction to the east of Arundel, and Fontwell to the west.

Crossbush Junction

3.4.1.2 The existing Crossbush Junction was developed as a temporary end to the A27 Crossbush bypass[12], waiting for the completion of a bypass to Arundel. It comprises a partially signal controlled gyratory with the A284 Lyminster Road and is a major junction on the A27 providing access to Littlehampton.

3.4.1.3 On the westbound approach the A27 is a dual carriageway with a national speed limit road (70mph), dropping to 50mph closer to the Crossbush junction, and 40mph at the base of the ramp up to the junction. At the west bound approach, the A27 bound traffic is directed to one lane with the other lane for the A284 bound traffic. The eastbound A27 approach and A284 approach are both single carriageway with 40mph speed limits. Access to the Crossbush services area is provided to the south of the junction off the A284. It is a combination of the lane reduction, turning traffic and the alignment, that generates congestion at peak times. During peak times extensive congestion occurs, particularly on the A27 west bound in the morning peak (see section 3.5.3).

[11] https://www.thetrainline.com/stations/arundel

[12] A27 Corridor Feasibility Study – Report 3 of 3: Investment Cases, Highways Agency, (February 2015), section 5.2.5

3.4.1.4 The junction is fully lit and has a continuous footway between the A284 and A27. Immediately to the east of the junction is a gap in the central reserve which provides an informal crossing between two public footpaths.

Crossbush junction to Causeway Junction

3.4.1.5 The 1km section between the Crossbush Junction and the Causeway Junction is single carriageway with a 40mph speed limit and has street lighting throughout. There are four minor priority junctions including the access to the Premier Inn Hotel, Crossbush Lane, Angmering Park Estate and the Arundel Station. In addition, there are numerous direct accesses to private properties and fields. This section of the route has a winding alignment as it drops down the valley side of the River Arun. The alignment is further constrained at the Arundel Station Bridge which carries the A27 over the Arun Valley Railway. Heading west there are dramatic open views of Arundel Castle and Cathedral.

3.4.1.6 There is a continuous footway between the Crossbush and Causeway junctions which switches between carriageways at two uncontrolled crossings with central islands. A signal controlled crossing is provided immediately to the east of the Causeway junction, providing access from private properties adjacent to the west bound A27 to Arundel town centre. Pedestrian and cycle access to Arundel Station is provided by a shared use footway cycleway adjacent to the eastbound A27 with access under the A27 at the Arundel Station Bridge.

3.4.1.7 The Causeway Junction is a three-armed roundabout between the Causeway, which provides access to Arundel, and the A27. A footway runs around the outside of the roundabout with uncontrolled crossings at each of the three arms of the roundabout. The footway adjacent to the Causeway and A27 westbound carriageway has been widened in 2015 to provide the shared footway cycleway.

Causeway Junction to Ford Road junction

3.4.1.8 This section of the existing A27 crosses the floodplain of the River Arun and on a low embankment. It was constructed in the 1970s as a bypass to the south of the historic town centre of Arundel. It is single carriageway of about 0.85km long and has a 40mph speed limit with street lighting throughout. There is one minor junction with Fitzalan Road and a continuous footway adjacent to the west bound carriageway.

3.4.1.9 The Fitzalan Arundel bridge carries the existing A27 over the River Arun and Fitzalan Road. The bridge provides sufficient clearance to the River Arun, for navigation. It has a restricted headroom over Fitzalan Road (signed as 2.8m). A footway is provided under the bridge adjacent to Fitzalan Road and footpath (FP) 206 passes under the bridge on the west bank of the river. Ramps provide access to the footway on the A27 on both sides of the bridge. The existing A27 vertical alignment at the bridge is humped, restricting forward visibility.

3.4.1.10 The Ford Road Junction is an existing five-arm roundabout at the intersection of the existing A27, A284, Ford Road and Maltravers Street. The residential area of Arundel south is located to the south of the junction and the historic town centre to the north. There are uncontrolled pedestrian crossing points across each of the five arms of the roundabout linking a footway located around the outside of the roundabout with links to FP 206. A bus stop is provided on both carriageways of the A27 east arm of the roundabout. The high traffic flows at the junction and on the existing A27 together with the poor facilities for pedestrians and cyclists contribute to severance.

3.4.1.11 The A27 between Crossbush and Ford Road as well as carrying through traffic also carries traffic traveling between sections of the A284, which links Littlehampton with the A29 near Madehurst and traffic local to Arundel. The reduction in road standard and poor alignment, coupled with the presence of two at-grade roundabouts gives rise to excess congestion at peak times, above average safety problems and the occurrence of rat running to avoid delays.

Ford Road Junction to Long Lane

3.4.1.12 This section of the existing A27 is single carriageway for approximately 1.7km before transitioning to dual carriageway near Long Lane. It has a 40mph speed limit for approximately 700m east of the Ford Road Junction and is then derestricted (60mph). There are four minor priority junctions with Arundel District Hospital, Jarvis Road, Binsted Lane and at the access to White Swan Hotel. In addition, there are direct accesses to private properties and farm accesses. The road is lit between the Ford Road junction and the access to the Arundel & District Community Hospital. This section of the route has a winding alignment as it climbs the valley side of the River Arun.

3.4.1.13 For approximately 0.75km the existing A27 is located on the boundary of the SDNP before entering the SDNP to the west of the junction with Jarvis Road. Ancient woodland is located either side of the road including at Waterwoods and Stewards Copse.

3.4.1.14 There is a continuous footway which switches carriageways at two uncontrolled at-grade crossings. The footway is in poor condition and in places, both narrow and directly adjacent to the existing A27 carriageway. The public PRoW intersects with the existing A27 at two locations. Access between them is provided via the footway adjacent to the existing A27 and the uncontrolled crossings. There are bus stops located east of the junction with Jarvis Road.

Long Lane to Fontwell Junction (east)

3.4.1.15 This section of the existing A27 is dual carriageway with a de-restricted (70mph) speed limit and is signed as a clearway (no stopping). There are three minor junctions with gaps in the central reserve located at Havenwood Park access, B2132 Yapton Lane junction and Copse Lane Junction. B2132 Yapton Lane junction has significant traffic movements to and from the A27 during the AM and PM peak periods[13]. In addition, there are four minor junctions with access to one carriageway of the existing A27 only. Three are located on the westbound carriageway at Binsted Lane, Tye Lane and Arundel Road and one on the eastbound carriageway at Mill Road. There are also many private accesses and farm accesses directly off the A27 on both carriageways. The route leaves the SDNP at the B2132 Yapton Lane/Shellbridge Road Junction.

3.4.1.16 There is a continuous footway adjacent to the west bound carriageway from Ford Road Junction up to Havenwood Caravan park, where a gap in the central reserve provides pedestrian access to bus stops located on both carriageways. The PRoW network intersects with the existing A27 at five locations with four informal crossing points with gaps in the central reserve. In addition, there are informal pedestrian crossing points with gaps in the central reserve at the Mill Road/Tye Lane Junction and B2132 Yapton Lane/Shellbridge Road Junctions.

[13] A27 Arundel traffic surveys, WSP (2016 and 2019)

3.4.2 Existing Structures

3.4.2.1 The following structures are located on the existing A27 Scheme extents between Crossbush and Fontwell (East) Junctions:

- A27 Lyminster Road Bridge at the existing Crossbush junction.
- Arundel Station Bridge carries the existing A27 over the Arun Valley Railway line.
- Spring Ditch Culvert takes Spring Ditch under the existing Ford Road roundabout.
- Fitzalan Arundel bridge carries the existing A27 over Fitzalan Road, the River Arun and FP 206. There is a restricted headroom for Fitzalan Road of 3.02m with advanced warning signs advising low headroom of 2.80m.

3.4.3 Existing Drainage

3.4.3.1 Information contained in the Highways England Drainage Data Management System (HADDMS) shows that the drainage system for the existing A27 comprise mainly of gullies and pipework, manholes, filter drains, ditches, edge channels, fin drains and soakaway trenches.

3.4.3.2 The hydraulic performance and capacity of the surface water drainage system, together with the system's ability to effectively treat surface water runoff is unknown at this stage.

3.4.3.3 Records on the existing drainage network of the local road network would be obtained from West Sussex County Council in PCF Stage 3 (Preliminary Design) to inform the design of the selected preferred route.

3.4.4 Existing Lighting

3.4.4.1 Road lighting is provided on the A27 from south of the Crossbush junction to the access to Arundel Community Hospital to the west of Arundel. Road lighting is also provided at Fontwell (East) Roundabout, extending to the junction with Copse Lane.

3.4.5 Existing Technology

3.4.5.1 The following technology assets are provided along the existing A27:

- Traffic signals at the existing Crossbush Junction
- Traffic Monitoring Units (TMUs) electronic loops[14]

3.4.6 Existing Walking Cycling and Horse Riding (WCHR) Facilities

3.4.6.1 The following WCHR facilities are located along the single carriageway section of the existing A27 within the Scheme extents:

- Uncontrolled crossings with refuge – two locations between Crossbush junction and Arundel station, three at the Causeway Junction, three at the Ford Road Junction and two between Ford Road roundabout and the White Swan Hotel
- Signal controlled pedestrian crossing - located to the west of Arundel station
- Shared cycle/pedestrian footway – from Arundel station to the west of the Causeway Roundabout.
- Footway located alongside one side of the existing A27 from the Crossbush junction up until Havenwood Park (with street lighting up to Arundel Community Hospital).

3.4.6.2 The condition of the footway along the existing A27 within the extents of the Scheme is variable, poorly lit and narrow in places. This, together with the fact that the footway is not continuous without using uncontrolled crossings, discourages their use and contributes to severance of communities in Arundel.

3.4.6.3 The following WCHR facilities are located along the dual carriageway section of the existing A27 within the Scheme extents:

- Informal crossings with central reserve gaps between Shellbridge Road and Yapton Lane and between Tye Lane and Mill Road.

[14] TMU Site 5759/1 on link A27 eastbound between A29 near Bognor Regis (east) and A284 near Arundel (west); GPS Ref: 496760;106857; Eastbound

TMU Site 5760/1 on link A27 westbound between A284 near Arundel (west) and A29 near Bognor Regis (east); GPS Ref: 496640;106862; Westbound

TMU Site 5761/1 on link A27 westbound between A284 near Arundel (east) and A284 near Arundel (west); GPS Ref: 502824;106061

TMU Site 5761/2 on link A27 eastbound between A284 near Arundel (west) and A284 near Arundel (east); GPS Ref: 502829;106061

- Informal crossing with central reserve gaps between FP 2825 to FP 393/1, Bridleway (BW) 392, BW 397 to 3667/336, FP 388 to FP 3400, FP 348 and FP 349.

3.4.6.4 High traffic volumes, high traffic speeds and the lack of safe, formal crossing facilities has resulted in severance at these crossing points and of the Public Right of Way (PROW) network linking communities located in the coastal plain and the South Downs to the north.

3.4.7 Existing Public Transport Facilities

3.4.7.1 There are nine bus stops that lie directly on the existing A27 within the Scheme extents. There are two just north of the Crossbush junction and a further two just south of the Causeway junction near Arundel Station. There are two more bus stops west of Ford Road junction and one further west near Jarvis Road. The final two on the A27 are situated adjacent to Havenwood Park. Other bus stops exist within Arundel Town Centre, south of Ford Road, Torton Hill Road and on Yapton Lane.

3.4.7.2 Table 3-1 provides details of bus services along the existing A27 at Arundel.

Table 3-1 – Bus Services

Route number	Direction	Weekday frequency	Saturday frequency	Weekday first service	Weekday last service
85	Arundel-Chichester	2 / hour	2 / hour	06:55	15:55
9	Arundel-Worthing-Littlehampton-Shoreham-By-Sea	1 / hour	1 / hour	06:54	18:14
69 (Only Tuesdays and Fridays)	Worthing - Arundel - Pulborough - Alfold	2 / day	-	10:23	13:46
668 (Schooldays only, excluding Fridays)	Ormiston Six Villages Academy - Yapton - Arundel - Tangmere	1 / day	-	16:17	-
Arundel Community Bus	Arundel Town Service	5 / day	-	08:56	12:11

3.5 Existing traffic conditions

3.5.1 Source data

3.5.1.1 The data used to describe existing traffic conditions comprises the following sources:

- Census journey to work, sourced from Nomis[15], the official labour market statistics website.
- Traffic count data from WebTRIS[16], WSCC and other sources
- Journey time data from TrafficMaster
- PCF Stage 2 A27 transport model

3.5.1.2 The PCF Stage 2 A27 transport model reflects an average weekday in March 2015, with March classified as a neutral month. The modelled time periods are:

- AM peak – 07:00 – 10:00
- Inter peak (IP) – 10:00 – 16:00
- PM peak – 16:00 -19:00

3.5.1.3 A further description of the PCF Stage 2 A27 transport model and how it has been developed further since PCF Stage 1 is provided in Chapter 9 – Summary of Traffic Appraisal.

3.5.2 Journey patterns

3.5.2.1 This section summarises the journey patterns within the area as context for the description of traffic flows and conditions in later sections.

3.5.2.2 The PCF Stage 2 A27 transport model indicates that two thirds (67%) of the traffic that currently uses the A27 along the extent of the proposed Scheme, is through traffic, whilst the remaining third (33%) is local traffic[17].

3.5.2.3 Roadside interviews on the A27 west of Arundel in 2015 indicated that there are higher traffic volumes eastbound (10,433 vehicles) than westbound (7,109 vehicles) between 07:00 and 19:00[18].

---

[15] https://www.nomisweb.co.uk/census/2011/qs701ew.

[16] http://webtris.highwaysengland.co.uk/

[17] Based on traffic on the A27 between Crossbush roundabout and Causeway roundabout. Local traffic defined as having an origin or destination within Arundel. Through-traffic has an origin and a destination outside of Arundel.

[18] HE551523,4_WSP-PB_A27AWL_P012_TDCRv1.4.1

3.5.2.4 Based on Census Journey to Work (2011) data, the car is the most prevalent means of transport within Arun district as a whole, with 45% of Arun District residents (aged 16 to 74) travelling to work by car or van. Walking is the second highest mode of transport at 6%, followed by working from home at 4%, train at 3%, cycling at 2%, bus/minibus/coach at 2%, motorcycle at 1%, other at 0.4%, taxi at 0.2% and lastly underground/metro/light train/tram at 0.1%[19]. The remaining 36% of the residents are not in employment.

3.5.2.5 The majority of travel to work movements are those which are travelling out of the district, at over 27,000 (75%)[20]. This is compared to nearly 9,000 (25%) who travel into the district to work. The major inflows into the Arun district are from the east, with inflows from Worthing accounting for 35% of the total journey to work movements and Adur accounting for 6%. From the west, 25% of the inflows originate in Chichester and 7% are from Horsham. The highest outflows are predominantly for destinations to the west, with 39% of outflows associated with Chichester and Horsham at 7%. To the east, 21% of outflows travel to Worthing whilst 3% travel to Adur. This illustrates a tidal movement of journey to work trips which is highest in a westbound direction in the morning peak, into and out of Arun, with the reverse pattern of movement in an eastbound direction during the evening peak.

3.5.3 Traffic flows

3.5.3.1 Figure 3-5 presents the estimated Average Annual Daily Traffic (AADT) two-way flows within the study area for the year 2015 and an estimate of the % of Heavy Goods Vehicles (HGV). AADT is calculated by converting the average and inter-peak hourly flows, extracted from the PCF Stage 2 A27 transport model for the 2015 base year, into the respective 12 hour and 24 hour AADT flows using pre-determined conversion factors[2].

[19] https://www.nomisweb.co.uk/census/2011/qs701ew. Note that the mode share proportions do not add up to 100% due to rounding

[20] ONS, Census WU03UK – Location of usual residence and place of work by method of travel to work. https://www.nomisweb.co.uk/census/2011/WU03UK/chart/1132462325

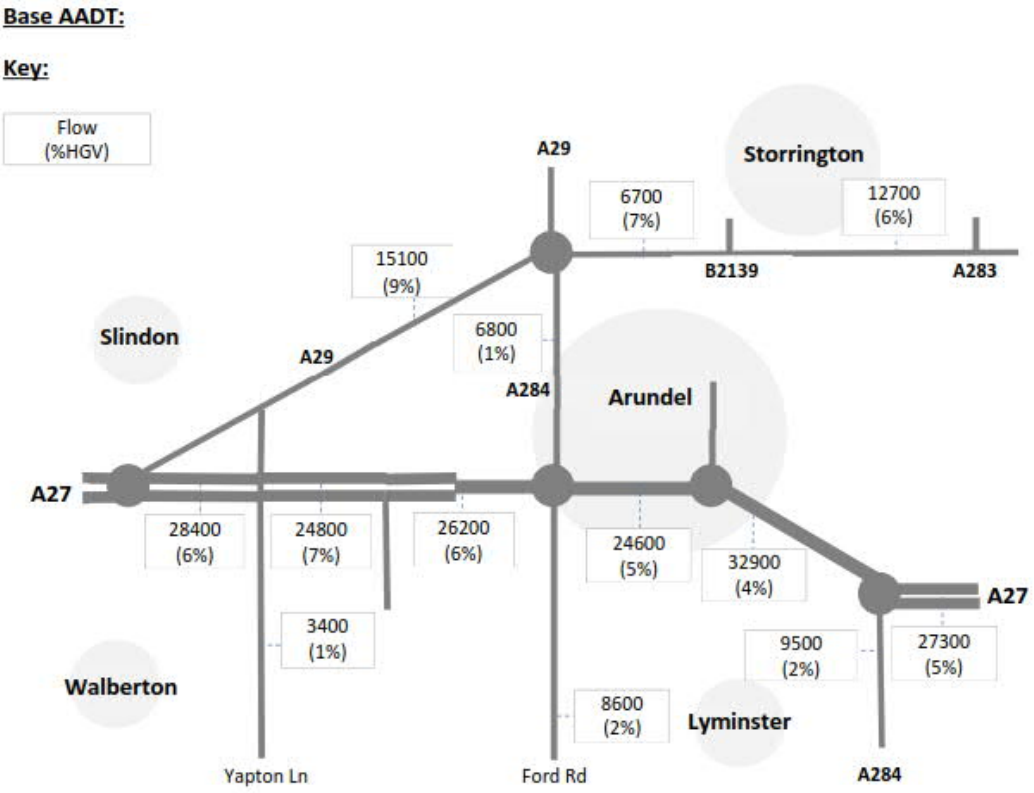


Figure 3-5 – Base Year (2015) two-way AADT

3.5.3.2 Within the Study Area, current traffic volumes are highest along the A27, particularly on the single carriageway section to the West of Crossbush junction where there is a volume of over 32,000 vehicles per day. The AADT has not changed notably since 2015[21].

3.5.3.3 AADT remains high on the A27 as it bisects Arundel, with 24,000 to over 26,000 vehicles per day using these sections of road. The A29 experiences flows of over 15,000 vehicles per day. The lower order roads in the study area, such as Yapton Lane, Ford Road and the A284, have lower AADT flows. It is acknowledged that the model is underrepresenting flows along Yapton Lane. Analysis of the existing 2019 observed flows is presented in the Local Roads Study report[22].

[21] Based on DfT manual count point data which illustrates an increase of around 5% in AADT between the years 2015 and 2018 at Arundel Station. AADT has been estimated between 29,000 and 35,000 vehicles per day since the year 2000. https;//://roadtraffic.dft.gov.uk/manualcountpoints/6297

[22] HE551523-WSP-GEN-SWI-RP-TR-00020 – A27 Arundel Bypass Local Roads Study, October 2019

3.5.3.4 Along the A27, the proportion of HGVs is highest to the west of Arundel, with a high of 7% of total vehicles on the dual carriageway section between Yapton Lane and Ford Road roundabout. To the east of this roundabout, HGV numbers decrease as a number have destinations within Arundel or along Ford Road. The percentage of HGVs along the A29 is high relative to other routes, at 9%.

3.5.3.5 The dual carriageway on either side of Arundel has the capacity to carry existing traffic flows and accommodate future traffic growth. However, the single carriageway sections are not able to accommodate the demand during peak periods, resulting in congestion. The main congestion points are at the Ford Road roundabout, the section between the Causeway roundabout and Crossbush, and the approaches to Crossbush junction.

3.5.3.6 Figure 3-6 and Figure 3-7 summarise the AM and PM peak flows and capacity, measured in number of vehicles, from the PCF Stage 2 A27 transport model. Capacity is defined in TA 79/99[23] as the maximum sustainable flow of traffic passing in one hour, under favourable road and traffic conditions and is measured in one-way hourly flow in each direction[24].

3.5.3.7 A Volume / Capacity (V/C) figure is presented for each link. Peak V/C compares traffic volume with the capacity of the road. The higher the value, the closer the road is to capacity, and therefore the more prevalent congestion is likely to be. In addition, where maximum junction Ratio of Flow to Capacity (RFC[25]) or Degree of Saturation (DoS)[26] exceeds 0.8, 0.9 or 1.0, this is indicated on the figures with the corresponding colour for the A27 / A284 / Ford Road and the A27 / A284 Crossbush junctions. These junctions have been identified during earlier PCF stages as having a significant impact on the performance of the A27. The junction modelling results are presented later in this section.

[23] Design Manual for Roads and Bridges (DMRB), Volume 5, Section 1, Part 2, TA 79/99 Traffic Capacity of Urban Roads (February 1999)

[24] TA79/99 Amendment No 1. Traffic Capacity of Urban Roads (February 1999)

[25] The Ratio of Flow to Capacity (RFC) is a measure of how well roundabout and priority junction approaches perform under varying flow conditions. In the case of roundabouts, the capacity is determined by the entry flows, circulatory flows and the junction geometric parameters. Similarly, for priority junctions, the scale of magnitude of opposed and opposing movements influence capacity, besides geometry. Typically, an RFC of less than 0.85 is considered to indicate satisfactory performance.

[26] Degree of saturation (DoS) is a measure of how well an approach lane to a signalled junction is performing. It is the ratio of the number of vehicles known to be approaching a stopline over an hour (the demand flow), to the number of vehicles which can actually get over the stopline (the capacity). A stopline with a DoS level below 90% is said to have spare capacity, whilst a value above 90% indicates queues and congestion.

3.5.3.8 The capacity of the A27 carriageway within the area varies according to the number of lanes, the width and other road characteristics[27].

3.5.3.9 The A27 carriageway capacity is lowest in the single carriageway section between Causeway roundabout and Crossbush junction past Arundel railway station where the carriageway narrows and gradient increases. This section also has a number of at-grade side road junctions along the route which are a factor in the capacity of the link. The signal controlled pedestrian crossing just east of Causeway roundabout interrupts the flow of traffic.

3.5.3.10 To the west of this section, the road capacity increases between Causeway and Ford Road roundabout as the standard of road improves. The capacity[28] then significantly increases from 1,590 to over 3,000 vehicles per hour where the single carriageway becomes dual carriageway. Other local routes have lower capacities, commensurate with the standard of the road.

3.5.3.11 Peak flows are generally highest in the AM peak and travelling westbound, which reflects the dominant tidal commuting pattern to destinations to the west of Arundel including Chichester. The highest average hourly flows are between Causeway roundabout and Crossbush junction, past Arundel Station. As this is a single carriageway section, congestion here is a significant problem and V/Cs indicate the link is operating at capacity.

[27] http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol5/section1/ta7999.pdf

[28] Capacities obtained from TA79/99

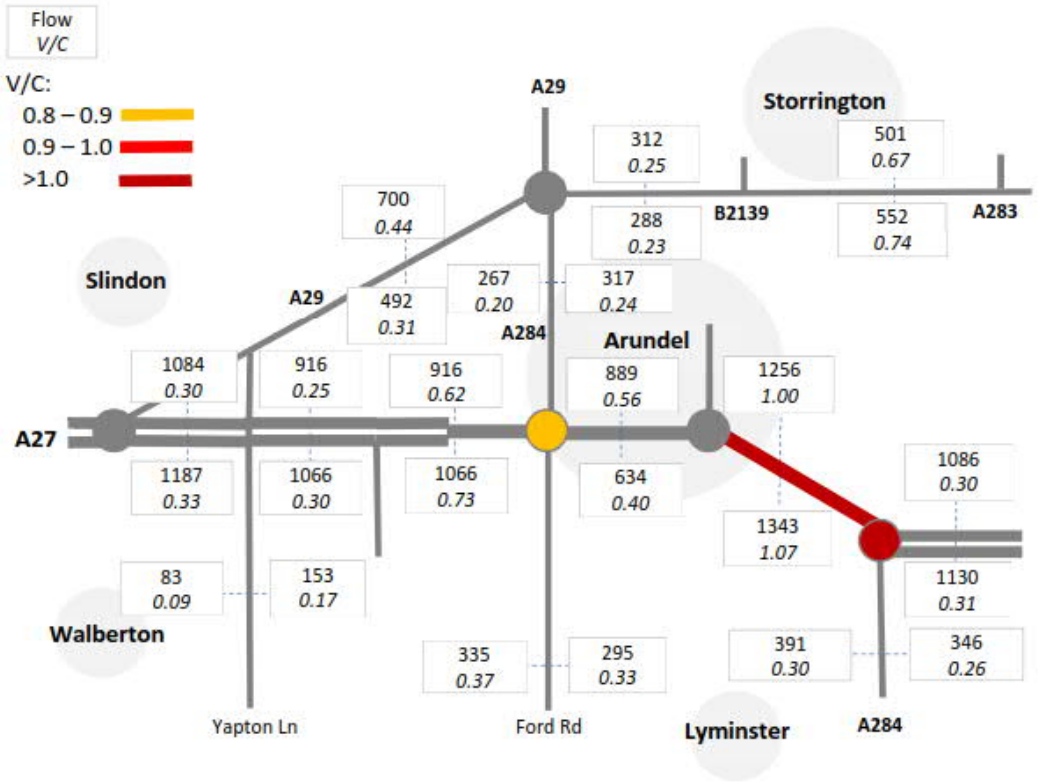


Figure 3-6 - Base Year Peak Period Flow and V/C (AM)

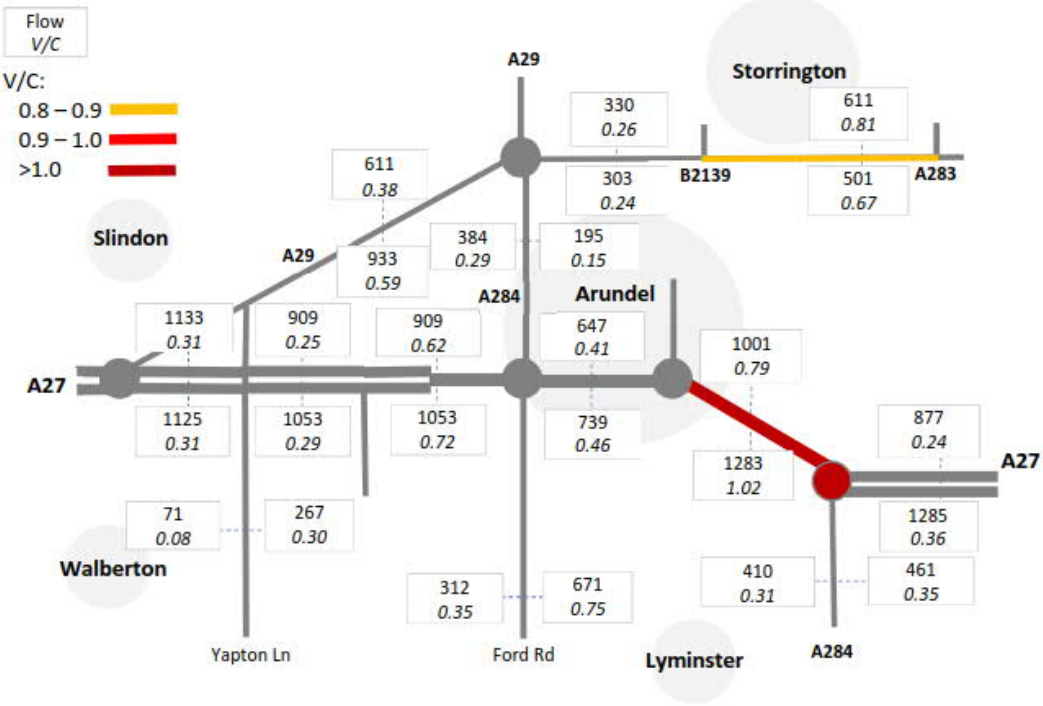


Figure 3-7 - Base Year Peak Period Flow and V/C (PM)

3.5.3.12 Elsewhere on the A27 within the Study Area, flows typically range from 900 to 1,200 vehicles per peak period in each direction. The only exception is on the link between Causeway roundabout and Ford Road roundabout, where flows are about 700 vehicles per hour. This is because traffic on the A27 with destinations within Arundel or to areas to the north or south exits at either one of these two roundabouts.

3.5.3.13 Away from the A27, the highest average flows are found on the A29. This indicates that this is the predominant route into the area from the north, with high AM southbound and PM northbound flows. Other routes within the locality see lower peak flows, although various lower order roads within the study area can be considered sensitive to traffic volumes due to their residential or rural nature and can be affected by 'rat-running' traffic which can utilise local roads in the event of congestion or incidents on the SRN. These roads include Ford Road and Yapton Lane.

3.5.3.14 The average 24 hour weekday traffic profile on the A27 Lyminster Road, the section of the A27 past Arundel railway station and on the approach to Crossbush junction, is illustrated on Figure 3-8. The average daily weekday flows (07:00 to 19:00) at this site totalled 18,114 vehicles westbound, and 17,147 eastbound.

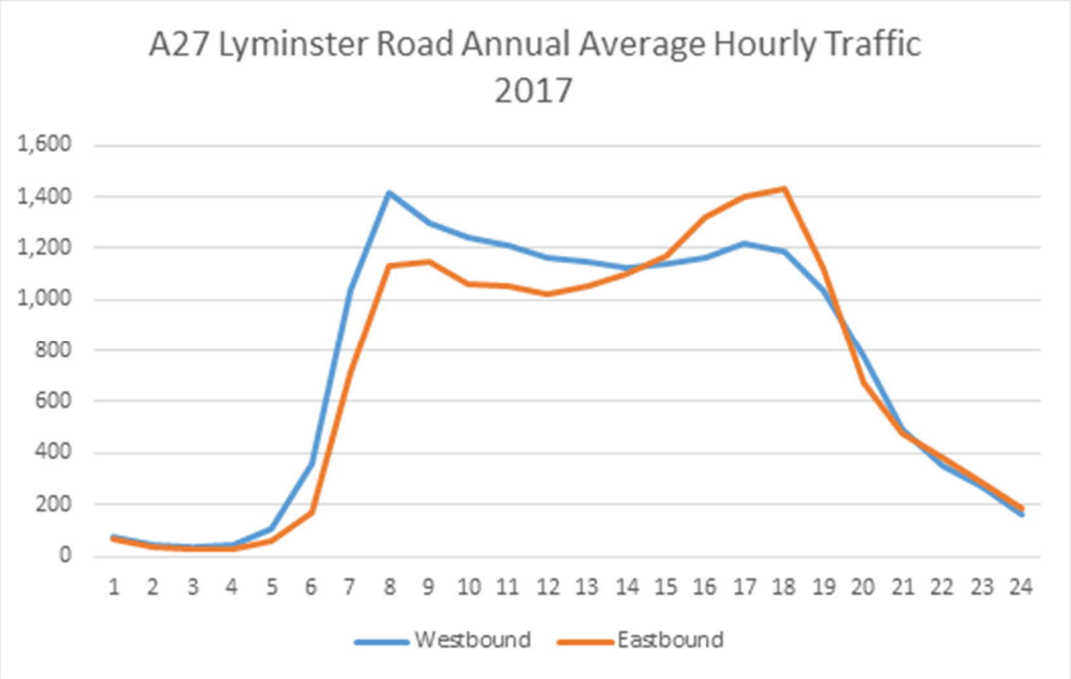


Figure 3-8 - Average 24-hour weekday traffic flow profile (A27 Lyminster Road)

3.5.3.15 Table 3-2 and Table 3-3 summarise the operational modelling results of Ford Road roundabout and Crossbush junction for 2015, in both the AM and PM peak periods. RFC's are presented in red where the value exceeds 0.85, and DoS presented in red where the value exceeds 90%. The results are presented in vehicles for Ford Road roundabout and in Passenger Car Units[29] (PCUs) for Crossbush junction.

Table 3-2 - Ford Road junction assessment (2015 AM and PM)

	AM Peak (2015)			PM Peak (2015)		
	RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
A284	0.27	0.36	5.43	0.31	0.44	5.46
Maltravers Street	0.63	1.69	12.47	0.54	1.14	10
A27 East (Arundel Bypass)	0.59	1.41	7.35	0.71	2.39	10.77
Ford Road	0.53	1.12	11.13	0.47	0.88	9.34
A27 West (Chichester Rd)	0.84	5.11	19.04	0.76	3.15	11.59

Table 3-3 - Crossbush junction assessment (2015 AM and PM)

Junction Arm		AM Peak (2015)			PM Peak (2015)		
Arm / Movement	Lane(s)	DoS (%)	MMQ[30] (PCUs)	Delay (s/PCU)	DoS (%)	MMQ (PCUs)	Delay (s/PCU)
A27 WB Left Turn	1/1	5	1	7	29	4	10
A27 WB Ahead	1/2	101	61	87	94	37	40
A27 WB Circulatory	2/1	80	12	68	34	5	44
A284 NB	3/1+3/2	98	19	126	95	18	99
A284 N/B Circulatory Right Turn	4/1	79	2	6	74	2	5
N/B Circulatory Give-way Right	5/1	38	5	22	25	4	10
Total Delay (PCUhr)		50.51			27.36		
Practical Reserve Capacity (%)		-12.7			-5.5		

[29] Traffic is composed of various types of vehicles, the range and relative composition of which can vary from location to location. Traffic modelling software frequently utilises a common unit, known as the Passenger Car Unit (PCU), to represent general traffic. In the A27 Arundel transport model, a PCU conversion factor of 2.5 has been used for the Other Goods Vehicles (OGV1) category

[30] Mean Maximum Queue or MMQ is the maximum queue predicted by the model for a stop line in each cycle, averaged over a number of cycles.

3.5.3.16 The tables illustrate that the Ford Road roundabout is approaching capacity, and Crossbush junction is over capacity in the base year. Ensuing long queues and delays are, therefore, a regular occurrence of the section of the A27 through Arundel.

3.5.4 Journey time

3.5.4.1 The average peak period journey times on the A27 between the junctions of A27/A29 Fontwell, and Blakehurst Lane/Poling Street to the east of Crossbush, extending 8.5km, are presented in Table 3-4. This data illustrates the typical peak period traffic conditions along the A27 within the study area and compares it to free flow conditions (based on the lowest inter-peak journey time in either direction).

Table 3-4 - Base year (2015) A27 journey times (mm:ss)

ROUTE		AM	IP	PM
A27 EB	Journey time	10:38	10:03	17:58
	Increase relative to free flow	+0:35	0.00	+7:55
A27 WB	Journey time	11:09	10:51	10:03
	Increase relative to free flow	+1:06	+0:48	00:00

3.5.4.2 The free flow time to travel this route is about 10 minutes. Travelling along the A27 eastbound during the PM peak period is the longest journey duration of all the time periods, taking over 7 minutes longer than in the AM and inter-peak periods. Much of this delay is caused by the lack of capacity in the section of the A27 near Arundel Station, which results in traffic queuing back through Causeway junction and to Ford Road roundabout. The longer journey times in an eastbound direction reflects the tidal nature of the traffic volumes which indicate higher traffic volumes westbound in the morning peak, and eastbound in the evening peak.

3.5.4.3 During the AM peak, the route is less affected by congestion, as the journey only takes an extra 35 seconds eastbound. In the westbound direction, it is the AM peak which takes the longest of journeys for this direction, with delays of over 1 minute.

3.5.4.4 Journey time reliability is one of the main issues associated with the Arundel section of the A27. The current congestion and delays impact upon the efficient and safe movement of people and goods within the area.

3.6 Accidents

3.6.1.1 Analysis has been undertaken of data available for all personal injury collisions (PICs) that have been reported on the section of the A27 between the A27 junctions with the A29, to the west, and with Crossbush Lane to the east over the latest reported 5-year period; 2013-2017 (see Figure 3-9). Rates and trends identified are compared with national statistics for rural A roads, as presented in 'Reported Road Casualties Great Britain: 2017 Annual Report' (RCGB)[31].

3.6.1.2 There have been 81 personal injury collisions recorded in the latest 5-year period (2013-2017) on the existing A27; resulting in 121 casualties. A broadly similar number of PICs and resulting casualties have been recorded each year; on average 16 PICs and 24 casualties. Although there have been no fatalities in the latest 5-year period 12% (15) of all casualties are recorded as serious, increasing to 19% of all casualties in 2017. Whilst the 5-year KSI rate is comparable with national statistics for all rural A roads, the 2017 rate is significantly higher. National rates, as presented in RCGB (2017), report KSIs as accounting for 13% of all casualties in the same 5yr period and 14% of all casualties in 2017.

3.6.1.3 More than half (47) of the PICs were recorded on the existing single carriageway section of the A27. In turn, more than half (8) of all PICs resulting in serious injury were recorded on the single carriageway section.

3.6.1.4 The distribution of PICs recorded and factors contributing to their occurrence are common to a heavily trafficked, high speed, strategic rural A road; with key collision types identified as:

- Loss of control - 14 collisions: 6 on single carriageway, 5 on dual west, 3 on dual east
- Rear-end shunts in traffic - 13 collisions: all on single carriageway section
- Side roads/accesses - 10 collisions: 9 on single carriageway, 1 on dual west
- Rear-end shunts at roundabouts - 21 collisions: 10 at Crossbush Roundabout, 9 at Ford Road Roundabout

3.6.1.5 Further details of the existing accident record can be found in Chapter 13.

[31] Department for Transport, "Reported Road Casualties Great Britain: 2017 Annual Report," September 2018. Available [Online] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/755698/rrcgb-2017.pdf. [Accessed 14/07/19]

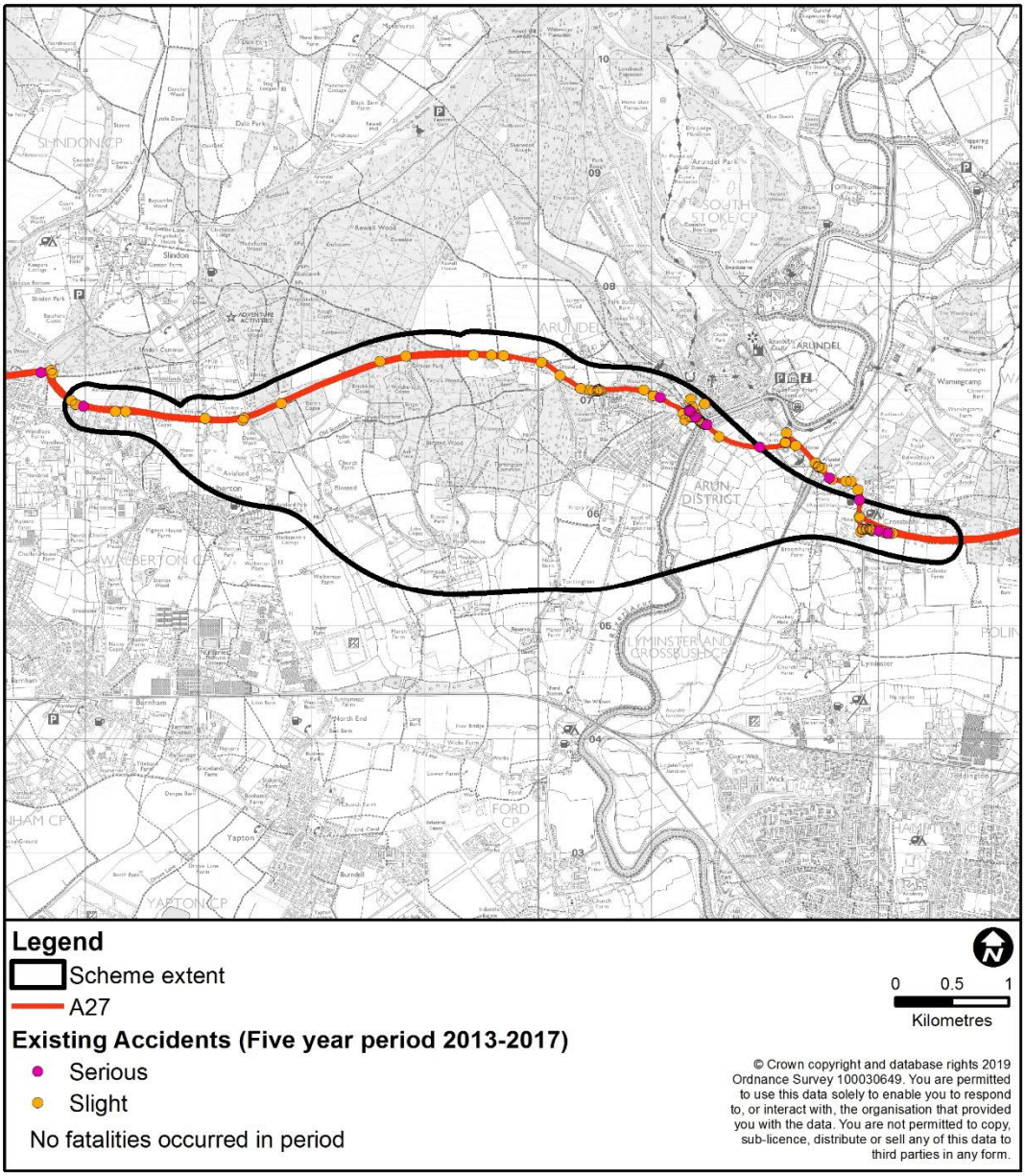


Figure 3-9 - Accidents

3.7 Lack of alternative modes of travel

3.7.1 Analysis of 2001 and 2011 Census Journey to Work data for East Sussex and West Sussex indicated that the proportion of non-car based modes has increased relative to travel by car in recent years. However, population growth has led to a continued increase in the volume of car-based travel demand. The level of increase in vehicle use is greater than the corresponding reduction in vehicle trips achieved through modal transfer.

3.7.2 The existing bus services operating around Arundel provide connections to a number of destinations including Chichester, Worthing and Littlehampton, and offer an alternative transport mode for local traffic. There are currently no regular long-distance services operating along the A27 to offer a suitable alternative transport mode for through traffic.

3.7.3 Southern Railway operates rail services through Arundel between London Victoria and Bognor Regis. There are currently no direct services operating through Arundel parallel to the A27 in an east-west direction. Passengers must change at Barnham or Ford for further services to Chichester, Portsmouth, Brighton and Littlehampton.

3.7.4 The PCF Stage 2 Multi-Modal Study[32] summarised the potential impact of public transport schemes and travel demand management, and concluded that whilst these options could move a small proportion of trips off the road network, the problems along the A27, and the objectives relating to the A27 Arundel Bypass, still had to be addressed.

3.7.5 The London and South Coast Rail Corridor Study[33] looked at infrastructure investment priorities for the London to South Coast Corridor. The Sussex Area Route Study[34] also examined opportunities for improvement and the practicality and costs of improvements to the Coastway rail service. Neither study recommended improvements in the Arundel area as a priority nor found them to offer good value for money.

3.7.6 The PCF Stage 2 Multi-Modal Study concluded that:

"Neither the South East Route: Sussex Area Route Study or the London and South Coast Rail Corridor Study recommended improvements in the Arundel area as a priority, nor found them to offer good value for money".

"Since no significant improvements are planned for the Coastway Services it is unlikely that the rail network alone will be able to support the regional growth aspirations along the corridor."

"People travelling on foot will remain similar to current levels of approximately 10%. Furthermore, the combination of through traffic (67%) and local traffic (33%) using the A27 means that walking (…and cycling…) will not always be a suitable alternative to car travel."

[32] A27 Arundel Bypass – PCF Stage 2 Multi-Modal Study, Highways England (August 2017)
[33] London & South Coast Rail Corridor Study, Department for Transport (April 2016)
[34] South East Route: Sussex Area Route Study, Network Rail (September 2015)

3.7.6.1 In summary, there is no evidence to suggest that there would be any material switch from road to rail along the A27 corridor between Chichester and Brighton that would reduce congestion at Arundel.

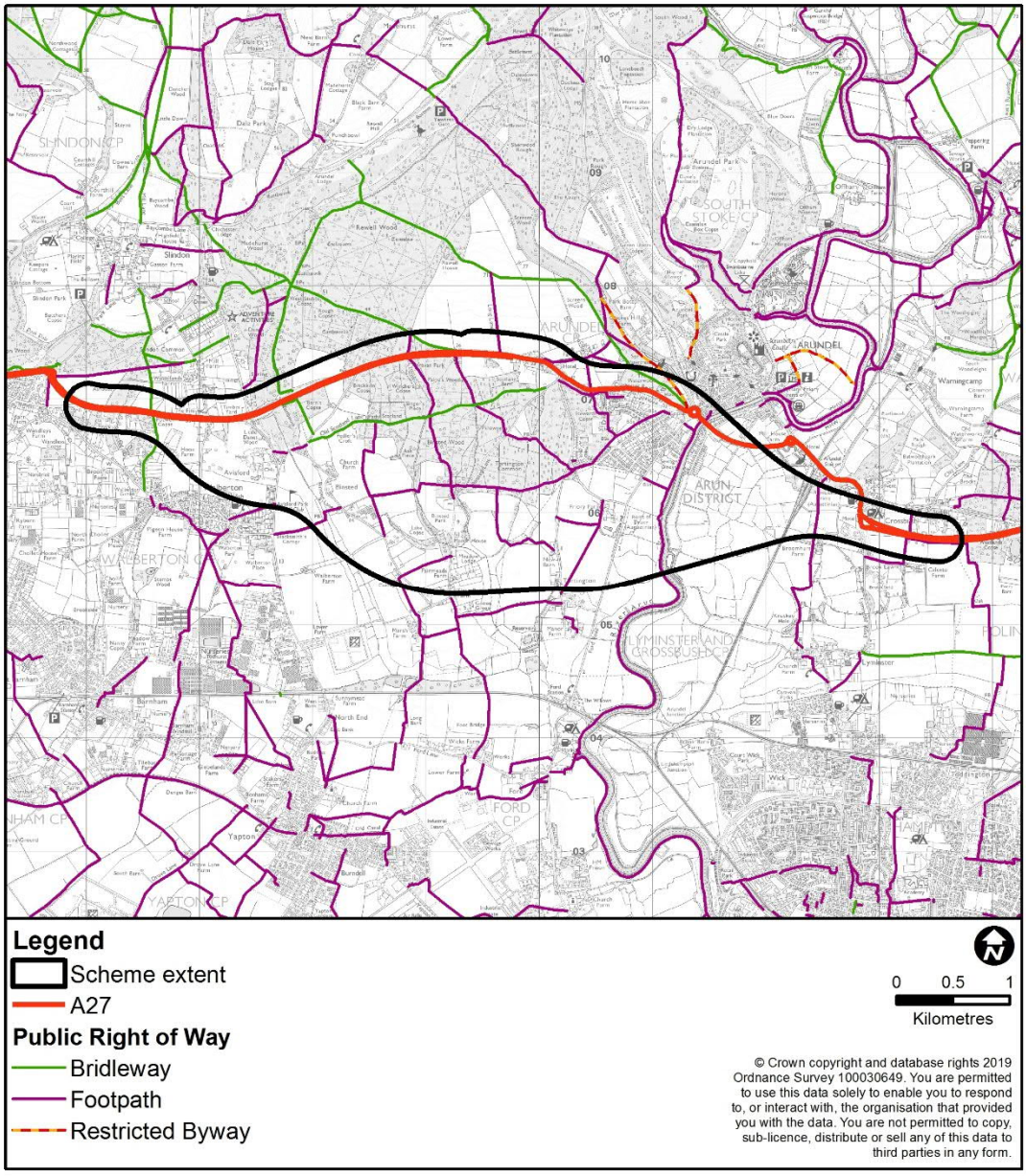


Figure 3-10 - Public Rights of Way Network

3.8 Public Rights of Way Network (PRoW)

3.8.1.1 The local PRoW network within the Scheme extents is shown in Figure 3-10. Footpaths link Arundel to the villages of Lyminster, Tortington, Binsted and Walberton. The network also extends into the SDNP and along the River Arun, through a series of footpaths and bridleways / byways. These routes are predominantly used for leisure and recreation purposes. Severance of these routes by the existing A27 between Crossbush and Fontwell (east) junctions is described in section 3.4.6.

3.9 Topography

3.9.1.1 A topographical contour map of the study area is shown in Figure 3-11.

3.9.1.2 The scheme is located primarily in the upper parts the South Coast Plain National Character Area (NCA) where the topography slopes gently southwards towards the coast from the higher dip slope of the South Downs to the North. The coastal plain is crossed by the River Arun which forms a wide flat alluvial floodplain with shallow valley sides. To the west of the River Arun the coastal plain is cut into by valley “rife” features containing small streams and which form a series of small valleys and ridges in the higher parts of the coastal plain. Binsted Rife is the most distinct of these rife features.

3.9.1.3 Arundel is located on a spur of the South Downs with most of town extending up the slopes of the valley west of the River. North of Arundel the floodplain comprises a flat floored valley with the South Downs rising steeply to the east and west.

3.9.1.4 The existing A27 varies in height along its length from a high point in the east of approximately 26m AOD near the Crossbush junction to approximately 2.5m AOD over the River Arun floodplain. After crossing the River Arun the existing A27 climbs to a high point of approximately 40m AOD near the White Swan Hotel. It then gently drops in height to approximately 34m AOD at the Fontwell (East) junction, undulating as it crosses small rife valleys crossing the coastal plain.

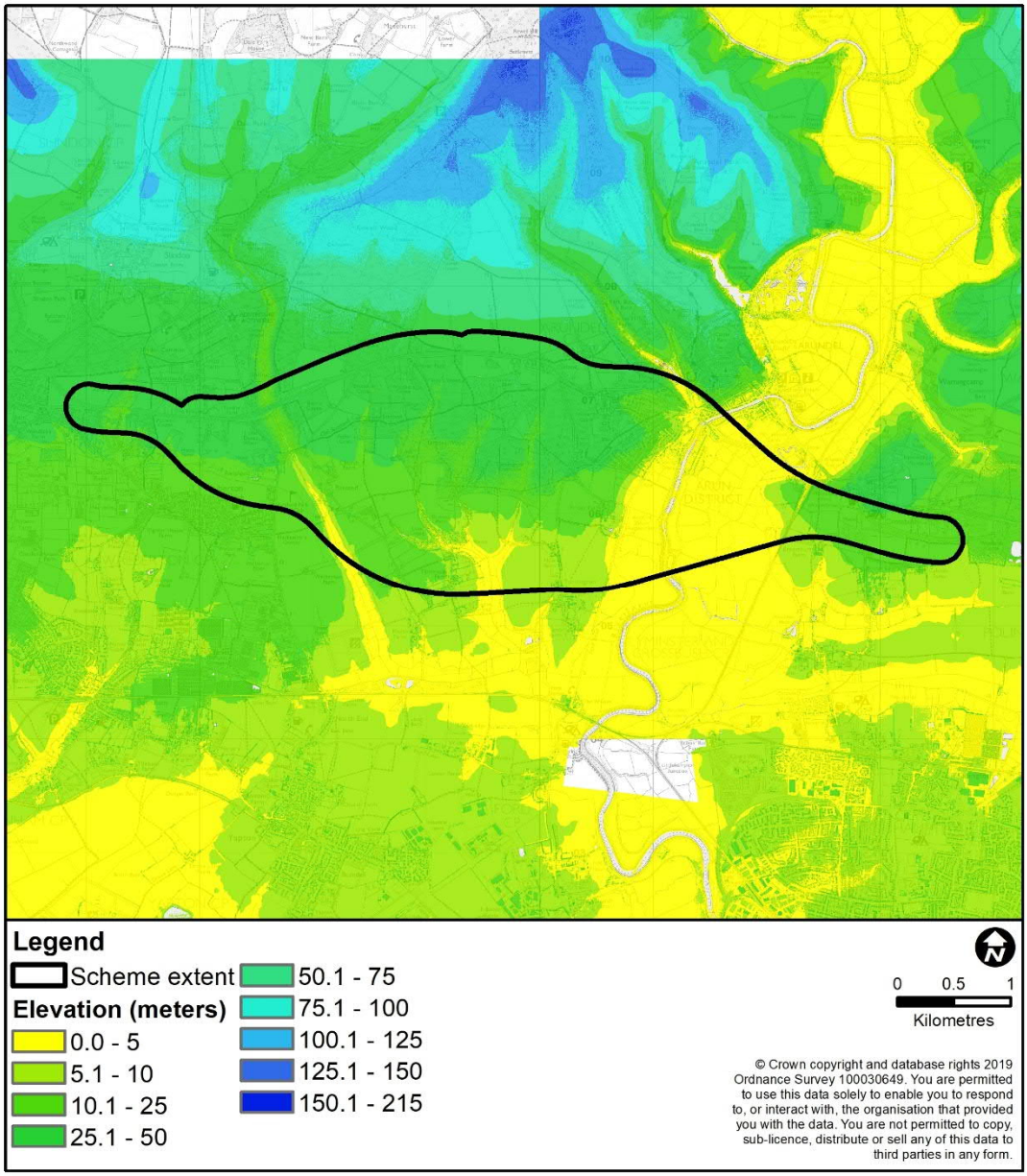


Figure 3-11 - Topography

3.10 Land use

3.10.1.1 The agricultural land is the main land use in the Scheme extents reflecting its rural location. Arable farming is primarily located on the southern coastal plain with livestock farming on the River Arun floodplain. There are also areas of equine grazing and horticulture with large commercial scale glass houses located to the south of Walberton and a smaller horticultural nursey at Binsted.

3.10.1.2 The main communities in the area are the town of Arundel and the village of Walberton with smaller communities at Binsted and Tortington. Binsted is characterised as a scatted or dispersed settlement compared to the more nucleated village of Tortington. In addition, there are scattered residential and farm properties along some of the local road network. The River Arun floodplain has few properties present.

3.10.1.3 There are extensive areas of woodland on the higher areas to the west of Arundel comprising both ancient woodland, coniferous plantations and wood-pasture and parkland.

3.10.1.4 Leisure and recreational land uses include the Avisford Hotel and Golf Course located north of Walberton. The golf course is located at the Hotel and extends down Binsted Rife. Arundel Cricket club is located north of the existing A27 at Park Farm. The woodland at Hundredhouse Copse is used by a local field archery club. West of the river Arun there is a dense PRoW network providing opportunities for recreational use of the countryside.

3.11 Drainage

3.11.1.1 There are three watercourses that are designated as Main Rivers within the Scheme option extents (see Figure 3-12). The River Arun is by far the largest and would be crossed by all route options. The tidal reach of the river extends to Pallingham Weir some 30 km inland of the mouth of the river at Littlehampton. The Arun is one of fastest flowing rivers in the UK and has a tidal range of up to 3m at Arundel Bridge[35]. The river is navigable for small craft as far as Stopham Road Bridge and is managed by Littlehampton harbour commissioners.

3.11.1.2 Binsted and Tortington Rifes are also designated as main rivers and flow initially north-south before flowing east to drain into the River Arun.

3.11.1.3 There are a number of flood risk areas associated with these watercourses (see Chapter 4).

3.11.1.4 There are a number of named and unnamed ordinary water courses and drainage ditches crossing the River Arun floodplain, including Spring Ditch, Tortington Ditch and Station Ditch (see Figure 3-12).

[35] Arun Valley Vision Group (January 2019) “A Vision for the Arun Valley.” Available [online] https://docs.wixstatic.com/ugd/37a7bb_ce317ef34b70482ab035b98ee4e3029d.pdf [Accessed: August 2019]

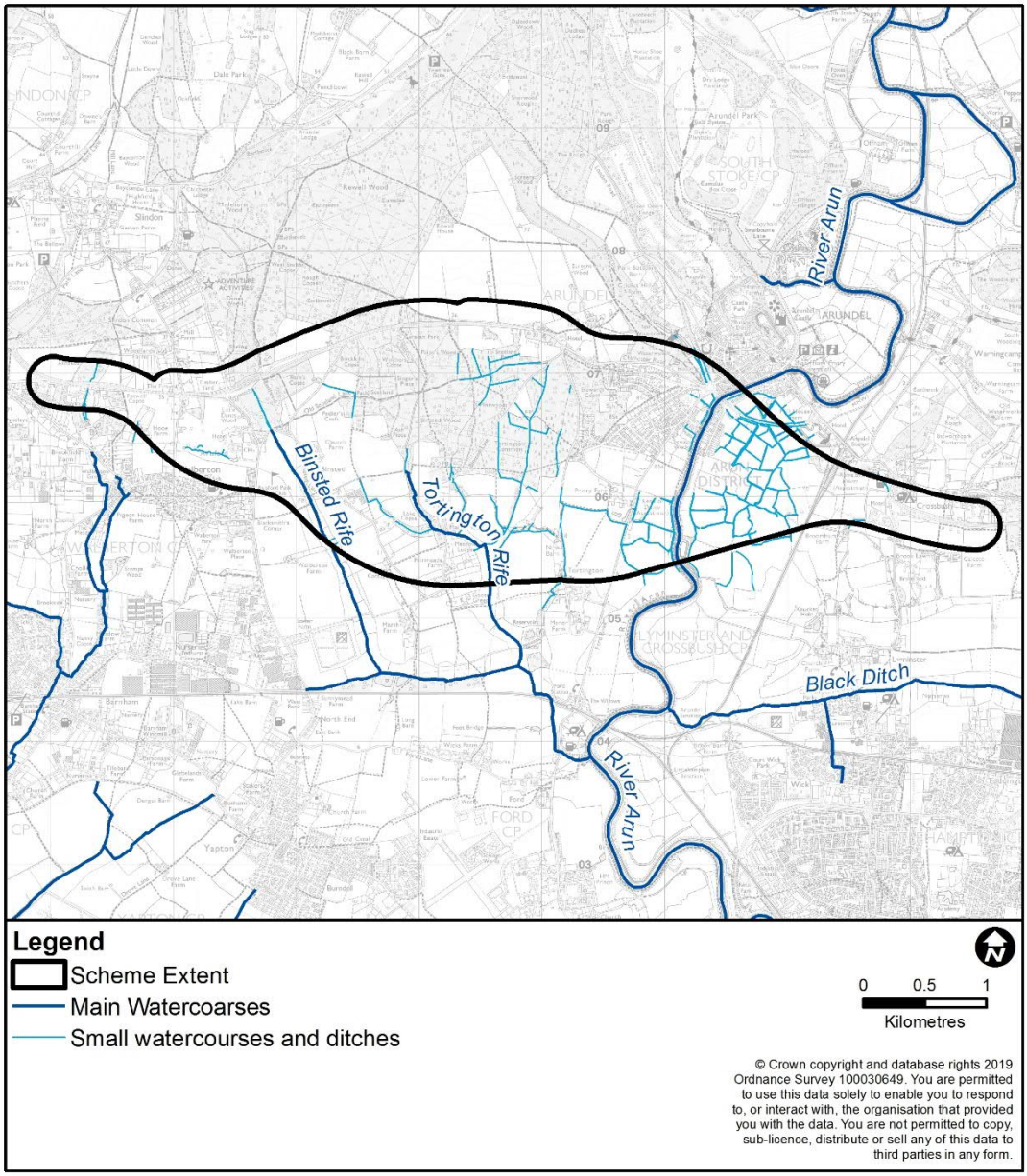


Figure 3-12 - Water Courses

3.12 Geology

3.12.1.1 The existing ground conditions are an important factor in the design of the scheme. A Preliminary Sources Study Report[36] (PSSR) has been produced for the Scheme. This report documents geotechnical (below ground) risks, implications and feasibility of the scheme options. A geotechnical site investigation would be undertaken on the preferred route in PCF Stage 3. Before then knowledge of the properties and risks associated with existing ground conditions is based on the content of the PSSR.

3.12.1.2 British Geological Survey mapping for the scheme area (Sheet 317/332 for Chichester/Bognor) shows that the options are likely to be founded upon a combination of the following sequences of Quaternary Age (<1Mya) Superficial Deposits and older Bedrock Geology.

3.12.1.3 The superficial deposits (see Figure 3-13) comprise layers of cohesive and granular Head Deposits, Aeolian Deposits, Alluvium, Arun Terrace Deposits, Tidal River Deposits River Terrace Deposits and Raised Storm Beach Deposits. Raised Marine Deposits and Alluvium.

3.12.1.4 The underlying solid geologies (see Figure 3-14) consist of Eocene Age (55-49Mya) cohesive London Clay Formation deposits of the Thames Group, the Palaeocene Age (56-55mya) clays, silts and sands of Reading Formation of the Lambeth Group and the Upper Cretaceous Age (99 – 65Mya) White Chalk Subgroup.

3.12.1.5 Historical geotechnical problems that have been remediated by the either WSCC or the Highways England Area 4 Managing Agent[37] include but are not limited to:

- Significant earthworks stabilisation around the existing A27 Crossbush Junction;
- The installation of a buried bored pile wall to arrest the migration of solifluction lobes in the area between Crossbush Junction and Arundel railway station;

3.12.1.6 The presence of up to 30m of soft sediments in the area of the River Arun Flood plain presents significant challenge for all route options. A summary of the challenges associated with each route option is given in Chapter 8 Description of Options

[36] WSP on behalf of Highways England (June 2019) Draft "Preliminary Sources Study Report"

[37] WSP on behalf of Highways England (June 2019) Draft "Preliminary Sources Study Report", Section 6.10

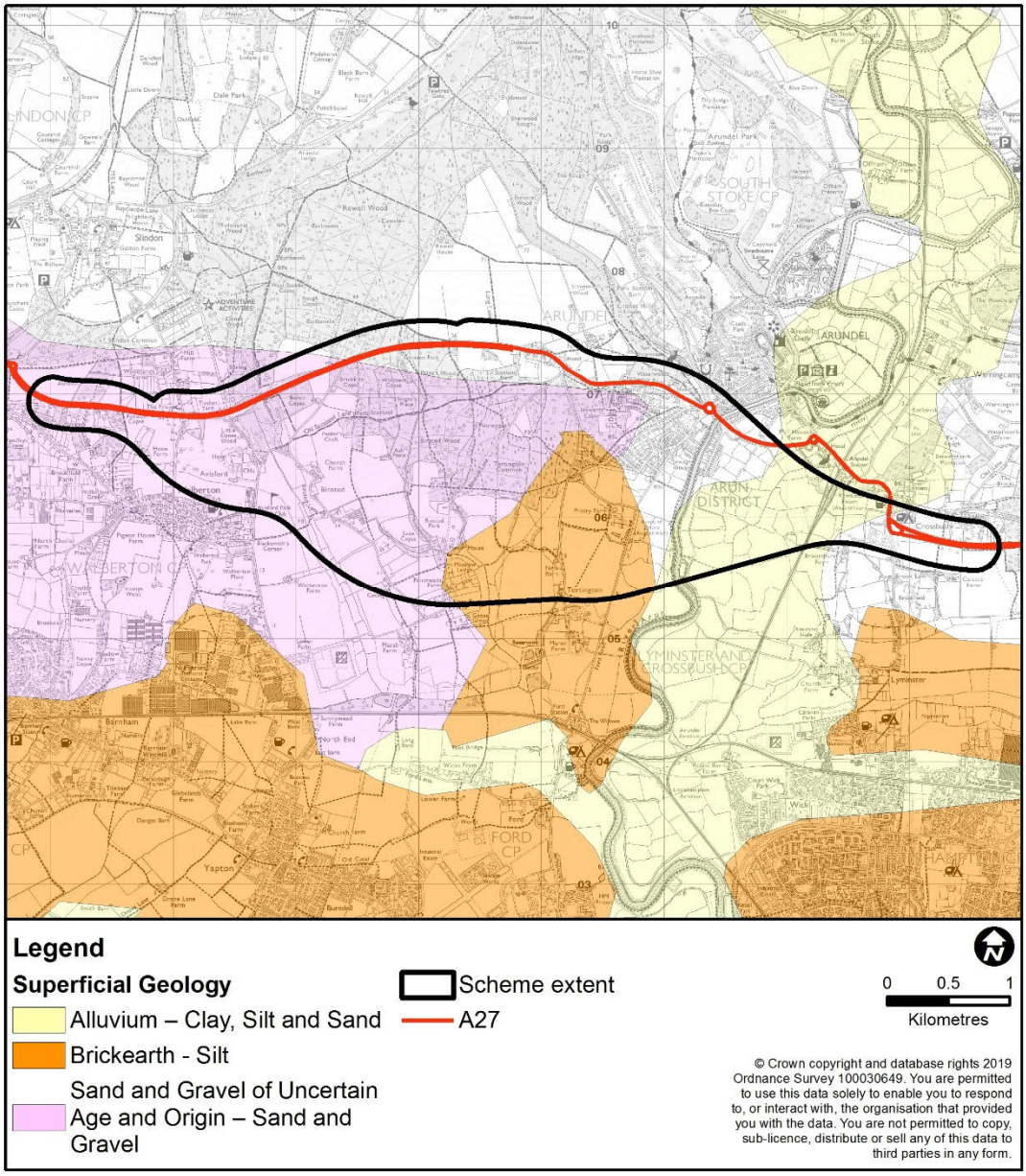


Figure 3-13 - Drift Geology

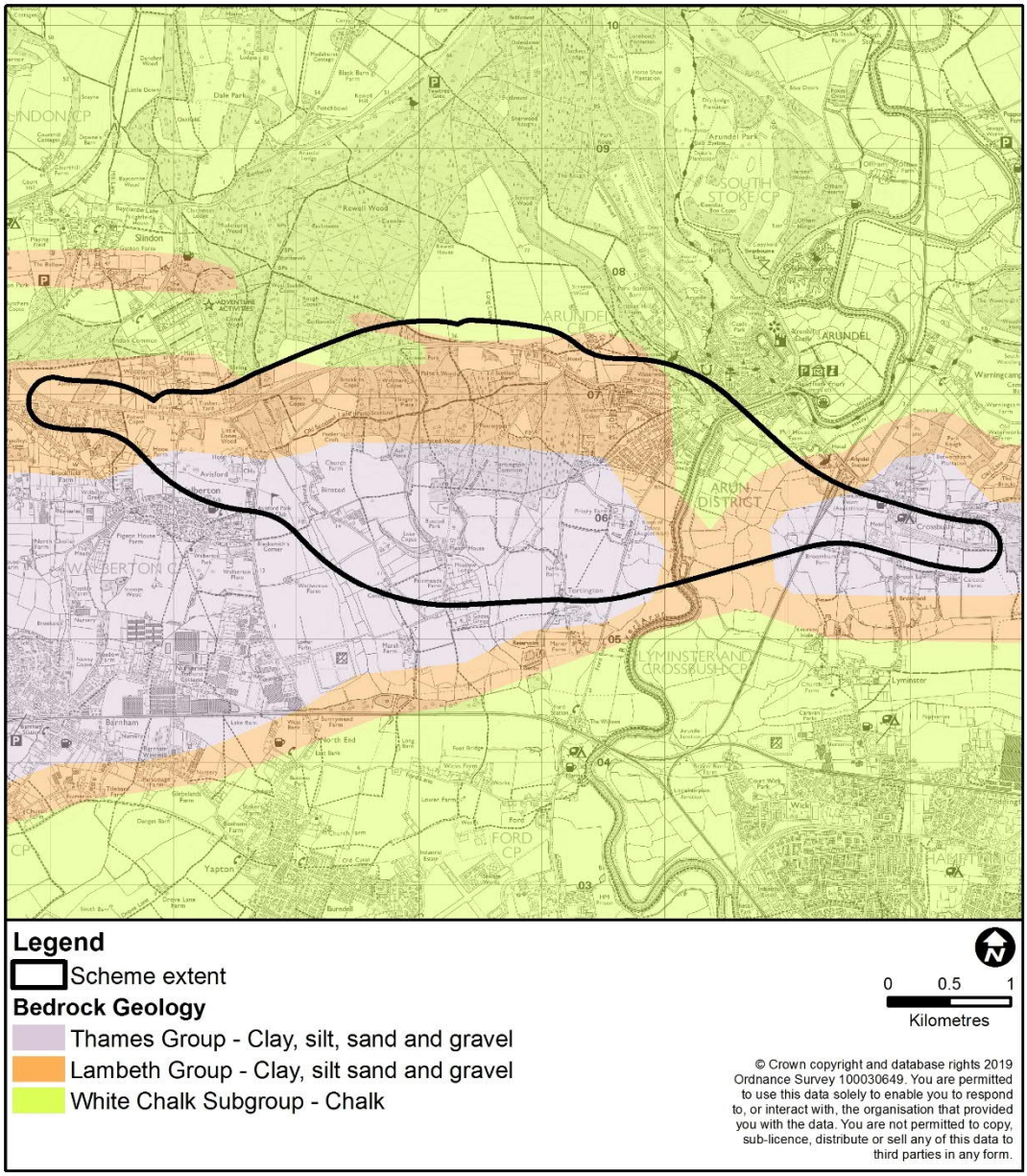


Figure 3-14 - Solid Geology

3.13 Mining

3.13.1.1 No records of mining activities within the vicinity of the scheme options have been identified but there are recorded sites of chalk extraction and clay pits. More information is provided in the PSSR.[38]

[38] WSP on behalf of Highways England (June 2019) Draft "Preliminary Sources Study Report" section 4.7.

3.14 Third Party Assets

3.14.1 Statutory Undertakers

3.14.1.1 Twenty three statutory undertakers[39] were contacted to identify the location of public utilities within the extents of the options described in Chapter 8 – Alternative Options.

3.14.1.2 Thirteen of the statutory undertakers identified have confirmed that they have apparatus within the scheme extents. Public utilities exist predominately parallel to the existing A27 corridor and near the Crossbush junction with the A284. A review of the information received from the affected utility providers has identified the following assets within the scheme extents:

Southern Gas Networks

3.14.1.3 Along the existing A27 corridor there are medium and low-pressure gas pipe lines present and there are no significant lengths of high-pressure gas mains within the Scheme option extents. Hence there is no major gas governor present. Although there are some minor gas governors located at various locations. There are also intermediate pressure gas mains present on the southern side of the existing A27 corridor.

Scottish and Southern Electricity

3.14.1.4 Along the existing A27 corridor there are no Electricity Mains running parallel but there are some locations where the Electricity Mains cross the A27. The Electricity Assets include but are not limited to 11Kv Mains, 95 Wavecon cables, 185 Wavecon cables, 95 ABC cables, ducts, inspection chambers, transformer units etc. including underground and overhead cables.

Openreach - British Telecom

3.14.1.5 Openreach - British Telecom has various types of assets within the site extents including but not limited to live cable ducts, poles, boxes, manholes, cabinets and telephone kiosks.

Virgin Media (Telecommunication)

3.14.1.6 The existing Virgin Media communication assets are along the existing Network Rail railway line. The existing assets include communication cables embedded within ducts, inspection chambers and cabinets.

[39] WSP on behalf of Highways England (June 2019) “Draft Statutory Undertakers Diversion Report”

Southern Water (Surface Water and Sewer and Potable Water)

3.14.1.7 There are very few Southern Water assets along the existing A27 corridor but there are a lot of assets within the scheme extents. The assets include but not limited to Sewer Main, Surface water mains, Potable Water Mains, Fire Hydrants, ducts, gullies, manholes, valves etc.

Portsmouth Water (Surface Water and Sewer and Potable Water)

3.14.1.8 There are no Portsmouth Water assets along the existing A27 corridor but there are some assets within the scheme extents. The assets include but not limited to Potable Water Mains, Abandoned Mains, Fire Hydrants, valves etc.

Instalcom - (CenturyLink, Global Crossing, Fibernet & Fiberspan)

3.14.1.9 There are no Instalcom assets along the existing A27 corridor all assets lie to the south of the existing corridor.

3.14.2 Network Rail

3.14.2.1 Network Rail has various types of assets within the Scheme extents associated with the rail lines outlined in Table 3-5. All of the scheme options would require a new crossing of Network Rail assets on the Arun Valley Line.

Table 3-5 – Network Rail Assets

Rail Route	Stations on Route (within vicinity of the Scheme)	Location in vicinity of the Scheme
Arun Valley Railway	Arundel	Line runs north-south on east side of River Arun. All route options would cross the railway. The existing A27 crosses the railway at Arundel Station
West Coastway Line	Ford	Line runs east-west to the south of the route options

Abbreviations

Abbreviation	Explanation
AADT	Annual Average Daily Traffic
AoD	Above Ordnance Datum
BW	Bridleway
DoS	Degree of Saturation
FP	Footpath
GVA	Gross Value Added
HADDMS	Highways England Drainage Data Management System
IP	Inter Peak
KSI	Killed Seriously Injured
LSOA	Lower Super Output Area
PIC	Personal Injury Collision
PROW	Public Right of Way
PSSR	Preliminary Sources Study Report
RCGB	Reported Road Casualties in Great Britain
RFC	Ratio of Flow to Capacity
SDNP	South Downs National Park
SRN	Strategic Road Network
TMU	Traffic Monitoring Units
WCHR	Walking Cycling and Horse Riding
WSCC	West Sussex County Council
V/C	Volume to Capacity ratio

A27 Arundel Bypass Scheme Assessment Report

Chapter 4 – Environmental Status

October 2020

CONTENTS

LIST OF TABLES

4 Environmental Status

4.1 Introduction

4.1.1.1 The following section summarises the existing environmental baseline conditions by each topic in relation to the proposed Scheme options which are described in Chapter 8.

4.1.1.2 The Scheme is located within the administrative boundaries of West Sussex County Council, Arun District Council and the South Downs National Park Authority.

4.1.1.3 The Study Area is the spatial area within which environmental effects are assessed (i.e. extending a distance from the project footprint in which significant environmental effects are anticipated to occur). The Study Areas for each environmental topic are defined in the following sections. Further information on environmental specialist topic Study Areas is provided in the PCF Stage 2 A27 Arundel Bypass Environmental Assessment Report (EAR) (August 2019).

4.1.1.4 The following sections summarise the environmental baseline conditions for each of the environmental specialist topic study areas. More information on all the environmental specialist topics can be found in the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

4.2 Air Quality

4.2.1.1 The air quality Study Area is defined by topic specific criteria provided by the DMRB, and by the 'Affected Road Network' (Figure 5-2 in the PCF Stage 2 A27 Arundel EAR (August 2019)).

4.2.1.2 The air quality Study Area for each Scheme option has been defined in accordance with the guidance outlined in Section 5.2 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

4.2.1.3 The air quality Study Area is defined in further detail in Section 5.5 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) and Figures 5-2A to 5-2F illustrate the Study Areas for each Scheme option.

4.2.1.4 The baseline air quality conditions are broadly typical of the predominately rural nature of the area with a low density of roads and scattered small population areas. The main source of emissions in the Study Area are vehicle emissions.

4.2.1.5 Pollutant concentrations in the vicinity of human receptors have tended to be well below the air quality thresholds in recent years. There have been no monitored exceedances of air quality thresholds for PM_{10} (data collected since 2009).

4.2.1.6 However, there are NO_2 exceedances in three locations, outlined below within the air quality Study Area, locations are illustrated in Figure 5-3 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) :

- Slight NO_2 exceedance within the Chichester (Stockbridge Roundabout) Air Quality Management Area (AQMA).
- NO_2 exceedance at the roadside on the A27 between the Ford Road roundabout and just after the turning to Arundel and District Hospital.
- NO_2 exceedance on A283 Manleys Hill (within the Storrington AQMA)

4.2.1.7 There are no air quality management areas (AQMA) within Arun District. The nearest AQMAs and approximate distance from the Scheme (measured from the Ford Road roundabout) are listed in Table 4-1, and those that lie within the air quality study area are shown within Figure 5-4 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019). Three of these are outside the air quality study area.

Table 4-1 – Air Quality Management Areas and distance from Arundel

AQMA	Distance from Arundel (Ford Road Roundabout) (km)
Horsham AQMA No1 (Storrington)	10.3
Worthing AQMA	11.9
Chichester (St Pancras)	15.0 (outside study area)
Chichester (Orchard Street)	15.5 (outside study area)
Chichester (Stockbridge Roundabout)	15.8
Shoreham AQMA	19.9
Southwick AQMA	22.4 (outside study area)

4.2.1.8 There are four SSSIs, but no SPA, SAC, or RAMSAR sites[1], in the air quality study area which contain habitats sensitive to airborne NOx and nitrogen deposition. These sites lie to the north of the A27 corridor and comprise:

[1] The only sites designated for nature conservation that require assessment under Annex F of DMRB HA207/07 are SACs, SPAs, RAMSAR sites, and SSSIs.

- Fairmile Bottom SSSI
- Arundel Park SSSI
- Sullington Warren SSSI
- Amberley Mount to Sullington Hill SSSI.

4.2.1.9 Background concentrations of NOx are provided by Defra. Baseline 2016 annual average NOx concentrations over these SSSIs show that area average concentrations are well within the air quality objective for the protection of vegetation of 30µg/m^3 (termed the critical level) over all sites (less than 15µg/m^3).

4.2.1.10 Nitrogen deposition loads for the habitats within these sites have been obtained from indicative values for impact assessment on the Air Pollution Information System (APIS). These loads range from 5 kgN/ha/yr (kilograms of elemental nitrogen per hectare per year) to 25 kgN/ha/yr depending on the habitat.

4.2.1.11 Within the vicinity of the roadside, both NOx concentrations and nitrogen deposition levels are higher than the area average values (based on Defra modelling (2016)). Away from the roadside, concentrations fall rapidly to the area average concentrations.

4.3 Cultural Heritage

4.3.1.1 The Study Areas for cultural heritage has been developed in accordance with the guidance discussed in the cultural heritage section of DMRB. The Study Area for cultural heritage comprises an inner 200 m buffer area, and a wider, 1 km buffer. That is, an area extending from the footprint of the Scheme option, any new land-take, plus an area extending 1 kilometre either side of them.

4.3.1.2 The existing cultural heritage baseline conditions within the Study Area are described in relation to each of the Scheme options in Chapter 8. This is due to the number of heritage assets in the vicinity of each Scheme option, see Chapter 6, Figures 6-1 and 6-2 in the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) and included in Appendix A of this report, for the location of heritage assets.

4.3.1.3 A total of 279 heritage assets were identified as being present within the Inner and Wider Study Areas of the Scheme. These comprise: 6 Scheduled Monuments, 5 Grade I, 8 Grade II* and 254 Grade II Listed Buildings, 1 Registered Park and Garden, 5 Conservation Areas.

4.3.1.4 A total of 7 Archaeological Notification Areas, and over 50 non-designated assets lie within the Inner Study Areas. A list of Buildings or Structures of Character, or locally listed buildings has been compiled by Arun District Council, the majority of which are located in Arundel and Walberton, with smaller numbers in Tortington, Slindon, Lyminster and Binsted[2]. These are of lesser significance and have not been assessed in this high level Stage 2 assessment.

4.3.1.5 Scheduled Monuments along with Grade 1 and II* Listed Buildings have the highest level of protection. There are six Scheduled Monuments within the Study Area:

- Arundel Castle
- Maison Dieu (former hospital of the Holy Trinity)
- Tortington Augustinian Priory
- Gobblestubbs Copse Earthworks
- Ringwork 400m NNW of Batworthpark House
- Madehurst Wood earthworks.

4.3.1.6 The majority of Grade I listed buildings are within Arundel Town and include Arundel Castle, the Church of St Nicholas, Fitzalan Chapel and the Cathedral of St Philip Neri. Half of the Grade II* Buildings are located within Arundel.

4.3.1.7 The majority of the remaining designated assets (e.g. Grade II listed buildings) are within Arundel Town.

4.4 Landscape and Visual

4.4.1.1 The Study Area for the landscape and visual effect baseline covers the Scheme options beyond the five-kilometre buffer zone - extending up to 10km in some areas - to cover the Scheme and the full extent of the wider landscape around it which the Scheme may influence in a significant manner or from where the Scheme may be potentially visible[3]. The baseline also considers the SDNP and the International Dark Sky status. The study area for landscape and visual receptors is defined in Section 7.5 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

4.4.1.2 Landscape features which define the setting of all Scheme options are as follows:

[2] Arun District Council, Local Development Framework, Supplementary Planning Document: Buildings or Structures of Character (September 2005); Available at https://www.arun.gov.uk/download.cfm?doc=docm93jijm4n1724.pdf&ver=1373 (Accessed on 15/08/2019)

[3] Landscape Institute and Institute of Environmental Management & Assessment, Guidelines for Landscape and Visual Impact Assessment, 3rd Edition, Routledge [paragraph 5.2]

- Ancient woodland and other woodland
- Enclosed and semi enclosed fieldscapes, bounded by woodlands and mature hedgerow
- Open landscape of the River Arun plain
- South Downs forming edge and extensive backdrop to the Scheme area, consisting of farmed landscape, woodlands and settlements
- Coastal plain consisting of farmed landscape, small settlements and coastal towns
- Historic and cultural environment of Arundel
- Rural settlements of Tortington and Lyminster which 'bookend' the river plain.

4.4.1.3 In the broader landscape context, the options are located within Natural England's National Character Area 126: South Coast Plain[4], and would be visible from the adjacent National Character Area 125: South Downs[5] to the north.

4.4.1.4 The Scheme options all fall within ten local Landscape Character Areas (LCAs 1 to 10)[6]:

4.4.1.5 The visual amenity of the Study Area is varied, with broad expansive views to the south coast and coastal plain afforded from the higher reaches of the South Downs, to enclosed views within the wooded downs to the west.

4.4.1.6 The SDNP was designated as a National Park in 2009[7] in recognition of its exceptional natural beauty and as a landscape of national importance. The special qualities of the South Downs National Park include, among others, 'Diverse, inspirational landscapes and breath-taking views'.

4.4.1.7 The landscape character of Arun and the setting of as well as views into and out of the South Downs National Park are protected by the Arun District Local Plan (2011-2031) which requires developments to avoid having visual impacts on the landscape.

[4] Natural England *NCA Profile: 126: South Coast Plain (NE525)* (2014). Available at http://publications.naturalengland.org.uk/publication/4923911250640896?category=587130 [Accessed March 2019]

[5] Natural England *NCA Profile: 125: South Downs (NE432)* (2013). Available at http://publications.naturalengland.org.uk/publication/7433354?category=587130. [Accessed March 2019]

[6] LCA 1: Western Downs, LCA2: Fontwell Upper Coastal Plain, LCA3: Chichester To Yapton Coastal Plain, LCA4: Lower Arun Valley, LCA5: Arundel, LCA6: Downland Arun Valley, LCA7: Central Downs, LCA8: Angmering Park, LCA9: Angmering Upper Coastal Plain and LCA10: Littlehampton And Worthing Fringes

[7] The Secretary of State signed the order designating the South Downs a National Park on 12 November 2009. The South Downs National Park Authority was established on 1st April 2010 and being fully functioning as the planning authority for the Park on 1st April 2011.

4.4.1.8 There are views within the Study Area that have important cultural associations. These comprise views of Arundel Castle from the river by the painter J.M.W. Turner (c. 1824).

4.4.1.9 The Scheme lies partially within the South Downs National Park (SDNP). The SDNP was designated as a National Park in 2009 as a landscape of national importance due to its special qualities.

4.4.1.10 The South Downs National Park received International Dark Sky Reserve status in 2016[8].

4.4.1.11 It should be noted that the above summary covers the Scheme baseline. The different Scheme options will interact with and impact the baseline features differently. These differences in interaction and impact are provided in the assessment section of Chapter 7 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

4.5 Biodiversity

4.5.1.1 There is a range of different study areas cited in Chapter 8 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) ranging as far as 30 kilometres for European sites containing bats. Two kilometres is generally the study area range used for collation of biological records from Sussex Biodiversity Records Centre and for analysis of GIS data available from Natural England and other parties.

4.5.1.1 The baseline conditions for biodiversity for each option are described in Table 4-2. Receptors of either county, regional or national importance are also listed in Table 4-2. The receptors are either within the Option Footprint (the area of permanent works associated with each option) or within 250m of the Option Footprint.

4.5.1.2 A large number of bat surveys were undertaken by Highways England between 2017 and 2018 and are reported in Appendices 8-5 to 8-9 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019). The survey information on potential flight lines, roosts and foraging areas was used to gain an understanding of the species present, and the importance of the woodlands and other ecological features in the study area. This understanding was then used to help guide design development and refinement.

4.5.1.3 All of the biodiversity receptors are described in more detail in Chapter 8 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

4.5.1.4 The ecological features listed in Table 4-2 are fully described in Chapter 8 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019). The following figures within Chapter 8 (included in Appendix A in this report) show the distribution and location of designated sites and habitats:

- Figure 8-1 – International statutory designated sites
- Figure 8-2 – National statutory designated sites
- Figure 8-3 – Non-statutory designated sites
- Figure 8-5 – Natural England Habitat of Principal Importance (HPI)
- Figure 8-6 – Ancient woodland and wood pasture and parkland HPI
- Figure 8-7 – Phase 1 Habitats

4.5.1.5 Detailed baseline survey information on species and habitats is provided in Chapter 8 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) - Technical Appendices 8-2 to 8-22.

Table 4-2 – Key biodiversity receptors

Receptor	Importance	Description
DESIGNATED SITES		
Binsted Wood Complex LWS	National	Mixture of ancient woodland, conifer plantation, ancient/veteran trees and species-rich grassland.
Rewell Wood Complex LWS	National	Ancient woodland, sweet chestnut coppice, conifer plantation, beech plantation and species-rich chalk grassland.
A27 Avisford Notable Road Verge	County	Unimproved neutral or calcareous grassland.
HABITATS		
Ancient woodland	National	Ancient woodland is sub-divided as broadleaved semi-natural woodland or mixed plantation woodland depending on the dominant tree species which are present (conifer or broadleaved).
Wood Pasture and Parkland HPI	National	Wood Pasture and Parkland HPI is broadly characterised as a habitat supporting open growth trees, many of which may be ancient or veteran trees, over pasture or other types of grassland.
Scattered Ancient / Veteran Trees	National to County	Clusters or individual ancient or veteran trees are an irreplaceable habitat and provide habitat to support populations of rare invertebrates, fungi and lichen species which specialise on dead wood.
Deciduous Woodland HPI	National to Local	Woodland qualifying as lowland mixed deciduous woodland and small areas of woodland qualifying lowland beech and yew woodland HPI.

Receptor	Importance	Description
Wet Woodland HPI	National (valued as part of Binsted Wood Complex LWS)	Downy birch and purple moor-grass wet woodland in Paine's Wood. Alder and ash woodland associated with springs in an area called Hundredhouse Copse and Little Danes Wood.
Traditional Orchard HPI	County	Areas of open-grown trees set in herbaceous vegetation, created for fruit or nut production.
Coastal and floodplain grazing marsh HPI (including Reedbed HPI and Lowland Fen HPI)	County	Periodically inundated pasture/meadow and freshwater or brackish ditches. This habitat type also comprises other HPI types. It is important for aquatic plants, aquatic invertebrates and/or wetland birds and other flora and fauna.
River HPI	County	Near-natural running water.
Lowland Meadow HPI and other grassland	County to Local	Unimproved neutral grassland.
Hedgerow	County to Local	Any boundary-line of trees and shrubs. Those hedges consisting of >80% of at least one woody UK native species qualify as Hedgerow.
Mudflat HPI	County	A narrow band of mudflat habitat is present along the River Arun.
Arable field margin HPI	County to Local	Arable fields between Ford Road and the west branch of Binsted Lane contain field margins managed under agri-environmental schemes which qualify as Arable Field Margin HPI.
SPECIES		

Receptor	Importance	Description
Bats	At least National and up to International	Desk and field studies have confirmed the presence of bat species in the Study Area. 15 bat species were identified during desk study and field surveys including nationally rare species.
Terrestrial Invertebrates	Regional	Desk study and field surveys collected over 2,600 specimens from 614 species including numerous ancient woodland specialist and Red Data Book species.
Amphibians	County to Local	Woodland, scrub and hedgerows near each of the Scheme options, provide suitable shelter, foraging and hibernating sites for great crested newt and common toad. Several common toad breeding populations were identified from desk study sources. No great crested newt populations were identified by field surveys.
Aquatic ecology (fish and invertebrates)	County to Local	Fish surveys mainly recorded species typical of watercourses that were generally slow-flowing, silted and poorly oxygenated. Aquatic invertebrate surveys recorded communities typical of slow-flowing, ditch-like environments with pollution tolerant species.
Water vole	County	Records of water vole were identified within the Study Area. Highway England's field surveys recorded widespread evidence of water vole on the western and eastern River Arun floodplain.
Hazel dormouse	County	Desk study and field surveys recorded the presence of hazel dormouse within the Study Area in woodland and hedgerow habitats.
Birds – breeding	County	Bird species including Schedule 1 Wildlife and Countryside Act species, Birds of Conservation Concern, wetland specialist passerine species and woodland and farmland specialist species were recorded in the Study Area.

Receptor	Importance	Description
Protected or notable plants	County to Local	Notable plant species (either England Red Data Book above Least Concern or Sussex Rare Species Inventory as updated by the Flora of Sussex) were identified by desk studies and field surveys.
Reptiles	County	Field surveys in 2017 and 2018 confirmed the presence of adder, common lizard, grass snake and slow worm .

4.6 Geology and Soils

4.6.1.1 The Study Area for geology and soils has been developed in accordance with Highways England guidance and DMRB, Volume 11, Section 3, Part 11 Geology and Soils. The Study Area comprises the maximum physical extent of the Scheme option footprints plus a buffer zone of 250 metres. The Study Area is presented in Figure 9-1 of the PCF Stage 2 A27Arundel Bypass EAR (August 2019) and in Appendix A of this report. This distance is referenced in best practice documents, including the Guidance for the Safe Development of Housing on Land Affected by Contamination: R&D Publication 66 [9], and is typical at the hazard identification stage of an assessment.

4.6.1.2 British Geological Survey mapping shows that the Scheme options described in Chapter 8 are founded upon a mixture of superficial deposits which comprise Head Deposits, River Terrace Deposits, Raised Beach Deposits, Raised Storm Beach Deposits, Raised Marine Deposits and Alluvium. These are underlain by the London Clay Formation, Lambeth Group (clay, silt and sand) and the White Chalk subgroup.

4.6.1.3 Non-coal mining has been identified to be present in the Study Area, and natural and non-natural cavities (including quarrying, and particularly within the White Chalk) may have been infilled.

4.6.1.4 Best and most versatile agricultural soils were identified in the west and the far east of the Scheme. Shallow deposits of Made Ground may be present in areas associated with all current and historical development activity, including all residential and commercial developments and the existing A27.

4.6.1.5 There are no geological SSSIs, and there are no known Regionally Important Geological Sites within the Study Area. A Mineral Safeguarding Zone is present across the north and west of the Study Area.

4.6.1.6 Four landfills are present within the Study Area (See Figure 9-1 of the PCF Stage 2 A27Arundel Bypass EAR (August 2019) and in Appendix A of this report). The presence of landfills may pose a risk to the existing design from a ground stability perspective.

[9] National House Building Council (NHBC) (2008). Guidance for the Safe Development of Housing on Land Affected by Contamination: R&D Publication 66

4.6.1.7 Potential sources of contamination in the Study Area include:

- Historical landfills.
- Petrol station sites.
- Arun Valley railway and Arundel railway station.
- The existing road and highways network.
- The historical gasworks, ironworks, and sewage treatment works, on Ford Road.
- Historical chalk, gravel, and clay extraction.

4.7 Material Assets and Waste

4.7.1.1 The Study Area for materials and waste has been developed in accordance with criteria set out in the Guidance on the Environmental Assessment of Material Resources[10].

4.7.1.2 The primary Study Area is defined by the footprint of the Scheme options.,.

4.7.1.3 A secondary Study Area will extend to the availability of construction material resources and waste management facilities within the south east of England, that are expected to be impacted by the Scheme.

4.7.1.4 The overall sensitivity of material assets in the existing baseline is determined to be low (see the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) for more information). This is because:

- The south east of England generally has good availability of materials used for highway construction, with greater stocks of materials such as sand and gravel, and ready-mixed concrete than other English regions.
- The level of recycled aggregates used on the Scheme would be at or above the regional percentage target of 26%.

4.7.1.5 The overall sensitivity of landfill capacity is expected to be high. This is because:

- The sensitivity of landfill capacity for different waste types varies because waste capacity in the south east is forecast to reduce by as much as 29% (inert), 98% (non-inert), and 66% (total) from 2017 to 2027, in the absence of future provision.
- Individually, the sensitivity of different landfill capacity types over the lifetime of the Scheme are therefore assessed to be inert (low), non-inert

[10] Highways Agency, IAN 153/11 Guidance for the Environmental Assessment of Material Resources (October 2011)

(very high) and total (high). On average, the sensitivity of landfill capacity is assessed to be high.

4.8 Noise and Vibration

4.8.1.1 There are 17 Noise Important Areas (NIAs) within the Study Area (See Appendix A - Figure 11-1 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019). A 3D detailed model has been prepared for a single Study Area. This area has been based on distances from the footprints of each Scheme option:

- A main Study Area up to one kilometre from each Scheme option in line with HD 213/11 guidance.
- Affected links between one and two kilometres from each Scheme option.
- Noise Important Areas within 2 kilometres of each Scheme option.

4.8.1.2 The Study Area is illustrated in Figure 11-1 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) (included in Appendix A)

4.8.1.3 Close to Arundel, around Ford Road roundabout the noise levels are high, about 72 dB $L_{Aeq,15min}$ during the daytime and 62 dB during the night-time. Residential properties south west of Ford Road roundabout are currently subject to noise levels in the range 54 to 59 dB $L_{Aeq,15min}$ during the daytime.

4.8.1.4 Areas such as Tortington Common, Binsted Wood, Binsted Park, Binsted and Tortington are currently subject to noise levels below 55 dB $L_{Aeq,16h}$ during the daytime.

4.8.1.5 Noise levels within close proximity to the A27 are currently in the order of 75 dB $L_{Aeq,16h}$ during the daytime. Noise measurements in the Walberton area were taken and the results show that the current noise levels are about 58 dB $L_{Aeq,15min}$ during the daytime. Broomhurst Farm is currently subject to a noise level of about 55 dB $L_{Aeq,16h}$. For further detail on the baseline noise conditions for all the Scheme options see Section 11.6 and Appendix 11-2 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

4.9 Population and health

4.9.1.1 This section provides a summary of the population[11] in the Study Area, and the health of the local community and road users. A number of Study Areas are used for population and health which can be found in Section 12.5 of Chapter 12 in the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

[11] The population data provided in this report are the most recent publicly available data.

4.9.1.2 The Study Areas include:

- Population: physical assets and land use
- Population: pedestrians, cyclists, equestrians and community effects
- Human health.

4.9.2 Population

4.9.2.1 Arundel has an estimated population of 3,475[12]. Neighbouring villages (Table 4-3) are smaller, although Littlehampton is substantially larger with a population size of 24,478.

Table 4-3 - Population Figures for towns and villages around Arundel

Town or village	Estimated population size
Arundel	3,475
Walberton[13]	2,175
Slindon[14]	595
Eastergate [10]	568

4.9.3 Vehicle travellers

4.9.3.1 The existing traffic conditions and road safety record experienced by motorised travellers on the A27 at Arundel is described in Chapter 3 of this report.

4.9.3.2 When entering the A27 from the east of Crossbush junction, views are screened by the embankment (limiting views to the south). Following the Causeway roundabout, open views from the A27 Arundel Bypass are intermittent with occasional screening of roadside vegetation. Following Ford Road junction, an increase in vegetation restricts open views until the Arundel Arboretum Garden Centre and Nursery, providing restricted views along the carriageway.

[12] Community profile for Arundel (Parish) (July 2013)

[13] This population Figure is for the civil parish of Walberton which includes Binsted and Fontwell and is included in the absence of population Figures for Walberton alone. Walberton Parish Council Community Profile, Action with Communities in Rural England (2013).

[14] NOMIS. Available online at: https://www.nomisweb.co.uk/reports/lmp/ward2011/contents.aspx

4.9.4 Physical assets and land use[15].

4.9.4.1 There is an area of designated Common Land registered under the Commons Act 2006, known as Broad Green Waste, adjacent to Tortington Road. This is a small linear area of land adjacent to the road that is unlikely to be used widely by the local community and those who hold rights due to its size (limiting its ability to be functional under the rights of Common Land) and location alongside the road. Binsted Park and woods is an area of privately owned woodland to the north east of Binsted. These woods are considered to be a recreational facility and permissively used by local residents and communities[16]. An annual event, the Strawberry Fair, is held in Binsted on land south of Binsted Nursery. For further detail on the baseline conditions see Section 12.7 in Chapter 12 of the PCF Stage 2 A27 Arundel EAR (August 2019).

4.9.5 Pedestrians, cyclists, equestrians and community effects

4.9.5.1 There are no National Cycle Network routes or National Trails within the Study Area. All other public rights of way within the search area are locally designated.

4.9.5.2 Up to 16 public footpaths may be affected by the Scheme (see Figure 12-1 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) for more details. Included in Appendix A of this report).

4.9.5.3 The majority of public rights of way (PRoW) outside of the built-up areas of Arundel are located within agricultural land. Based observations made on a walkover survey in 2017, PRoW surface types, distances and consideration of the linkage of the public rights of way to the wider PRoW network, it is assumed that they are likely to be used primarily for recreational purposes (i.e. not used for accessing employment or community facilities).

4.9.6 Community Severance

4.9.6.1 Community severance is defined as the separation of residents from facilities and services that they use within their community. Community severance can be caused by existing highways or major roads as well as temporary road and public rights of way diversions or closures.

[15] This section only describes land that are used publicly which may be directly impacted by the Scheme. Private properties, private land and businesses are not included.

[16] Highways England (Spring 2018), A27 Arundel Bypass Report on public consultation.

4.9.6.2 The existing A27 divides Arundel into the northern Arundel old town (the historic town centre) and the predominantly residential area to the south. Most of the community facilities and services are to the north of the existing A27. Due to the current spatial pattern, distribution of development and uses in relation to existing transport infrastructure, it is likely that some level of community severance is currently experienced by the residents located to the south of the existing A27.

4.9.6.3 The communities of Fontwell, Walberton, Binsted, Tortington, Lyminster and Crossbush are potentially affected by existing community severance, where residents may be required to travel between communities to reach facilities and / or services that are not provided within their local area.

4.9.7 Human health

4.9.7.1 Using indicators, outlined in more detail in Section 12.7 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019), it is considered that overall, the health of people in the Arun District is comparable to the national average.[17] [18] [19] [20]

4.9.7.2 There are several factors that are likely to increase drivers stress along the existing A27 including congestion. These include congestion and travel delays, accident rates and accompanying diversions onto unsuitable roads, trepidation at pedestrian crossings and frustration at being unable to drive at a speed consistent with their own wishes.

4.9.7.3 The West Sussex Transport Plan 2011 - 2026 describes the A27 at Arundel as a bottleneck, where there are high accident rates and diversions onto unsuitable routes occurred at times of delay[21]. This delay increases the levels of driver frustration along with other factors, including existing pedestrian crossings through Arundel.

[17] Public Health England, Local Authority Health Profile: Arun District (03/07/18) Available online at: https://fingertips.phe.org.uk/profile/health-profiles/data#page/1/ati/101/are/E07000224 (Accessed: 19 July 2018)

[18] Arun District Council, Ward Profiles (2013) www.arun.gov.uk/ward-profiles (Accessed: 23 July 2018)

[19] NOMIS, 2011 Ward Labour Market Profile E36005987: Arundel (2011) www.nomisweb.co.uk (Accessed: 24 July 2018)

[20] NOMIS, 2011 Ward Labour Market Profile E36006007: Walberton (2011) www.nomisweb.co.uk (Accessed: 24 July 2018)

[21] West Sussex County Council West Sussex Transport Plan 2011 – 2026 (2011) Available: https://www.westsussex.gov.uk/media/3042/west_sussex_transport_plan_2011-2026_low_res.pdf (Accessed: 18 March 2019).

4.10 Road Drainage and the Water Environment

4.10.1 Surface Water

4.10.1.1 A buffer was applied to create the surface water Study Area. This involved creating a minimum of a 1km buffer from the furthest extent of the Scheme options as illustrated on Figure 13-1 of the PCF Stage 2 A27 Arundel EAR (August 2019) and contained in Appendix A in this report. This is considered a conservative approach based on professional judgement and experience of working in the area.

4.10.1.2 The River Arun, designated as a main river, flows through the centre of Arundel in a southerly direction to discharge to the sea approximately 6.5 kilometres downstream at Littlehampton. Two further designated rivers, Tortington Rife and Binsted Rife, discharge into the River Arun. The Study Area also has 2 tributaries of the Lidsey Rife (Figure 13-2) designated a main river at National Grid References 496644, 106031 and 496458, 106090 (West Walberton Lane). The tributaries converge approximately 800m downstream of the Study Area extent (to the of north of Nanny Copse) before discharging into the Lidsey Rife (main river) 2.8km downstream of their convergence as part of a network of ordinary watercourses.

4.10.1.3 The River Arun is classified as a heavily modified waterbody, with its current ecological quality assessed to be ‘moderate’ and chemical quality assessed to be ‘good’ (cycle 2, 2016) under the Water Framework Directive. Tortington Rife and Binsted Rife and the tributaries of Lidsey Rife have not yet been assessed against the objectives of the Water Framework Directive as determined by the Environment Agency. The tributaries of the Lidsey Rife flow into the main channel of the Lidsey Rife which is assessed against the objectives of the Water Framework Directive at National Grid Reference 494637, 103139 (outside of the Study Area). It is not designated as an artificial or heavily modified waterbody, with its current ecological quality assessed to be ‘moderate’ and chemical quality assessed to be ‘good’ (cycle 2, 2016). The scope of assessment will be established in PCF Stage 3 Preliminary Design.

4.10.1.4 There is a large network of named and unnamed ordinary watercourses within the Study Area that may be crossed by the Scheme (see Figure 13-1 of the PCF Stage 2 A27 Arundel EAR (August 2019) and contained in Appendix A in this report).

4.10.1.5 The Arundel Wetland Centre is located north of the Ford Road Roundabout. The wetland centre is important as both a nature reserve and an area of recreational amenity.

4.10.1.6 Surface water abstractions occur within the Study Area from Station Ditch, Brookfield Stream and other unnamed watercourses. Abstractions from these surface waterbodies are reported[22] to be used for agricultural, aquaculture, irrigation or industrial purposes.

4.10.1.7 There are 47 identified active discharge points in the Groundsure Environinsight[23]. The discharge points include discharges of road drainage to surface water features, including the River Arun.

4.10.2 Groundwater Features

4.10.2.1 The Study Area in relation to groundwater features and groundwater abstractions is up to a minimum of 1 kilometre from the furthest extent of the Scheme options. This distance is based on professional judgement of the assessor from experience of similar schemes and current knowledge of the area.

4.10.2.2 Groundwater features (such as aquifers) are dependent on the type of sediment found in underlying geological layers. British Geological Survey mapping[24] (see Chapter 3) shows that the Scheme options are founded upon a mixture of superficial deposits which comprise Head Deposits, River Terrace Deposits, Raised Beach Deposits, Raised Storm Beach Deposits, Raised Marine Deposits and Alluvium. These are underlain by the London Clay Formation, Lambeth Group (clay, silt and sand) and the White Chalk subgroup.

4.10.2.3 The Environment Agency Catchment Data Explorer[25] Service identifies the following significant groundwater features in the area:

- A principal aquifer
- Secondary A aquifers
- Secondary undifferentiated aquifer (within head deposits)
- Inner Zone (Zone 1) of a designated groundwater Source Protection Zone.

4.10.2.4 There are licensed groundwater abstractions within the Study Area. Water abstracted from these abstraction points is reported to be used for potable use and also non-potable use (including agricultural, aquaculture and irrigation uses).

[22] GroundSure Insights Ltd. (April 2015). Arundel.- Appendix 9-1 of the EAR
[23] Ibid
[24] BGS GeoIndex mapping accessed 11 March 2019
[25] EA Catchment Data Explorer accessed 11 March 2019

4.10.2.5 There are six active sewage discharge points to groundwater within one kilometre of the Proposed Scheme options.

4.10.2.6 Groundwater quality for the aquifers in the Chalk and Lambeth Group geological layers is monitored against the objectives of the Water Framework Directive.

- The overall quantitative status for groundwater quality of the Chalk aquifer to the north of Arundel has a current quantitative and chemical status of 'poor'.
- The overall quantitative status for groundwater quality of the Lambeth Group aquifer to the south and west of Arundel has a current quantitative and chemical status of 'poor'.

4.10.3 Flood Risk

4.10.3.1 The Study Area for the assessment of flood risk has been defined by the extent by which flood risk may be influenced and the extent of relevant flood zones. This is driven by the need to consider the impact of the Scheme to people and property elsewhere, regardless of their location, although for a scheme such as this it is typical to consider risks up to a distance of 1 kilometre from the Scheme.

4.10.3.2 The Environment Agency stated that the last recorded flood event south of Arundel was recorded to have taken place in 2014. The 2014 event affected most of the River Arun and Rother catchments.

4.10.3.3 There is fluvial and tidal flood risk associated with the River Arun, Tortington Rife and Binsted Rife.

4.10.3.4 Consultation with the Environment Agency confirmed that whilst there is some fluvial interaction, the predominant source of flooding is tidal. The Scheme passes through Flood Zone 2 (flood risk of between 0.1 and 1% of river flooding and 0.1 to 0.5% risk of sea flooding) and Flood Zone 3 (flood risk of between >1% of river flooding and >0.5% risk of sea flooding) adjacent to the River Arun as outlined in further detail in Section 13.6 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) and illustrated in Figure 13.1 - Water Constraints Map: All Variants of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) and included in Appendix A of this report. There are other areas of flood risk associated with water courses described in Section 4.10.1. A summary of the impact on the water environment on the Scheme options is outlined in the PCF Stage 2 A27 Arundel EAR (August 2019) Chapter 13: Road Drainage and Water Environment and summarised in Section 13.10.

4.10.3.5 The land surrounding the River Arun in the Study Area is currently defended by raised earth embankments that extend from Arundel to Littlehampton. The Environment Agency plans to discontinue the maintenance of these earthworks after a 50 year[26] period starting in 2014, further information on this is outlined in Section 5.9.4 of this report.

4.10.3.6 Fluvial flooding may occur from a number of small watercourses located to the west of Ford Road, isolated areas along the existing A27 alignment and in the centre of Arundel, further detail can be found in the PCF Stage 2 A27 Arundel EAR (August 2019) Chapter 13, Sections 13.7 and 13.9.

4.11 Climate: Greenhouse Gases

4.11.1.1 The Study Area for greenhouse gases (GHG) is not restricted by geographical area but instead includes any increase or decrease in emissions, from both construction and operation, as a result of the Scheme.

4.11.1.2 GHG emissions occur constantly, and widely, due to human and natural activity including energy consumption (fuel and power) and industrial processes. The greenhouse gas baseline is driven by the current emissions from existing traffic in the Study Area. The current estimated level of CO_2 in West Sussex (based on industrial, domestic and transport inputs) is 3,819,000 tonnes. This is equivalent to approximately 1% of the national CO_2 emissions. For further detail on the GHG baseline information, see Chapter 14 from the PCF Stage 2 A27 Arundel Bypass (August 2019).

4.11.1.3 There are no construction emissions within the baseline scenario.

4.11.1.4 The operation and management of existing assets (the current road network) is likely to require the consumption of a small number of components (for example, light bulbs and signage) as well as some bulk material (asphalt, cement, concrete, sand and gravel) and operation of plant and vehicles to deliver management and maintenance through minor works and repairs.

4.11.1.5 These materials will have embodied emissions associated with them, and the installation of these materials will result in emissions due to the transport of these materials, and plant use. These baseline emissions are expected to be negligible in the context of the Scheme.

[26] Statement of environmental particulars for the Lower Tidal River Arun Flood Risk Management Strategy [January 2014]

4.12 Climate: Vulnerability to Climate Change

4.12.1.1 The Study Area for the climate change vulnerability assessment is related to the impact of climate on the Scheme (rather than the impact of the Scheme on the environment). Therefore, the Study Area is the Scheme option footprints.

4.12.1.2 The scheme is located in the South-East of England which has a warm, dry climate, compared to the UK average over the period 1981 - 2010[27].

4.12.1.3 The region is drier than most parts of the UK. The long-term (1981 to 2010) average monthly rainfall shows May is the driest month (48.4mm) and October being the wettest month (105.4mm). The annual rainfall was 826.8mm (based on data from North Heath, 11 miles north of Arundel)[28].

4.12.1.4 The region is warmer than the UK average. The long-term (1981 to 2010) average shows July being the warmest month (21.8°C). High temperatures can lead to operational disruption due to deformation of road surface materials and unsafe working conditions.

4.12.1.5 The region is less windy than the UK average, with highest wind speeds occurring in January and lowest wind speeds occurring in August[29]. Further detail on the baseline conditions and climate trend can be found in Section 15.6 in the PCF Stage 2 A27 Arundel Bypass (August 2019).

4.13 Major Accidents and Disasters

4.13.1.1 The Study Area for Major Events has been developed based on professional judgement as there is no specific regulatory guidance nor significant precedent or standardised methodology. Both manmade and natural features, as well as distances, are factors that are used for setting the Study Area in order to capture internal and external influencing factors which may have high adverse consequences on the Scheme. The Study Area is illustrated in Figure 16-1 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) and included in Appendix A of this report.

4.13.1.2 A desktop study was undertaken to identify and collate all possible major events that could occur by considering existing facilities or natural features or scenarios (such as fluvial flooding) associated with the Study Area.

---

[27] Met Office, 2016. Southern England: climate. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/regional-climates/southern-england_-climate---met-office.pdf . Last accessed 13/08/2019

[28] Jenkins, G.J., Perry, M.C., and Prior, M.J. (2008). The climate of the United Kingdom and recent trends. Met Office Hadley Centre, Exeter, UK

[29] Jenkins, G.J., Perry, M.C., and Prior, M.J. (2008). The climate of the United Kingdom and recent trends. Met Office Hadley Centre, Exeter, UK

4.13.1.3 The Environmental Impact Assessment Regulations (2017) require a consideration of the potential vulnerability of the development to risks of major accidents and/or disasters.

4.13.1.4 An overview of the most significant baseline features likely to lead to sources of major events are shown in Table 4-4. These assets may act as a source to cause additional environmental effects should a major event occur.

Table 4-4 - Significant baseline features likely to be a source of major events

Existing feature or asset	Typical day-to-day activities
BP Petrol Station, Crossbush	Fuel storage and vehicle refuelling.
Crossbush Caravan Park	Camping and caravan site. LPG storage.
National Grid pylons or transmission lines	High voltage transmission lines.
Arun Valley (mid Sussex) railway line	Rail passenger and freight transportation.
Existing retained A27 route through Arundel	Road transport infrastructure.
River Arun	River and flood plain.
South Downs National Park	Residential properties, areas, recreational paths and visitors.
Binsted Wood Complex and Rewell Wood Complex LWS	Ancient woodland on the site is considered nationally important and irreplaceable.

4.13.1.5 The existing features or assets listed in Table 4-4 may, if affected by a major event, lead to significant environmental effects. These potential major events may comprise:

- Natural, such as:
  - Landslides
  - Sinkholes
  - Flooding (i.e. fluvial, surface water and groundwater)
  - Thunderstorms and gales
  - Extreme temperatures (e.g. heatwaves or sub-zero temperatures)
  - Droughts
  - Wildfires (e.g. forest fire or brush fire)
  - Poor air quality
- Manmade and technological, such as:
  - Transport accidents
  - Industrial and urban accidents
  - Unexploded ordinance
  - Infrastructure failure (e.g. bridge failure or flood defence failure).

4.13.1.6 Overall, the assessment concluded that there is no likely requirement for further mitigation measures as based on the information currently available in all the topic chapters in the PCF Stage 2 A27 Arundel Bypass EAR (August 2019). It is considered that the vulnerability of the Scheme to the risk of a Major Event is anticipated to be as low as reasonably practicable.

4.14 Conclusion

4.14.1.1 The above section summarises the existing environmental baseline conditions and Study Areas for each environmental topic which are outlined in full in the PCF Stage 2 A27 Arundel Bypass EAR (August 2019), which should be used as a reference for all further information to that outlined above. A summary of the assessment of the Scheme options is contained in chapter 12

Abbreviation

Abbreviation	Explanation
APIS	Air Pollution Information System
AQMA	Air Quality Management Area
ARN	Affected Road Network
DMRB	Design Manual for Roads and Bridges
EAR	Environmental Assessment Report
GHG	Greenhouse Gas
HPI	Habitat of Principal Importance
LCA	Landscape Character Area
LPG	Liquified Petroleum Gas
LWS	Local Wildlife Site
NIA	Noise Important Area
OS	Ordinance Survey
PCF	Project Control Framework
SAC	Special Area of Conservation
SDNP	South Downs National Park
SSSI	Site of Special Scientific Interest
TRA	Traffic Reliability Area

Glossary

Term	Definition
Affected Road Network	Affected roads are those that meet any of the following criteria: Road alignment will change by 5 m or more; Daily traffic flows will change by 1,000 Average Annual Daily Traffic (AADT) or more; Heavy Duty Vehicle flows will change by 200 AADT or more; Daily average speed will change by 10 km/hr or more; Peak hour speed will change by 20 km/hr or more.
Best and Most Versatile Soils	Agricultural land classification Grades 1-3a as defined in the National Planning Policy Framework. This is the land which is most flexible, productive and efficient in response to inputs and which can best deliver future crops for food and non food uses such as biomass, fibres and pharmaceuticals.

Term	Definition
Flood Zone 2	Land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.
Flood Zone 3	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.
Landscape Character Area	Landscape character may be defined as a distinct and recognisable pattern of elements, or characteristics, in the landscape that make one landscape different from another[30]
Made Ground	Man-made deposits such as embankments, spoil heaps, infilled land, quarries, road cuttings or disturbed ground.
Major accident	In the context of the Scheme, an event that threatens immediate or delayed serious damage to one or more of human health, welfare, the environment and requires the use of resources beyond those of the Applicant or its contractors to respond to the event. Serious damage includes one or more of the loss of life, permanent injury, permanent or long-lasting damage to an environmental receptor that cannot be restored through minor clean-up and restoration efforts. The significance of this effect will take into account the extent, severity and duration of harm and the sensitivity of the receptor.
Major event	Term used by Highways England to refer to either or both major accidents and disasters.
Medium Surface Water Flood Risk	Less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance in any given year.
Mineral Safeguarding zone	An area with the potential to be used for the future extraction of mineral resources or local and national importance.
Natural disaster	In the context of the Scheme, a naturally occurring phenomenon such as an extreme weather event (e.g. storm, flood, temperature) or ground-related hazard events (e.g. subsidence, landslide, earthquake) with the potential to cause an event or situation that meets the definition of a Major Accident as defined above.

[30] Natural England (2014). An Approach to Landscape Character Assessment.

Term	Definition
Principal aquifer	Layers of rock or drift deposits that have high intergranular or fracture permeability, meaning they usually provide a high level of water storage and may support water supply or river base flow on a strategic scale.
Secondary A Aquifer	Permeable layers capable of supporting water supplies at a local rather than a strategic scale, and in some cases forming an important source of base flow to rivers.
Secondary B Aquifer	Predominantly lower permeability strata which may in part have the ability to store and yield limited amounts of groundwater by virtue of localised features such as fissures, thin permeable horizons and weathering.
Secondary Undifferentiated aquifer	Assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
Traffic Reliability Area	The Traffic Reliability Area defines the sub-set of traffic data from the traffic model, that has been identified as suitable for informing the Environmental Assessment.
Waste	Any substance or object that is discarded, and that has not been subject to acceptable recovery (including recycling) or disposal.

A27 Arundel Bypass Scheme Assessment Report

Chapter 5 – Do Minimum Scenario

October 2020

CONTENTS

LIST OF TABLES

LIST OF FIGURES

5 Do Minimum Scenario

5.1 Introduction

5.1.1.1 Sections 5.2 to 5.8 of this chapter summarises how the forecasts of traffic conditions have been developed and presents traffic volume and journey time data for a do minimum scenario. These forecasts exclude the A27 Arundel Bypass scheme. They also describe how changes in traffic excluding the Scheme would affect future conditions for walking, cycling and horse riding. The traffic information from the A27 Arundel transport model (PCF Stage 2 Further Consultation) has been used to appraise the effects of the A27 Arundel Bypass scheme options.

5.1.1.2 Sections 5.2 to 5.8 also describes how changes in traffic in a do minimum scenario may affect social and demographic factors and the wider economy, including housing and population growth, productivity, economic development and the tourist industry.

5.1.1.3 For the purposes of the traffic and economic appraisal, a 2026 opening year and 2041 design year have been established to describe do minimum conditions. Forecast scenarios for the average AM, Inter-peak and PM peak periods have been developed. Sections 5.2 to 5.8 of this describes the year 2041 conditions.

5.1.1.4 It should be noted that the traffic forecasts presented in this chapter relate to the core scenario only.

5.1.1.5 Section 5.9 provides a summary of the future baseline conditions over the topic study areas. The future baseline environmental conditions are projected to year 2026, the Scheme opening year. This forecast is based on prescribed methods under DMRB (where applicable), professional judgement and experience on similar schemes.

5.2 Land use development

5.2.1.1 To develop the forecast scenarios, the committed and proposed land use and infrastructure development within the study area, and in the broad vicinity of the A27 has been established. A ‘core’ forecast scenario has been created based on:

- Planned development outside the modelled area
- Committed dwellings within the modelled area
- Committed jobs within the modelled area

5.2.1.2 Details of how the land use development has been utilised to inform the traffic forecasting for the core scenario is presented in detail within Chapter 11 of the PCF Stage 2 Further Consultation Combined Modelling and Appraisal Report (ComMA)[1] (August 2019)

5.2.1.3 Information was provided by local authorities in 2018 based on then current Local Plans and other planning data to determine the anticipated level of development. This information was recorded in an Uncertainty Log[2]. Land use development sites considered to be 'near certain' or 'more than likely' were included explicitly within the forecasts according to the definition contained within WebTAG Unit M4 – Forecasting and Uncertainty[3].

5.2.1.4 The total land use development assumed for the forecast scenarios is consistent with the levels described in the National Trip End Model (NTEM) version 7.2 datasets (March 2017). These are summarised below in Table 5-1.

Table 5-1 – TEMPRO Planning Projections

Location	Households		Jobs	
	2015	2041	2015	2041
Arun	70,051	87,587	57,622	63,275
Adur	27,962	32,249	25,913	28,344
Worthing	48,757	55,684	57,782	63,366

5.3 Infrastructure schemes

5.3.1.1 The transport infrastructure schemes that are included in the core scenario forecasts are listed below (see section 11.8 of the PCF Stage 2 Further Consultation ComMA):

[1] HE551523-WSP-GEN-SWI-RP-TR-00017-P03 – A27 Arundel Bypass, PCF Stage 2 Further Consultation Combined Modelling and Appraisal Report (August 2019)

[3] https://www.gov.uk/government/publications/webtag-tag-unit-m4-forecasting-and-uncertainty-may-2018

- A284 Lyminster Bypass/ Fitzalan link road – two sections, one to the south of the A27 at Crossbush to East Street in Littlehampton town centre, with a new roundabout on the A259 Worthing Road. The other section between Toddington Nurseries and the A259[4].
- A259 corridor improvements – between the new A259/A284 roundabout in the west and the A259/A280 roundabout in the east.
- Bognor Regis relief road – connecting the A29 at Shripney to the A259 at Felpham.
- A27 Worthing and Lancing - a preferred route has not been announced, but the latest arrangement of the scheme has been included within the forecasts.[5]
- Yapton Level Crossing – The existing crossing has a fixed life and will require replacement prior to 2025, and will not be replaced on a like-for-like basis. Extended crossing closure times will be introduced on the local road.
- Arundel 20mph zone – covers roads within Arundel and a 30mph speed limit on Mill Road
- Fontwell – access changes at the A27/A29/Arundel Road roundabout
- Ikea signalised access junction – located on the A27 at Lancing.

5.4 Traffic growth

5.4.1.1 The level of traffic growth within the A27 transport model is based on data from a number of sources. Forecasts of the overall growth in car trips was obtained from TEMPRO version 7.2, a software tool that provides projections of growth over time for use in transport models based on outputs from NTEM. Growth for Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV) was obtained from the National Transport Model (NTM using National Road Traffic Forecasts (NRTF) 2018 (Scenario 1, September 2018).

[4] A sensitivity test has been undertaken which excludes the northern section of the proposed Lyminster Bypass from the 'do minimum' scenario. The outcome of this assessment is presented in Chapter 10

[5] A sensitivity test has been undertaken to exclude the Worthing and Lancing scheme from the 'do minimum' scenario. The outcome of this assessment is presented in Chapter 10.

5.4.1.2 The combination of NTEM growth, NRTF growth and development-specific traffic combine to make up the forecast year matrices for each peak period. The total traffic movements and percentage growth by journey purpose between the years 2015 and 2041 within the modelled area is set out in Table 5-2. The level of traffic growth in the A27 transport model has decreased relative to the level of growth that was set during PCF Stage 2 (described further in Chapter 8).

Table 5-2 – Traffic Growth to 2041

Purpose	Peak	2015	2041	%Difference
Car Business	AM	3280	3883	18.4%
	PM	3005	3523	17.2%
Car Commute	AM	12237	14086	15.1%
	PM	13453	15310	13.8%
Car Other	AM	17088	22293	30.5%
	PM	23441	29146	24.3%
LGV	AM	5863	8275	41.1%
	PM	5476	7729	41.1%
HGV	AM	3961	4357	10.0%
	PM	2893	3200	10.6%
Total	AM	42429	52894	24.7%
	PM	48268	58908	22.0%

5.5 Traffic flows

5.5.1.1 Figure 5-1 presents the 2041 AADT volumes in the do minimum scenario, together with the percentage change from the 2015 base year and the HGV percentage.

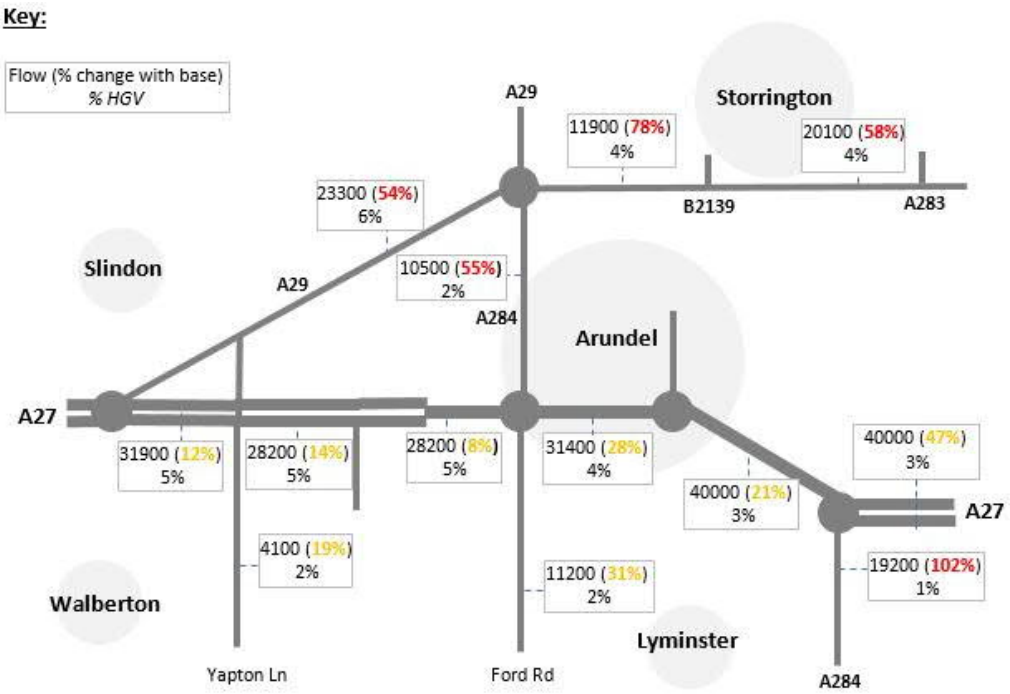


Figure 5-1 - 2041 do minimum AADT forecast

5.5.1.2 There is an increase in AADT in 2041 for all sections of road. Along the A27, the greatest percentage increase is on the dual carriageway section of the A27, east of Crossbush. This is followed by the section between Ford Road roundabout and the Causeway roundabout. However, the percentage increases on the A27 are modest relative to the increase on local roads and are constrained through Arundel relative to the overall growth percentages shown in Table 5-2.

5.5.1.3 The forecast increase in traffic on particular sections of the A27, without the implementation of a scheme, will exacerbate the current congestion issues. It is also considered that the existing capacity constraints along the single carriageway sections of the A27 would result in the diversion of traffic onto lower order roads, resulting in the traffic increases seen on local roads such as the A284 and through Storrington.

5.5.1.4 Figure 5-2 and Figure 5-3 present the year 2041 percentage change on base year AM and PM peak period traffic flows and volume / capacity[6] (V/C) for the same locations presented in Chapter 3. The maximum Ratio of Flow to capacity (RFC[7]) or Degree of Saturation (DoS[8]) at Ford Road roundabout and Crossbush junction, based on the respective junction assessments under a 2041 do minimum scenario, is also indicated on these figures.

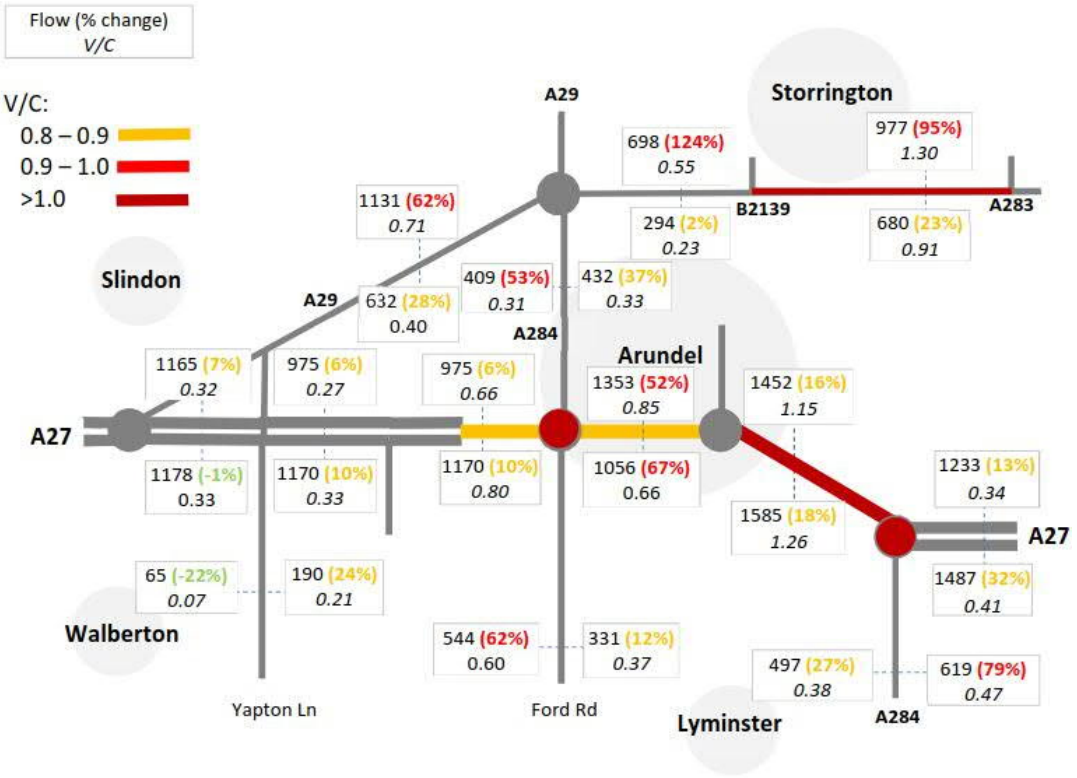


Figure 5-2 - 2041 do minimum peak period forecast (AM)

[6] Capacity is defined in TA 79/99 as the maximum sustainable flow of traffic passing in one hour, under favourable road and traffic conditions and is measured in one-way hourly flow in each direction

[7] The Ratio of Flow to Capacity (RFC) is a measure of how well roundabout and priority junction approaches perform under varying flow conditions. In the case of roundabouts, the capacity is determined by the entry flows, circulatory flows and the junction geometric parameters. Similarly, for priority junctions, the scale of magnitude of opposed and opposing movements influence capacity, besides geometry. Typically, an RFC of less than 0.85 is considered to indicate satisfactory performance

[8] Degree of saturation (DoS) is a measure of how well an approach lane to a signalled junction is performing. It is the ratio of the number of vehicles known to be approaching a stopline over an hour (the demand flow), to the number of vehicles which can actually get over the stopline (the capacity). A stopline with a DoS level below 90% is said to have spare capacity, whilst a value above 90% indicates queues and congestion

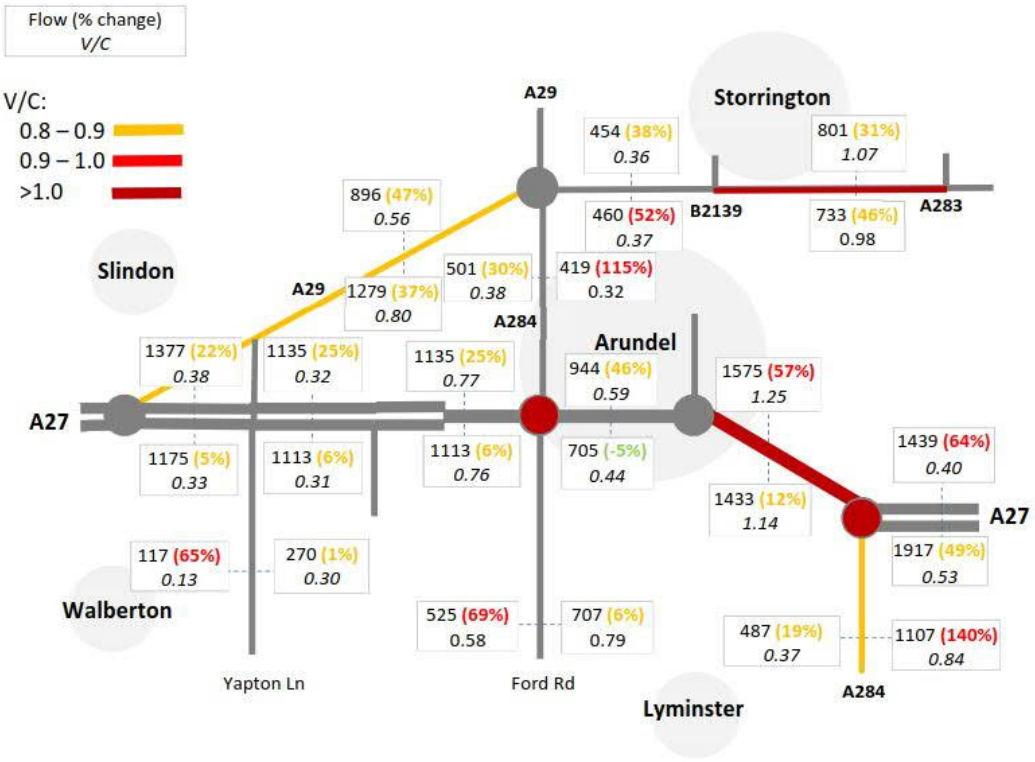


Figure 5-3 - 2041 do minimum peak period forecast (PM)

5.5.1.5 On the A27 traffic volumes increase by up to 67%. The sections that experience the highest of these increases are westbound in the AM between Ford Road roundabout and Causeway roundabout, and eastbound in the PM on the section east of Crossbush junction. This is closely followed by the eastbound section between the railway station and Crossbush junction.

5.5.1.6 There are some sections of the A27 where a reduction in traffic flow is forecast in comparison to the base year. These include westbound between A29 and Yapton Lane in the AM, and westbound between Causeway roundabout and Ford Road roundabout in the PM. The reduction in traffic flows on the westbound section of the A27 west of Yapton Lane may be due to the re-routeing of traffic on Yapton lane as a consequence of the proposed level crossing. The drop in flows on the A27 westbound between Ford Road and Causeway roundabouts may be due to the reassignment of traffic onto minor roads in response to the congested conditions at these roundabout during the PM peak in 2041.

5.5.1.7 The single carriageway section of the A27 between Causeway roundabout and Crossbush junction is shown to be over capacity in both the AM and PM peak. The effect of the capacity constraints is for some traffic to re-route to less suitable roads, and the increases in traffic flows on local roads is generally higher than on the A27.

5.5.1.8 The locations with the highest increases in traffic flow include the southern section of the A284 travelling southbound which is associated with the capacity improvements provided by the Lyminster bypass. Although there are significant increases in flow on these local roads, the volume of traffic does not exceed the capacity of each link.

5.5.1.9 Table 5-3 and Table 5-4 summarise the operational modelling results of Ford Road roundabout and Crossbush junction in 2041 for both peak periods. Both junctions are forecast to operate significantly in excess of capacity by 2041.

5.5.1.10 The results in Table 5-3 indicate that, under a 2041 do minimum scenario, the A27 west (eastbound approach) and Ford Road would operate over capacity[9] with RFCs exceeding 0.9 and ensuing long queues in the AM peak. The A27 west is predicted to operate over capacity in the PM peak as well, with an RFC of more than 1.

Table 5-3 – Ford Road Junction Assessment (2041 do minimum AM and PM Peak)

Junction Arm	AM Peak (2041)			PM Peak (2041)		
	RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
A284	0.74	3	15.93	0.51	1	9.34
Maltravers Street	0.41	1	11.48	0.73	3	22.77
A27 East (Arundel Bypass)	0.88	7	21.48	0.72	3	11.56
Ford Road	0.94	10	61.88	0.77	3	20.81
A27 West (Chichester Road)	0.99	20	65.88	1.04	41	103.95

[9] An RFC of less than 0.85 is considered to indicate satisfactory performance for a roundabout arm. An RFC above 0.85 would result in significant queues and delays

Table 5-4 – Crossbush Junction Assessment (2041 do minimum AM and PM Peak)

Arm / movement	Lane(s)	AM Peak (2041			AM Peak (2041)		
		DoS (%)	MMQ (PCUs)	Delay (s/PCU)	DoS (%)	MMQ (PCU)	Delay (s/PCU)
A27 Westbound Left Turn	1/1	25	4	1	91	31	9
A27 Westbound Ahead	1/2	121	171	138	106	75	47
A27 WB Circulatory	2/1	89	16	8	52	8	3
A284 Northbound	3/1+3/2	119	62	55	106	39	30
A284 N/B Circulatory Right Turn	4/1	79	2	2	78	2	2
N/B Circulatory Give-way Right	5/1	41	4	1	41	4	1
Total Delay (PCU hr)		204.62			92.42		
Practical Reserve Capacity (%)		-34.5			-17.8		

5.5.1.11 Table 5-4 indicates that, in the absence of any capacity improvement, the already congested conditions on the A27 westbound and the A284 northbound approaches would be exacerbated, during both peak periods, with significantly longer queues and delays than those currently experienced by motorists at Crossbush junction.

5.6 Journey times

5.6.1.1 Table 5-5 shows the year 2041 forecast journey times along the A27 for the same locations presented in Chapter 3. Free flow conditions are represented by the eastbound direction in the base year IP period (10 minutes 3 seconds).

Table 5-5 – 2041 Journey Times (mm:ss)

Route	AM	IP	PM
A27 Eastbound			
Journey time	11:59	13:06	16:58
Increase relative to free flow conditions	01:56	03:03	06:55
A27 Westbound			
Journey time	13:35	11:48	12:34
Increase relative to free flow conditions	03:32	01:45	02:31

5.6.1.2 In a do minimum scenario, journey times would deteriorate further, compared to the base year (see Chapter 3). With the A27 operating in excess of its capacity, traffic conditions would become increasingly unreliable and unpredictable. This would result in consequential impacts on the economy, and on journey quality, with increased levels of stress for drivers.

5.6.1.3 The eastbound direction in the PM peak continues to experience the longest journey times which increases by almost 7 minutes compared with free flow conditions along the route. For the same direction in the AM and IP, the journey time increases by around 2 minutes and 3 minutes per vehicle respectively. For the westbound movement, the AM peak would see the highest increase in journey times, with over 3 minutes delay in comparison to the base year journey times.

5.7 Walking cycling and horse riding (WCHR)

5.7.1.1 Without the implementation of a scheme along the A27 at Arundel, travel conditions for WCHRs are expected to deteriorate.

5.7.1.2 The increase in vehicle numbers along the A27 and the limited crossing facilities will increase the severance between the north and south of Arundel. This would be particularly notable at the Ford Road roundabout, which lacks controlled crossing facilities. As a result of this, people may be further discouraged to travel on foot or by cycle, and opt to travel by vehicle. This may further contribute to the increased flows both on local roads and on the A27.

5.7.1.3 The collision rate would be expected to increase as a result of traffic growth. This would further dissuade vulnerable road users such as horse riders and cyclists from using the travel network.

5.7.1.4 Those that continue to walk and cycle will continue to rely upon the signalised crossing for access to the Arundel railway station and this is a factor in the constrained link capacity which limits vehicle throughput along this section of the A27.

5.7.1.5 The significant increases in traffic along some of the local roads will change the nature of these routes, many of which are rural country lanes and not intended for use as strategic through-routes. The conditions for pedestrians and cyclists along these routes are expected to deteriorate without intervention, with journey quality and health and safety impacts.

5.8 Wider economy

5.8.1 A27 corridor impacts

5.8.1.1 An increase in the level of delay and congestion along the A27 at Arundel will impact upon the performance of the route, resulting in a further constraint on the strategic function of the corridor for longer distance traffic movements. The route has an important role in providing accessibility across a wider area and supporting economic activity and growth within the region.

5.8.1.2 Based on Office for National Statistics (ONS) Gross Value Added (GVA) regional data, West Sussex currently falls behind other parts of the South East in terms of GVA per head generated and travel conditions and accessibility can be seen as a constraint for the local population in terms of access to employment.

5.8.2 Housing and population growth

5.8.2.1 Population estimates from the ONS show that Arun is the most populous district in West Sussex, and it represents 19% of the county's population. Figure 5-4 depicts the ONS population growth forecasts for West Sussex between 2014 and 2039 indicating that there will be an additional 37,000 residents within Arun by 2039.

Figure 5-4 - Population Growth by District in West Sussex 2014 to 2039 (Source ONS)

5.8.3 Productivity

5.8.3.1 GVA per head in the Arun and Adur districts has been lower than the UK average, and the 'productivity gap' between the two districts and UK has been increasing over time. The gap for Arun District Council for example was just under £3,900 per head in 1997 whereas by 2015 this had more than doubled to £9,600. Without improved transport provision, the productivity gap is likely to increase as delays and congestion will continue on the road network[10].

5.8.4 Future economic development

5.8.4.1 Coastal West Sussex's Economic Plan stresses the importance of road infrastructure improvements, specifically along the A27 corridor, in improving local economic prospects. The A27 Arundel Bypass will enhance connectivity between urban areas and enable skilled workers and young people to access higher values jobs and education opportunities in Chichester, Worthing and beyond[11].

[10] The Eddington Transport Study (2006)

[11] Coastal West Sussex, Economic Plan, Coastal West Sussex Partnership Board 2016-20

5.8.4.2 To support local economic development, The Arun Place Plan[12] sets out the emerging priorities for the District which could deliver over 5,000 jobs. These include investment in:

- Littlehampton – A284, A259, town centre and seafront, and public estate optimisation
- Bognor Regis – Enterprise Bognor Regis, town centre and seafront, University of Chichester, and 'Better Bognor' concept
- skills development in emerging growth locations through the Local Plan process
- support for tourism and healthcare sectors to take advantage of future opportunities and to meet demographic challenges in the District

5.8.4.3 These priorities are consistent with and will contribute to the Coast to Capital Local Enterprise Partnership (LEP) targets to develop 970,000 square metres of employment floor space by 2021[13].

5.8.4.4 The accessibility of the local area will be an important factor in the potential to deliver growth and inward investment. Transport infrastructure deficits at existing junctions[14] may constrain the potential of some of the proposed development both commercial and residential land, with the benefits of investment in Arun and wider West Sussex not being fully realised[15].

5.8.4.5 The ability of an area to secure higher value employment, develop the skills of the labour force and deliver improved levels of GVA depends upon supporting transport infrastructure. Where accessibility constrains labour market catchments, opportunities to resolve skill gaps and realise business growth opportunities will be missed.

5.8.4.6 For example, the potential for a comprehensive investment package to support existing and new development in Littlehampton town centre and seafront may be limited by existing accessibility issues[16]. This would present a missed opportunity to support and develop the tourism economy and realise GVA growth in this sector.

[12] The Arun Place Plan, Arun District Council and WSCC (January 2016)
[13] Coastal West Sussex, Economic Plan, Coastal West Sussex Partnership Board 2016-20
[14] Arun Transport Study, Stage 3, 2016, Chapter 4.2
[15] Arun Local Plan 2011-2031 (Adopted July 2018), 15.3.2
[16] Ibid

5.8.4.7 The A27 Arundel Bypass scheme is a key part of the future vision of Arun[17]. Without the scheme, existing traffic constrained junctions could act as a barrier to development, as investors may invest in other areas that have higher quality transport links and which require less investment in off-site junctions works. The scheme could negate the need for mitigation at capacity constrained junctions in the district[18]. If these sites still come forward without the bypass, they may not reach their full potential without improved transport infrastructure.

5.8.5 Tourism sector

5.8.5.1 The visitor economy in West Sussex is another key driver of economic activity and is subject to the adverse impacts of constrained highway capacity, especially during busy holiday periods[19].

5.8.5.2 With the area being situated on a strategic road corridor for visitors making journeys to and from attractions further afield, the high levels of congestion and unreliable journey times will continue to hold back the potential of the sector.

5.9 Environmental Conditions

5.9.1.1 Chapter 4 provided a summary of the environmental baseline over the topic study areas. This section discusses the potential future baseline conditions over the topic study areas without the scheme (the do minimum scenario). The future baseline environmental conditions are projected to year 2026, the Scheme opening year. This forecast is based on prescribed methods under DMRB (where applicable), professional judgement and experience on similar schemes.

5.9.1.2 For the majority of environmental topics, the future baseline conditions will remain similar to the baseline condition summarised in Chapter 4 and de described in detail in the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

5.9.1.3 Where future baseline conditions are considered to potentially change through natural processes, these are highlighted in the relevant discipline topic below.

[17] Ibid,

[18] Arun Transport Study, Stage 3, 2016, 5.6.2

[19] Sussex-by-the-Sea Visitor Strategy (2006-2011)

5.9.1.4 No changes, or negligible changes are expected in the following topics: Cultural heritage, materials, geology and soils, and major events and have therefore been scoped out of this assessment.

5.9.2 Air Quality

5.9.2.1 The air quality projection for the future baseline is based on Interim Advice Note 170/12v3 and considers the air quality at the time of opening year (2026).

Human Receptors

5.9.2.2 Future baseline concentrations are likely to be lower due to reductions in vehicle exhaust emissions of PM_{10}.

5.9.2.3 Between the 2016 baseline and the 2026 opening year, ambient NO_2 concentrations are expected to decrease across the Study Area. The do-minimum model for 2026 predicts that annual mean NO2 concentrations at receptors within the Storrington Air Quality Management Area (AQMA) will be lower than in 2016 but would still be in excess of the air quality standard in some areas. The other AQMAs (e.g. Chichester (Stockbridge) AQMA), had modelled concentrations would be lower than in 2016 and below the air quality standard.

Ecological Receptors

5.9.2.4 Between the 2016 baseline and the 2026 opening year, both ambient NO_x concentrations and nitrogen deposition levels are expected to decrease over the sites designated for nature conservation.

5.9.2.5 Background NOx concentrations would, therefore, remain well within the critical level for the protection of vegetation of 30µg/m^3 over the Fairmile Bottom and Arundel Park SSSIs (and Sullington Warren SSSI and Amberley Mount to Sullington Hill SSSI).

5.9.2.6 Whilst deposition levels are predicted to decrease, they would continue to exceed the critical load range for the most sensitive habitat (Broadleaved, Mixed and Yew Woodland, 5 – 15 kgN/ha/yr). The 5-kilometre by 5-kilometre average deposition levels are expected to range from 16.5 – 18.0 kgN/ha/yr for woodland habitats over the SSSIs and 10.0 – 11.5 kgN/ha/yr over grassland habitats.

5.9.2.7 Do-minimum 2026 dispersion modelling shows that exceedances of the critical level for the protection of vegetation for annual mean NO_x will remain widespread along the major routes in the study area, although the magnitude of the exceedances and the distance from the roadside at which concentrations decrease to within the critical level decreases from the 2016 baseline. The exceedances of the critical level extend to around 20 metres from the A29 and 10 metres from the A284. As in the 2016 baseline, concentrations fall rapidly to background levels away from the roadside.

5.9.3 Biodiversity

5.9.3.1 The future biodiversity baseline in 2026 is not anticipated to differ significantly from the current baseline. It is recognised that there may be changes to the following ecology feature types in the future, however, these changes are assumed rather than certain.

5.9.3.2 Otter (*Lutra lutra*) populations are increasing in the UK[20] and otters are increasingly frequently seen in Sussex[21]. There is no evidence of their occurrence in the vicinity of the Scheme at present, but the habitat in the area is suitable to support a small number of otter territories. If their range continues to increase throughout Sussex they may be present in the future.

5.9.3.3 It is likely that ash trees (*Fraxinus excelsior*) in the area will die because of ash dieback[22], so gaps in woodland and tree lines can be expected to occur where this species is currently present.

5.9.3.4 Operational effects have therefore been assessed against the current baseline.

5.9.4 Road Drainage and the Water Environment

5.9.4.1 There is a potential for the ordinary freshwater watercourses to eventually become a more saline and tidally influenced environment if the existing earth embankments are no longer maintained (undefended scenario). This could change the existing characteristics of the catchment including the ecology over time.

[20] The Mammal Society. (2018). Britain's Mammals 2018 The Mammal Society's Guide to their Population and Conservation Status. The Mammal Society

[21] Sussex Wildlife Trust (2018). [on-line] https://sussexwildlifetrust.org.uk/news/otter-spotted-in-central-sussex (accessed November 2018).

5.9.4.2 The most significant change in the baseline conditions is likely to be associated with an increase in peak river flows and peak rainfall intensity associated with the potential effects of climate change. The peak rainfall intensity may also increase as a result of climate change, which could potentially increase the risk of surface water flooding to the site.

5.9.4.3 The Environment Agency in this region acts as the Internal Drainage Board. The Lower Tidal River Arun Flood Risk Management Strategy states that the existing earth embankments will be maintained for the next 50 years. After 50 years the strategy indicates that maintenance would stop, and new inland defences would be built to protect Arundel from flooding. For more information refer to Section 13.6 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019), Chapter 13: Road Drainage and the Water Environment.

5.9.4.4 The lack of maintenance and subsequent deterioration of the raised earth flood defences along the River Arun may also increase the susceptibility of the agricultural land within the study area to flooding.

5.9.4.5 Under the Water Framework Directive, the overall quantitative status for groundwater quality in the Chichester and Lambeth Group aquifers are expected to improve from a 'poor' chemical status, to a 'good' chemical status by 2027.

5.9.5 Landscape and Visual

5.9.5.1 Both local landscape character and visual amenity within the South Downs National Park (SDNP) are unlikely to be subject to new major changes as its status offers it a high level of protection. However, the localised effect of traffic levels on the existing A27 road corridor are liable to continue for the foreseeable future and could deteriorate further.

5.9.5.2 Outside the SDNP, undesignated landscapes are vulnerable to a range of pressures including:

- Residential expansion of settlements
- The intensification of agriculture
- Poor management of existing woodland and parkland
- The decision by the Environment Agency to cease the maintenance of the river Arun flood defences is likely to result in changes to the floodplain (such as flooding of agricultural land and the public right of way along the Arun river). This may result in a more naturalised landscape (and slightly increased quality) but could physically degrade the public right of way.

- The A27 around the Ford Road roundabout and at Crossbush, will remain dominated by traffic and existing traffic flow problems could intensify further.

5.9.6 Population and Health

5.9.6.1 The "Do Nothing" scenario for 2026, and traffic flow figures for opening year (2026) and design year (2041) for each Scheme option for driver stress calculations have been calculated using traffic modelling and predicted levels of growth.

5.9.6.2 There would be no change to views from the road for the existing A27. Driver stress has the potential to worsen due to the anticipated increase in traffic on the A27 and surrounding road network.

5.9.6.3 There would be no change for pedestrians, cyclists and equestrians' amenity and journey length.

5.9.6.4 No new or relief from community severance is anticipated at the future baseline/do minimum scenario.

5.9.6.5 There is the potential for health outcomes to worsen should the anticipated increase in traffic result in an increase in noise and/or poorer air quality at specific locations.

5.9.7 Climate – Greenhouse Gases

5.9.7.1 The future baseline for end user emissions is calculated in accordance with HA 207/07[23]

5.9.7.2 During operation, the baseline emissions produced by traffic on the road network without the scheme in place are set out in Table 5-6 (adapted from Chapter 14 in the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

[23] Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 Air Quality; HA 207/07 (2017) Available at http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/ha20707.pdf [last accessed Jul 2018]

Table 5-6 – Future Baseline/Do Minimum Scenario Traffic Emissions

Year	Baseline DM traffic emissions (tCO2e)
2026	327,073
2041	357,027
Average Year	353,059
Total emissions over schemes reference lifespan	21,537,013

5.9.8 Climate – Vulnerability to Climate Change

5.9.8.1 In the 'Do Nothing' scenario in 2026, the climate of the study area is expected to be broadly similar to that experienced today. Whilst there is evidence that the UK is warming[24], the UKCP18 climate projections show more significant changes in temperature and rainfall from the 2040's onwards. In the 'Do Nothing' scenario in 2026, the existing road will be vulnerable to extreme weather events (as it is today) such as: intense rainfall which may overwhelm drainage infrastructure, leading to flooding; and extreme temperature events (heatwaves) which could cause damage to the pavement and vegetation.

5.9.9 Noise and Vibration

5.9.9.1 Future baseline scenarios have been modelled in accordance with DMRB HD 213/11. The future modelling scenarios correspond to opening year 2026 and design year 2041. The traffic modelling includes the trip generation resulting from committed developments in the area.

5.9.9.2 An analysis of effects of the future baseline in the opening and future years is below in Table 5-7, taken from Chapter 11 in the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

[24] Met Office undated. UKCP18 Headline Findings. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-headline-findings-2.pdf [last accessed August 2019]

Table 5-7 – Future Baseline Summary

Receptor areas	Effects
Existing properties east of Crossbush	A change of +4 dB at facades in the opening and future years compared to the baseline year, with properties nearest the A27 above the SOAEL in both future years, particularly within NIA12485.
Existing properties south of Crossbush	A change of +2 dB at façades in the opening year and +3 dB in the future year compared to the baseline year. with properties nearest the A284 most affected by the change in the future year. NIA 12487 would experience a change of +2 dB in the opening year and +3 dB in the future year.
Existing properties north Ford Road Roundabout	Facades to the north of Ford Road roundabout would largely experience negligible changes in noise levels compared to baseline in both opening and future years. Noise levels within NIA 5486 would also experience a negligible change.
Existing properties on Fitzalan Road	Facades facing the A27 would experience a change of around +2 to 3 dB in the opening and future years compared to baseline.
Existing properties on Ford Road	A change up to +2 dB in the opening and future years compared to baseline, which is likely to increase noise levels for some properties to the east of Ford Road to above the SOAEL.
Existing properties in Tortington	Mainly influenced by Ford Road, façades in Tortington experience an increase of up to +2 dB in the opening and future years compared to baseline.
Existing properties south of A27, west of Ford Road Roundabout	A change of +2 dB in the opening and future years compared to baseline. NIAs 5487, 5488, 12488, 5485, and 5486 would experience the same increase above the SOAEL in both years.
Existing properties in Binsted	A change of +1 to 2 dB compared to baseline in the opening and future years influenced by the A27 to the north.
Existing properties in Walberton	Mainly negligible with some beneficial changes on façades facing The Street, Tye Lane and Eastergate Lane. Properties to the north close to the A27 experience a 1 to 2 dB increase to baseline. NIAs 5490 and 6158 will experience an increase of around 1 dB over the SOAEL compared to baseline.

Receptor areas	Effects
Existing properties in Slindon	The majority of properties will experience a change of up to +2 dB in the opening and future year. A limited number of properties will experience noise level changes above +2 dB along School Hill into Slindon

5.9.9.3 The location of the NIA's given in Table 5-7 are shown in Figure 11-1 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) and included in Appendix A of this report.

Abbreviations

Abbreviation	Explanation
AADT	Annual Average Daily Traffic
AQMA	Air Quality Management Area
DMRB	Design Manual for Roads and Bridges
DoS	Do Something
GVA	Gross Value Added
HGV	Heavy Goods Vehicles
IP	Inter Peak
LEP	Local Enterprise Partnership
LGV	Light Goods Vehicles
NIA	Noise Important Area
NRTF	National Road Traffic Forecast
NTM	National Transport Model
NTEM	National Trip End Model
RFC	Ratio of flow to capacity
SDNP	South Downs National Park
SSSI	Site of special scientific interest
TEMPro	Trip End Model Presentation Program
V/C	Volume to Capacity
WebTAG	Web-based Transport Analysis Guidance
WCHR	Walking Cycling and Horse Riding

A27 Arundel Bypass Scheme Assessment Report

Chapter 6 – Alternative Options

October 2020

CONTENTS

LIST OF TABLES

LIST OF FIGURES

6 Alternative Options

6.1 Introduction

6.1.1.1 The Project is following the PCF process shown in Figure 6-1. This chapter describes the development of alternative options for the Scheme in Stage 0 and Stage 1 which resulted in a Preferred Route Announcement (PRA) in May 2018. Subsequent development of alternative options is described in Chapter 7.

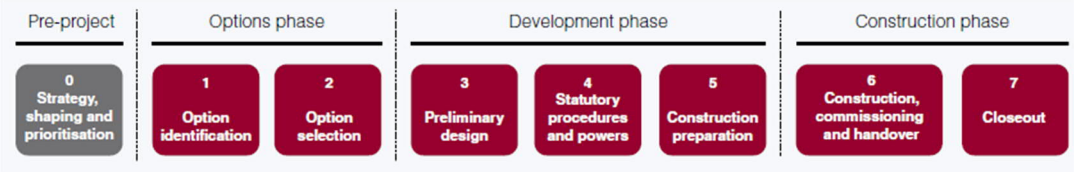


Figure 6-1 - Highways England's Project Control Framework

6.1.1.2 Proposals for the improvement of the A27 at Arundel have been the subject of extensive study and consultation for many years. A number of routes for a bypass have been proposed including a Preferred Route (PR) known as the Pink/Blue route announced by the Secretary of State (SoS) in July 1993. The main events providing background context to the current Scheme are outlined in Chapter 1.

6.1.1.3 In 2013, HM Treasury's Investing in Britain's Future[1] set out a programme of infrastructure investment, including provision for a feasibility study for the A27 corridor on the south coast[2].

[1] HM Treasury "Investing in Britain's future," June 2013. [Online]. Available https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/209279/PU1524_IUK_new_template.pdf [Accessed 09 July 2019]

[2] Highways Agency, "A27 Corridor Feasibility Study," February 2015. [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/409062/a27-report-3-inv-cases-report.pdf. [Accessed 20 June 2019].

6.1.1.4 That study evaluated several potential solutions to problems at Arundel of which two were identified as offering the greatest case for investment. These both comprised a dual carriageway bypass to the south of Arundel and the existing A27 and extending into the South Downs National Park (SDNP):

- Option A – Based on the previous 1993 preferred route (pink/blue route)
- Option B – Longer route to avoid ancient woodland at Tortington Common.

6.1.1.5 Following the completion of the feasibility study in March 2015, the Department for Transport (DfT) published its Road Investment Strategy for 2015-20[3] (RIS 1) containing proposals for a new dual carriageway bypass to link together the two existing dual carriageway sections of the road either side of Arundel. The starting point was proposed to be the previous 1993 preferred route, subject to consultation with the South Downs National Park Authority (SDNPA), local government and the public on this and alternatives.

6.1.1.6 RIS 1 also made a commitment to develop sustainable transport measures at Arundel.

6.2 Project Control Framework (PCF) Stage 0

6.2.1.1 The PCF Stage 0 Report[4] reviewed the evidence from the A27 Corridor Feasibility Study and confirmed that both the Option A and Option B from the A27 Feasibility Study would provide a practical solution for the Scheme and should be subject to further assessment in PCF Stage 1 (Option Identification). Alignments were developed for these options and they were renamed as Option 3 and Option 4 respectively.

6.2.1.2 The PCF Stage 0 Report also included a recommendation for 5 alternative options to be considered in PCF Stage 1 (Option Identification). The recommendation for additional alternative options included non-dual carriageway options, online dual carriageway options and shorter offline options.

6.2.1.3 A brief description of all the options recommend for consideration in Stage 1 is provided in Table 6-1.

[3] Department for Transport, "Road Investment Strategy: for 2015/16 – 2019/20 Road Period," March 2015. [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/408514/ris-for-2015-16-road-period-web-version.pdf [Accessed 20 June 2019]
[4] Highways England, "A27 Arundel Improvements Road Investment Strategy PCF Stage 0 Report - Strategy, Shaping and Prioritisation," September 2015

6.2.1.4 The Stage 0 study process included a programme of stakeholder meetings to inform scheme strategy and prioritisation. In July 2015 a Stakeholder Workshop[5] was held, attended by 22 organisations excluding Highways England and WSP. The event included an individual exercise, a breakout session, a comment session and a question and answer session.

- The individual exercise focussed on identifying the current issues that stakeholders have with the A27 as well as what they felt needed improvement.
- The breakout session consulted on the different concepts currently being considered and asked stakeholders to provide their opinion, including advantages and disadvantages of each option.
- The comments session allowed attendees to provide further suggestions on scheme solutions and comment on current objectives for the scheme.
- The questions and answer session provided delegates with an opportunity to debate any general queries relating to the scheme.

Table 6-1 - Recommended Options for further assessment in PCF Stage 1

Option	Description
Option 0A	Junction improvements at Crossbush Junction, Causeway roundabout and Ford Road roundabout. The existing single carriageway section of the A27 would be retained.
Option 0B	Dual 2 lane urban all-purpose road (D2UAP) on the line of the existing A27 with junction improvements at Crossbush Junction, Causeway roundabout and Ford Road roundabout. With direct access and gaps in central reserve.
Option 1	Dual 2 lane urban all-purpose road (D2UAP) on the line of the existing A27 to the west of Ford Road. Then offline Dual 2 lane all-purpose road (D2AP) to the south of the existing A27 across the River Arun floodplain to tie into Crossbush Junction.
Option 2	D2AP offline bypass to the south of the existing A27. From Crossbush Junction the route passes just south of Arundel Railway station, skirts the existing A27 Arundel Relief Road

[5] WSP|Parsons Brinckerhoff on behalf of Highways England, "A27 Arundel Improvements Stakeholder Meeting July 2015," October 2015. [Online]. Available: https://s3.eu-west-2.amazonaws.com/assets.highwaysengland.co.uk/roads/road-projects/A27+Arundel+Improvement/55123_A27A_Report_V1.4_StkhWks.pdf [Accessed 10 July 2019]

Option	Description
	across the River Arun floodplain. It then crosses Ford Road to the north of Tortington Priory. It then follows the line of Tortington Lane passing through the ancient woodland at Tortington Common and Stewards Copse close to properties at Birch Close and Hazel Grove in Arundel before connecting to the existing A27 near The White Horse Hotel.
Option 3	D2AP offline bypassing to the south of the existing A27. From Crossbush the route crossed the River Arun floodplain to the south of Arundel. It crossed the river Arun and Ford Road to the south of Tortington Priory. It then turned to pass through the ancient woodland at Tortington Common to end at a new grade separated junction on the existing A27 to the east of Havenwood Park.
Option 4	D2AP offline bypass to the south of the existing A27. From Crossbush it followed the same route as Option 3 crossing the River Arun and Ford Road to the south of Tortington Priory. To the west of Ford Road, the route is taken to the south of Tortington Common and Lake Copse to re-join the existing A27 near the existing Junction with Yapton Lane passing through the ancient woodland at Hundredhouse Copse.
Option 5	D2AP offline bypass to the south of the existing A27. Option 5 crosses the River Arun floodplain on a route from Crossbush junction to the north of Tortington Priory. It then passes to the south of Tortington Common, passing through the Binsted Park to re-join the existing A27 near the existing Junction with Yapton Lane passing through the ancient woodland at Hundredhouse Copse as Option 4.

6.3 PCF Stage 1 – Option Identification

6.3.1.1 During PCF Stage 1 a total of 10 alternative options were considered. These included the 7 options described in Table 6-1 and three additional alternative options developed in Stage 1 (Option 0BA, Option 5A, Option 5B).

6.3.1.2 Option 0BA was a variant of Option 0B including a short offline section at the Arundel Station Bridge. Option 5A was a longer route to Option 5 with a crossing of the River Arun located to the south of Tortington Priory but was a shorter route than Option 4 extending further into the SDNP at Binsted Park. Option 5B was a longer option to avoid the SDNP and ancient woodland.

6.3.1.3 A summary of the additional three options is given in Table 6-2.

Table 6-2 – Additional Stage 1 Options

Option	Description
Option 0AB	As Option 0B but with short offline section to the north of the existing A27 at Arundel Station.
Option 5A	D2AP offline bypass to the south of the existing A27. From Crossbush it follows the same route as Option 3. Crossing the River Arun and Ford Road to the south of Tortington Priory. It then turns to follow the same alignment as Option 5. To re-join the existing A27 near the existing Junction with Yapton Lane passing through the ancient woodland at Hundredhouse Copse.
Option 5B	D2AP offline bypass to the south of the existing A27. From Crossbush it follows the same route as Option 3. Crossing the River Arun and Ford Road to the south of Tortington Priory. It then continues west to follow a similar alignment as Option 4. After crossing Binsted Lane the route continues west to pass to the south of the boundary of the SDNP. It passes to the north of Wallberton, passing through part of the Avisford Park Golf Course. It re-joins the existing A27 west of the existing junction with Mill Road / Tye Lane.

6.3.1.4 During this stage a further programme of engagement was undertaken[6]. The primary means of communicating the progress and findings of the Study to consultees was through workshops and meetings. The following meetings / workshops were undertaken during PCF Stage 1:

- Arundel Stakeholder Meeting - May 2016[7]
- Key Stakeholder Liaison Group (KSLG) Meeting 1 - July 2016
- KSLG Meeting 2 – October 2016
- KSLG Meeting 3 and Focus Group Meeting - February 2017
- Focus Group Meeting - February 2017

[6] Para 20.3 WSP on behalf of Highways England, "A27 Arundel Bypass Technical Appraisal Report" August 2017. [Online] Available: - https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/supporting_documents/Technical%20Appraisal%20Report.pdf [Accessed 09 July 2019]

[7] WSP on behalf of Highways England (May 2016) "A27 Arundel Improvements May 2016 Stakeholder Meeting Report" [Available online] https://s3.eu-west-2.amazonaws.com/assets.highwaysengland.co.uk/roads/road-projects/A27+Arundel+Improvement/A27_Arundel_Stakeholder+Workshop+Report+May+2016.pdf [access August 2019]

6.3.1.5 The aim of the 2016 stakeholder meeting was to re-engage with those who attended the previous stakeholder meeting in July 2015 and to give an update on progress. The scheme objectives were presented and the process through which the Scheme was to be taken was discussed.

6.3.1.6 The KSLG meetings were an opportunity for the project team to talk to statutory consultees about the proposals. The purpose of the Focus Group was to liaise with Local Authorities and the SDNPA about proposals for the 2017 Consultation.

6.3.1.7 An environmental assessment of all ten options was carried as well as an assessment of their advantages and disadvantages. Table 6-3 summaries the findings and identifies the key reasons why Options 0A, 1, 3, 5A and 5B, illustrated in Figure 6-2, were selected for further assessment in Stage 1 while Options 0B, 0BA, 2, 4 and 5, and illustrated in Figure 6-3, were not.

Table 6-3 – Summary of the Initial Assessment of Stage 1 Options

Option	Benefits	Issues	Decision
OA	No impact on SDNP and ancient woodland. Strong value for money case	Poor strategic case. Limited support to economic growth residual traffic performance issues	Low cost option retained for consideration
OB	Minimal impact on SDNP and Ancient Woodland. Strong value for money case	Impact on properties adjacent to A27 and on heritage sites. Impact on bridge over railway	Rejected - Engineering and property issues. Discarded in favour of other part-online options
OBA	Route avoids weak bridge over railway Minimal impact on SDNP and Ancient Woodland. Strong value for money case	Deliverability issues for new railway bridge associated with a veteran tree	Rejected - Engineering and property issues. Discarded in favour of other part-online options
1	Strong value for money case. Link east of Arundel avoids property impacts	Involves substantial earthworks (embankment) Floodplain issues	Optimal part-online scheme which would deliver RIS objectives. Retained for consideration.
2	Makes use of the existing A27 dual carriageway	Close to existing urban area resulting in noise and vibration issues. Landscape and visual impact Sub-standard alignment due to sharp bends	Rejected - Engineering issues in relation to alignment. Does not mitigate landscape impacts. Discarded in favour of other offline options

Option	Benefits	Issues	Decision
3	Makes full use of existing dual carriageway. Strong value for money case	Floodplain issues Landscape and visual impact. Impacts on SDNP and Ancient Woodland	Selected as the Preferred Route previously (1993), this route is supported by many key stakeholders (at the time of preparation). Retained for consideration
4	It reduces impact on Ancient Woodland in comparison to other offline options. Strong value for money case	Bypasses existing dual carriageway section west of Arundel. Floodplain issues. Route passes close to Binsted. The section outside the National Park is still within the area of influence of SDNP. Impacts on Ancient Woodland at western end	Rejected - Does not provide further scope for mitigation of SDNP and Ancient Woodland impacts and is discarded in favour of other offline options as it provides no additional benefit
5	Minimises impact on Ancient Woodland and SDNP in comparison to other offline options. Limits floodplain issues. Strong value for money case	Close to existing urban area. Bypasses existing dual carriageway sections. Engineering issues associated with topography and a requirement for a higher crossing of River Arun	Rejected - Inferior to other offline options due to engineering issues and greater visual and heritage impacts
5A	Reduced negative visual impact on Tortington Priory. Minimises impact on Ancient Woodland and SDNP in comparison to other offline options. Strong value for money case	Bypasses existing dual carriageway section west of Arundel	Reduced visual and heritage impacts and limited Ancient Woodland impact compared with other offline options. Retained for consideration
5B	No impact on Ancient Woodland Limited impact on SDNP. Reduced negative visual impact on Tortington Priory	Higher cost option Modest value for money case. Runs close to Binsted	No impact on Ancient Woodland and limited impact on SDNP. Reduced visual impacts in comparison to other offline options Retained for consideration

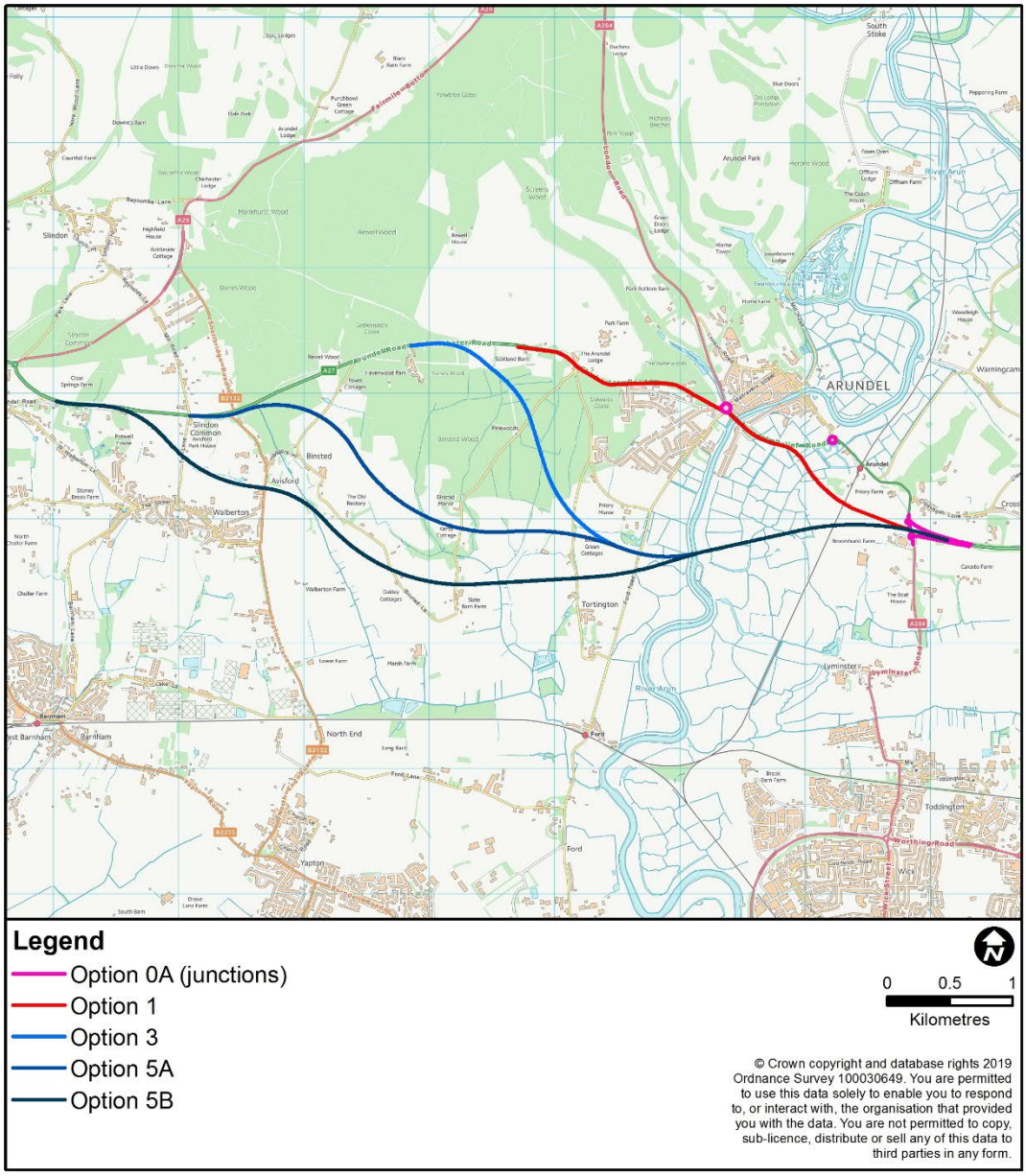


Figure 6-2 - Stage 1 Options Selected for WebTAG Appraisal

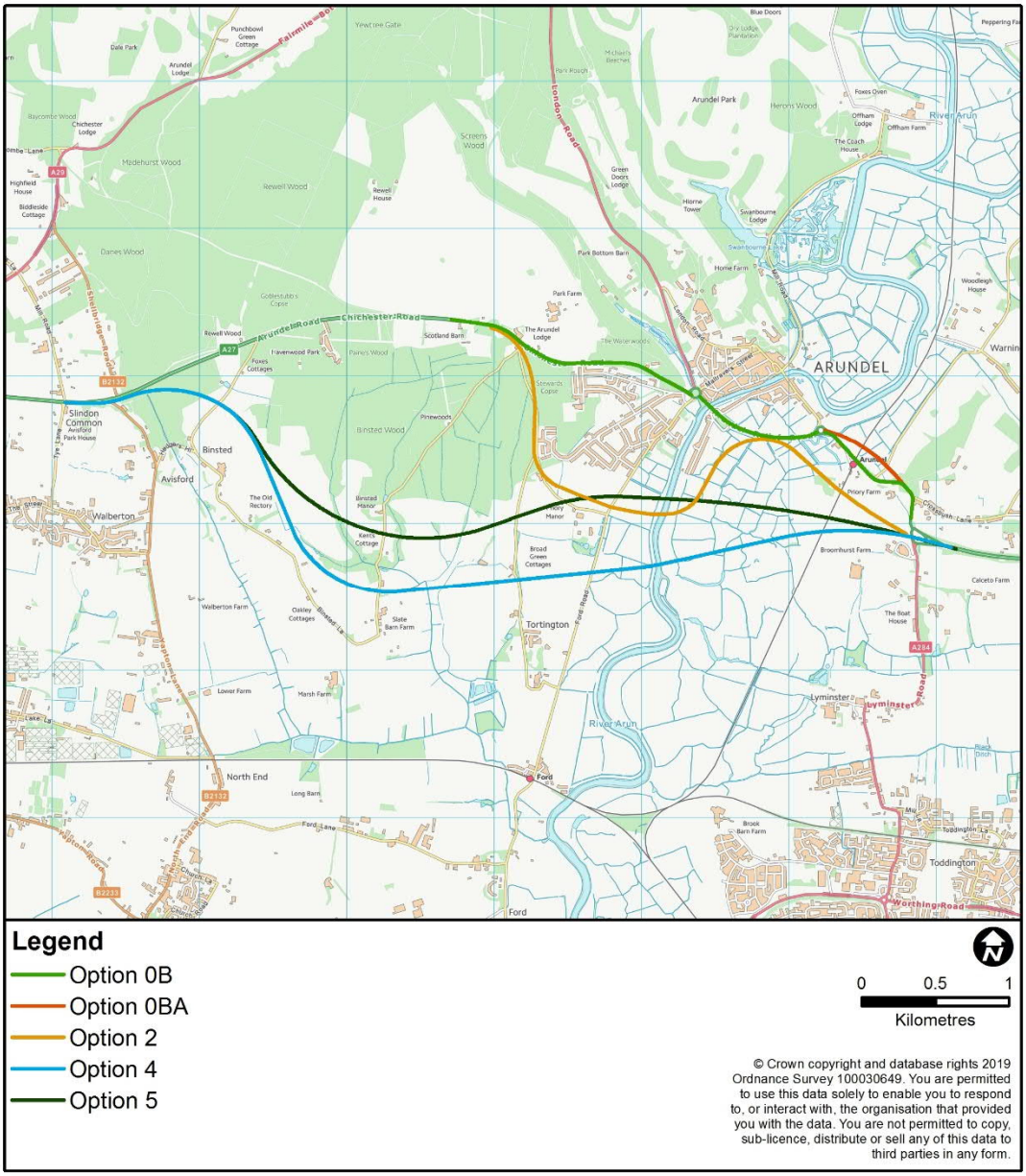


Figure 6-3 - Stage 1 Options Rejected

6.3.1.8 Options 0A, 1, 3, 5A and 5B, were then subjected to a WebTAG appraisal and Appraisal Summary Tables (ASTs) which collate all the assessments against the criteria of Economy, Environmental, Social and Distributional impacts and Public Accounts. A summary of the results are provided in Table 6-4. Full copies of the AST's are provided in the Technical Appraisal Report (TAR)[8].

Table 6-4 – Summary of Stage 1 AST's

Impact	0A	1	3	5A	5B
Business users & transport providers	£52.629m	£129.889m	£131.869m	£167.873m	£142.217m
Reliability impact on Business users	NA	NA	NA	NA	NA
Regeneration	NA	NA	NA	NA	NA
Wider Impacts	NA	NA	NA	NA	NA
Noise	Slight adverse	Slight adverse	Neutral	Neutral	Neutral
Air Quality	Slight adverse	Neutral	Moderate beneficial	Moderate beneficial	Moderate beneficial
Greenhouse gases	Likely to be positive	Likely to be positive	Likely to be positive	Likely to be positive	Likely to be positive
Landscape	Slight adverse	Slight adverse	Large adverse	Large adverse	Large adverse
Townscape	NA	NA	NA	NA	NA
Historic Environment	Neutral	Large adverse	Large adverse	Large adverse	Large adverse
Biodiversity	Neutral	Moderate adverse	Large adverse	Moderate adverse	Slight adverse
Water Environment	Slight adverse	Moderate adverse	Moderate adverse	Moderate adverse	Moderate adverse
Commuting and Other users	£63.032m	£153.386m	£141.278m	£182.894m	£149.111m
Reliability impact on Commuting and Other users	NA	NA	NA	NA	NA
Physical activity	Neutral	Neutral	Neutral	Neutral	Neutral
Journey quality	Slight Positive	Slight Positive	Slight Positive	Slight Positive	Slight Positive

[8] Appendix M WSP on behalf of Highways England, "A27 Arundel Bypass Technical Appraisal Report" August 2017. [Online] Available: - https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/supporting_documents/Technical%20Appraisal%20Report.pdf [Accessed 09 July 2019]

Impact	0A	1	3	5A	5B
Accidents	£0.053m	£38.50m	£63.72m	£76.41m	£63.83m
Security	Neutral	Slight positive	Slight positive	Slight positive	Slight positive
Access to services	NA	NA	NA	NA	NA
Affordability	NA	NA	NA	NA	NA
Severance	Slight Positive	Slight Positive	Slight positive	Slight positive	Slight positive
Option and non-use values	NA	NA	NA	NA	NA
Cost to Broad Transport Budget	£25.573m	£87.190m	£166.997m	£162.005m	£213.756m
Indirect Tax Revenues	£3.047m	£8.129m	£0.863m	£5.317m	£4.417m

6.4 PCF Stage 2 – Option Selection

6.4.1.1 The process of considering which of the five options should be presented at public consultation was considered at the start of PCF Stage 2. The performance of the five options was assessed by the Highways England Project Board in April 2017 in line with the criteria set out in the paragraph below. The aim was to recommend options to be taken forward to public consultation in PCF Stage 2.

6.4.1.2 The differences between the options were highlighted and discussed to present justifications for shortlisting options for public consultation in PCF Stage 2. This was achieved via the following considerations:

- How well does each option fit with the RIS requirements?
- How well does each option fit with the Scheme objectives (as set out in the Client Scheme Requirements)? In particular, how do the options help achieve the objectives on environment and journey times?
- How well does each option fit with the NN NPS?
- How affordable is each option?
- How well do the options perform in terms of providing value for money?

6.4.1.3 At the Board meeting a series of recommendations were made based on the overall performance of each option:

- Though Option 0A performs well in terms of value for money, it does not meet the RIS requirements and does not adequately meet Scheme objectives. It was therefore not recommended that Option 0A be taken forward to public consultation.
- Options 3, 5A and 5B meet the RIS requirements. Option 5B performs marginally better in terms of environmental impacts and significantly better NN NPS compliance. However, it performs least well in terms of value for money, possessing the highest cost to deliver the scheme. This cost was assessed as above the scheme affordability range. Option 5B was therefore not recommend to be taken forward to public consultation, while both Options 3 and 5A were.
- Option 1 out-performs Options 3 and 5A in overall value for money, NN NPS compliance and has a lower overall environmental impact. Though it does not meet the stated RIS policy of providing a bypass it was assessed as performing well against some of the Scheme objectives. Option 1 was therefore recommended to be taken forward to public consultation.

6.5 Public Consultation

6.5.1.1 Option 1, 3 and 5A, illustrated in Figure 6-4, were presented for public consultation between 22 August and 16 October 2017 (The 2017 Consultation). The 2017 Consultation also presented those options not taken forward and the reasons for their exclusion. The consultation used evidence from the assessments and appraisals carried out in Stage 1.

6.5.1.2 A total of 2,062 people attended the exhibitions and stakeholder meetings that were held during the consultation period. 2,821 completed questionnaires were returned and a further 7,135 responses by letter or email were also received. Of the written responses, 132 were from key stakeholders such as Local Authorities, Parish Councils and environmental groups. There were also 2 petition email response campaigns, co-ordinated by Friends of the Earth and the Woodland Trust. These received 737 and 5,748 signatories, respectively.

6.5.1.3 The analysis of the 2017 Consultation responses identified that:

- 79% (2,200) of respondents agreed that there was a need for a scheme to upgrade the A27 at Arundel to a dual carriageway
- Option 5A was the most supported option with 48% (1,537) of responses, with Option 1 favoured by 27% (764) and Option 3 supported by 23% (662).
- There were significant concerns over the environmental impact of the scheme with 82% of environmental groups who responded opposed to the scheme.

6.5.1.4 Further information is published in the Report on the Public Consultation[9].

6.6 Further Assessment of the Public Consultation Options

6.6.1.1 Further traffic, environmental and economic assessments of the three options presented at the 2017 Consultation (Option 1, 3 and 5A) were undertaken in PCF Stage 2 to inform the decision of the preferred route. The findings of these assessments are summarised in the SAR published in May 2018[10]. Updated AST's were prepared and published in the 2018 SAR. A summary is provided in Table 6-5.

6.6.1.2 A new traffic model was developed in PCF Stage 2 from Highways England's South East Regional Transport Model (SERTM, Version DF3) in order to refine the model's representation of observed transport conditions[11].

6.6.1.3 The new model included a variable demand component using the DfT's DIADEM (Dynamic Integrated Assignment and Demand Modelling) software (version 6.3.3). The new model, the PCF Stage 2 A27 Strategic Traffic Model, was used for the further assessments carried out in Stage 2.

6.6.1.4 The further environmental assessments were also carried out in Stage 2 for the 2017 Consultation options. These included noise and air quality modelling and considered the findings of field surveys which had commenced in 2017[12].

[9] WSP on behalf of Highways England, "A27 Arundel Report on public consultation" Spring 2018, [Online] Available- https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/stage2-a27arundel-reportonpublicconsultationp04.pdf [Accessed 09 July 2019]
[10] Highways England, "A27 Arundel Bypass Scheme Assessment Report," May 2018. [Online]. Available: https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/sarv1forpublishing.pdf [Accessed 20 June 2019]
[11] WSP on behalf of Highways England, "A27 Arundel Bypass PCF Stage 2 – Combined Modelling and Appraisal (ComMA)," May 2018
[12] WSP on behalf of Highways England, " A27 Arundel Bypass Environmental Assessment Report" January 2018

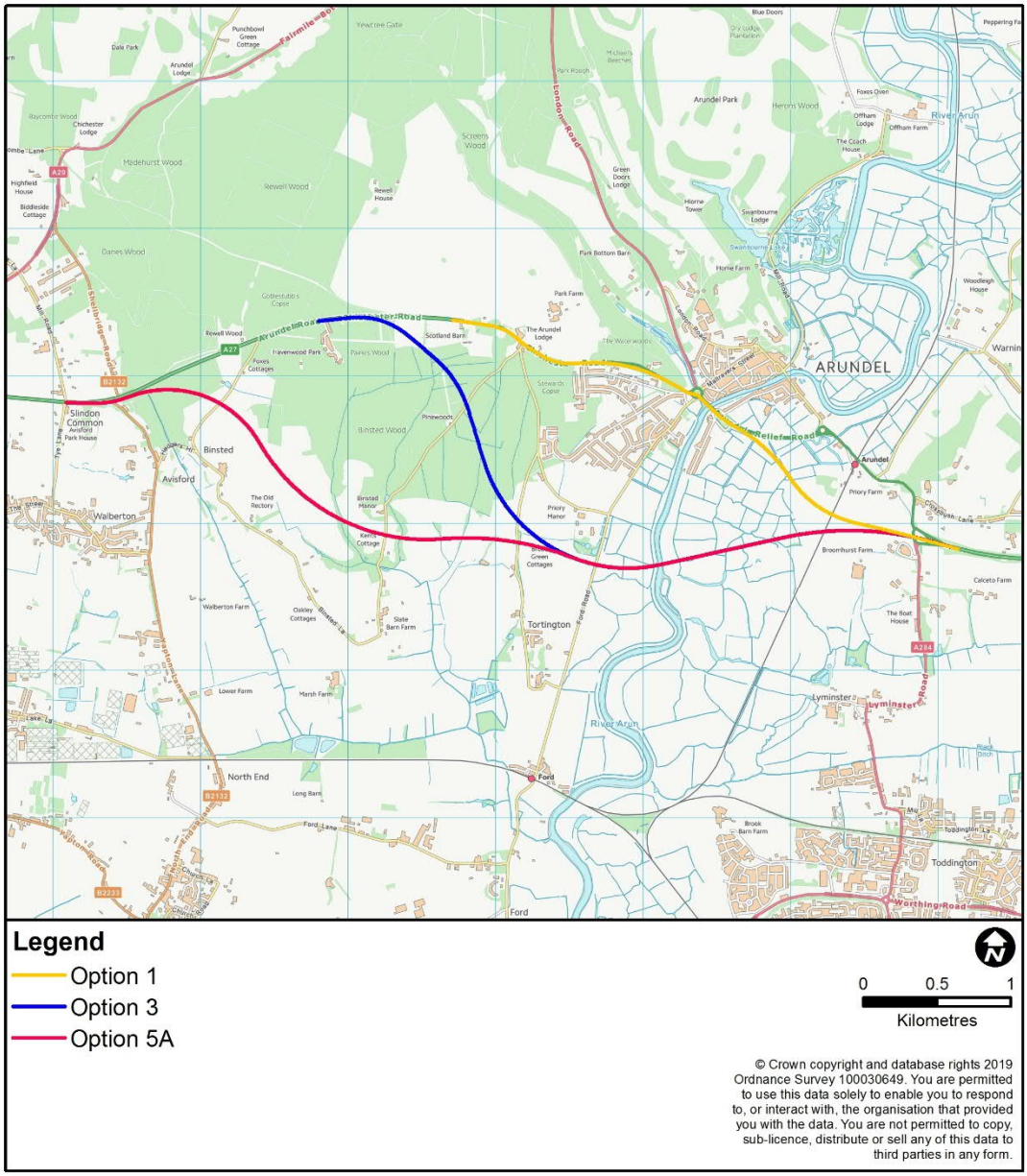


Figure 6-4 - Stage 2 2017 Public Consultation Options

Table 6-5 – Summary of Updated AST's Post Public Consultation

Impact	Option 1 (see footnote)*	Option 3	Option 5A
Business users & transport providers	£54.489M	£51.858m	£66.889m
Reliability impact on Business users	Moderate beneficial	Moderate beneficial	Moderate beneficial
Regeneration	Not Applicable	Not Applicable	Not Applicable
Wider Impacts	£54.8m	£25.90m	£22.90m
Noise	-£9,966,530	-£1,334,042	-£1,518,992
Air Quality	£9,251,942	£9,016,356	£9,465,240
Greenhouse gases	-£19,144,931	-£25,180,794	-£23,899,268
Landscape	Moderate Adverse	Large Adverse	Large Adverse
Townscape	Moderate Adverse	Neutral	Neutral
Historic Environment	Large Adverse	Large Adverse	Large Adverse
Biodiversity	Moderate Adverse	Very Large Adverse	Very Large Adverse
Water Environment	Low significance	Low significance	Low significance
Commuting and Other users	£98.404m	£113.515m	£141.410m
Reliability impact on Commuting and Other users	Moderate beneficial	Moderate beneficial	Moderate beneficial
Physical activity	Slight Beneficial	Slight Beneficial	Slight Beneficial
Journey quality	Slight Beneficial	Slight Beneficial	Slight Beneficial
Accidents	£16.008m	£34.778m	£30.042m
Security	Slight Beneficial	Slight Beneficial	Slight Beneficial
Access to services	Not applicable	Not Applicable	Not Applicable
Affordability	Slight Beneficial	Slight Beneficial	Slight Beneficial
Severance	Slight Adverse	Slight Beneficial	Slight Beneficial
Option and non-use values	NA	NA	NA
Cost to Broad Transport Budget	£87.190m	£166.997m	£162.005m
Indirect Tax Revenues	£17.056m	£23.821m	£21.461m

Footnote* - The results for A27 Arundel Bypass (Option 1) are presented for completeness. See Paragraphs** *6.6.1.5* **for issues with assessment results for Option 1

6.6.1.5 Following completion of the further assessments it was found that the A27 Strategic Traffic Model underrepresented the delays at Ford Road junction for Option 1 as presented at the 2017 Consultation. As a result, the reported benefits were likely to be over-estimated[13] and further design work would be required to develop a revised layout for the Ford Road Junction.

6.6.1.6 A variety of potential practical alternative solutions for the junction at Ford Road including both at grade and grade separated junctions were identified[14].

6.7 Further Development of Consultation Options

6.7.1.1 Following the conclusion of the 2017 Consultation various modifications to the three route options were developed and considered for inclusion within a preferred route. This review was informed by the concerns raised at the 2017 Consultation and by additional environmental surveys carried out in 2017. Importantly, these modifications include options that would avoid or reduce impact on Ancient Woodland in the light of the responses received from Natural England and the Forestry Commission along with consultation feedback from others about potential impacts on Ancient Woodland.

6.7.1.2 A series of workshops were held, attended by Highways England and WSP at which the modifications were reviewed and their performance against key selection criteria were assessed including compliance with key policy tests contained within the NN NPS, the Scheme objectives and environmental, economic, social and engineering factors.

6.7.1.3 Due to the route of Option 3 passing through Tortington Common it was concluded that there is very limited opportunity with Option 3 to reduce the environmental impacts on the Ancient Woodland to levels comparable to the other options and so the further design development focused on Option 1 and Option 5A.

6.7.2 Development of Option 1

6.7.2.1 Various modifications to Option 1 were developed to reduce the impact on Ancient Woodland and to improve the operational performance of the route. The modifications developed are summarised in Table 6-6.

[13] Section 6.6.3 to 6.6.8 Highways England, "A27 Arundel Bypass Scheme Assessment Report," May 2018. [Online]. Available: https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/sarv1forpublishing.pdf [Accessed 20 June 2019]
[14] Section 10.5 Highways England, "A27 Arundel Bypass Scheme Assessment Report," May 2018. [Online]. Available: https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/sarv1forpublishing.pdf [Accessed 20 June 2019]

Table 6-6 – Development of Option 1 Post Public Consultation

OPTION	LOCATION	CHANGE
Option 1(V)	Ford Road roundabout to western tie -in	The alignment of the route between the Arundel District and Community Hospital and the White Swan Public House was moved away from the Ancient Woodland located alongside the existing A27. This would result in additional land take from the White Swan Hotel and Arundel Cricket ground and the route moving closer to properties located along Canada Road.
Option 1(V)	Ford Road roundabout to western tie-in	Gaps in the central reserve were removed. An additional at grade roundabout would be provided near the existing transition from single carriageway to dual carriageway to provide for the local traffic movements that would be affected. This would increase the length of some local movements but would improve the safe operation of the route. Removing the central reserve gaps and right turning facility would also reduce the impact on the Ancient Woodland.

6.7.3 Development of Option 5A

6.7.3.1 Modifications to Option 5A were developed following the 2017 Consultation with the aim of improving the option's performance against key policy tests in the NN NPS and to address comments received during the 2017 Consultation on the layout of the junction. These are summarised in Table 6-7.

Table 6-7 – Development of Option 5A Post Public Consultation

OPTION	LOCATION	CHANGE
5A(V3)	River Arun Crossing and Tortington Priory	The alignment of Option 5A was moved away from Tortington Priory scheduled monument to reduce the scale of the infrastructure adjacent to the site while still maintaining appropriate design standards and limiting the extent of the change in alignment. The revised alignment would bring the route closer to Broad Green Cottages. The revised centre line is shown in Figure 6-5.
5A(V3)	Western tie-in Junction with existing A27	The junction at the western tie in was modified to provide separate two-way local roads to Yapton Lane and Shellbridge Lane from the junction. This would remove the conflicts with

OPTION	LOCATION	CHANGE
		traffic entering and leaving the A27 that could occur with the 2017 Consultation layout. To reduce impacts on Ancient Woodland at Hundredhouse Copse the layout would be made more compact using retaining walls. The revised junction layout is illustrated in Figure 6-5.
5A+	Western tie-in Junction with existing A27	The alignment at the western end of Option 5A was moved away from the Ancient Woodland at Hundredhouse Copse to form an at grade roundabout junction located nearer to the existing junction at Binsted Lane. Operational assessment of the roundabout showed that it would need to be partially controlled by traffic signals. The centre line of the revised layout is shown in Figure 6-5.
5A+	River Arun Crossing and Tortington Priory	As 5A(V3). The revised centre line is shown in Figure 6-5.

6.8 Review of Modified Options

6.8.1.1 The modified route options were compared using a pairwise comparison process with the equivalent public consultation option[15]. The comparison was made based on an assessment of the performance of the routes using key selection criteria including compliance with key policy tests contained within the NN NPS, the Scheme objectives and environmental, economic, social and engineering factors.

6.8.1.2 This included an initial economic assessment of the modified routes and an assessment of the implications of the modified route on the environmental assessment of the 2017 Consultation options which had been developed through Stage 2. To ensure that relevant considerations in the NN NPS were included in the process the Planning Statement & National Policy Statement Accordance table[16] was completed and used to inform the process.

[15] WSP on behalf of Highways England, "A27 Arundel Bypass PCF Stage 2 – Value Management Workshop 2B Report" April 2018
[16] WSP on behalf of Highways England (May 2018) "A27 Arundel Bypass Scheme Assessment Report – Appendix E-1 NN NPS Compliance Table" [Available online] https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/sarv1forpublishing.pdf [accessed August 2019]

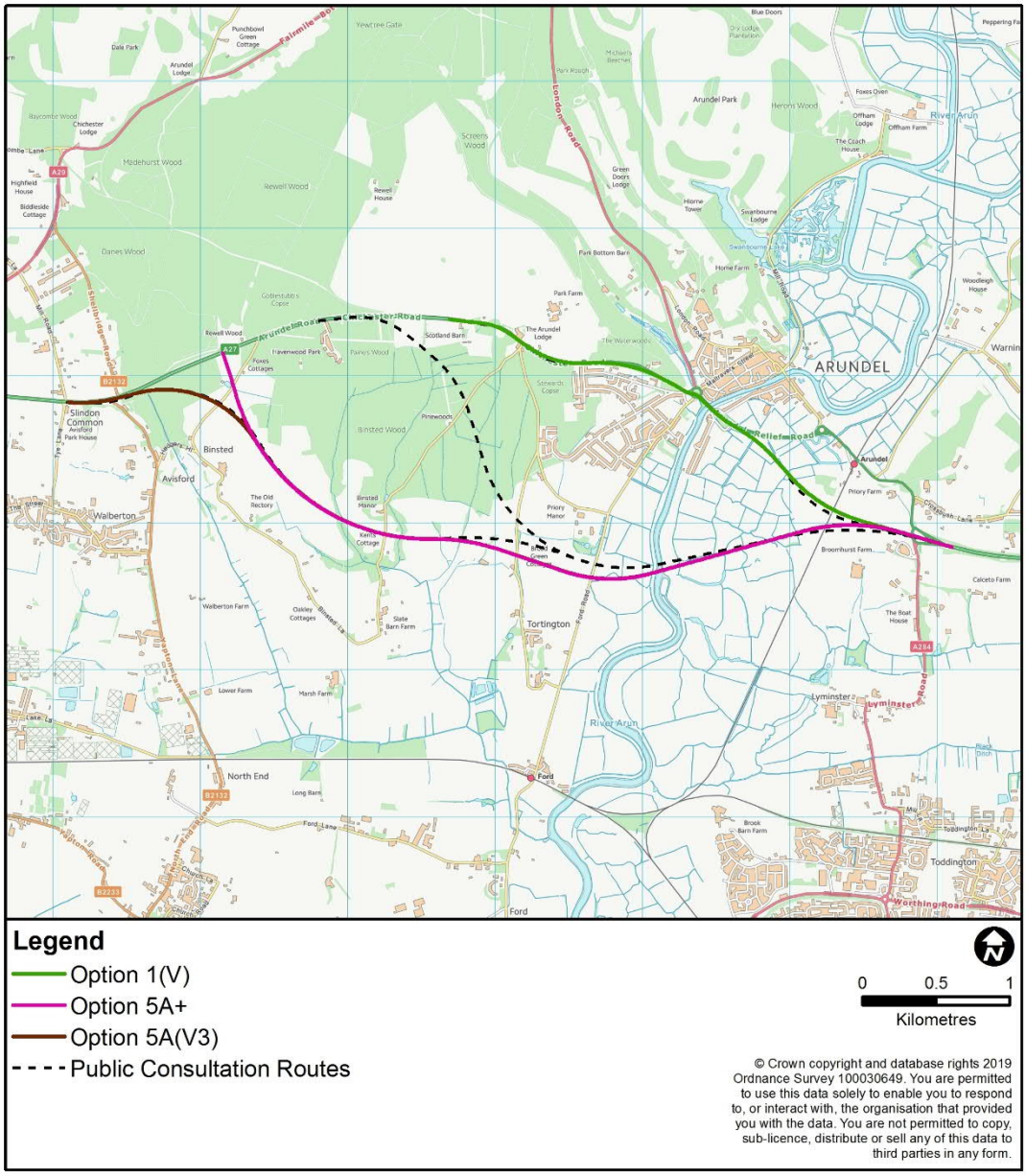


Figure 6-5 - Post 2017 Public Consultation Modified Options

6.8.1.3 The findings of the comparisons were then reviewed at a Value Management Workshop[17]. The conclusions of the workshop are summarised below:

- Option 1(V) performed better than the 2017 Consultation option due to the significantly reduced impact on Ancient Woodland, improved NN NPS compliance and improved safety performance. Nevertheless, it still results in the loss of Ancient Woodland.
- Option 5A+ performed better than Option 5A because it avoided direct impact on Ancient Woodland, but it still had significant problems with compliance with NN NPS and the drop in economic performance was significant. The operational performance of the roundabout junction was also not satisfactory and would not meet the Scheme objectives in terms of improving capacity and reducing congestion. This change was therefore not recommended to be adopted.
- Option 5A(V3) – The revised alignment at Tortington Priory performed better than the alignment at the 2017 Consultation due to a reduced impact on the site of the Priory. The change in alignment was therefore recommended to be adopted. The review concluded that modifications to the western tie in junction the 2017 Consultation layout would be needed. Option 5A(V3) was preferred from a safety perspective and addressed the concerns raised at the 2017 Consultation and would reduce the impact on the Ancient Woodland.

6.8.1.4 Option 1(V) would still result in some loss of Ancient Woodland. It would have the same impacts as Option 1 for cultural heritage (large adverse) and landscape (moderate adverse).

6.8.1.5 Option 5A(V3) would still have significant impacts including loss of Ancient Woodland. Further Option 5A(V3) would require extensive use of retaining walls to achieve this reduction. Further work would therefore be needed in PCF Stage 3 on the type, layout and location of the junction to reduce the impact of the route further.

6.9 Preferred Route

6.9.1.1 The results of the 2017 Consultation and the further assessments carried out in stage 2 were then used to inform the selection of a preferred route.

[17] WSP on behalf of Highways England, "A27 Arundel Bypass PCF Stage 2 – Value Management Workshop 2B Report" April 2018

6.9.1.2 Highways England considered many factors to identify the preferred route for the Scheme. These were identified in the PRA leaflet[18] and included:

- The extent to which the design meets the Scheme Objectives
- The build cost and the value for money that this would offer
- How well the chosen option fits with national planning policy as set out in the NN NPS as well as with local planning policy
- The effects on the heritage and cultural value of historic assets in Arundel
- Feedback from the 2017 Consultation
- The options for keeping traffic moving and minimising disruption for local communities during construction.

6.9.1.3 Highways England chose Option 5AV3 for the PRA in May 2018 (see Figure 6-6). The route was chosen because it would provide a long-term solution to relieve congestion and delays in the area, and help reduce severance in the town centre[19].

6.9.1.4 As summarised in the PRA leaflet, Option 1 was discounted because:

- It achieved a low level of support during the 2017 consultation
- It increased severance in Arundel town
- It provided fewer safety benefits
- There was uncertainty around the ability of the improved road to deal with anticipated traffic volumes particularly at the Ford Road Junction
- Potential design changes to mitigate the above points would impact significantly on both the environment and the local community.

6.9.1.5 As summarised in the PRA Leaflet Option 3 was discounted as:

- It was the least popular at 2017 consultation
- It had the greatest impact on areas of ancient woodland and the SDNP.

[18] Highways England (Spring 2018) "A27 Arundel Bypass Preferred Route Announcement" [Available online] https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/a27arundelbypassprabrochure-webversion-final-100518.pdf [accessed August 2019].
[19] Ibid

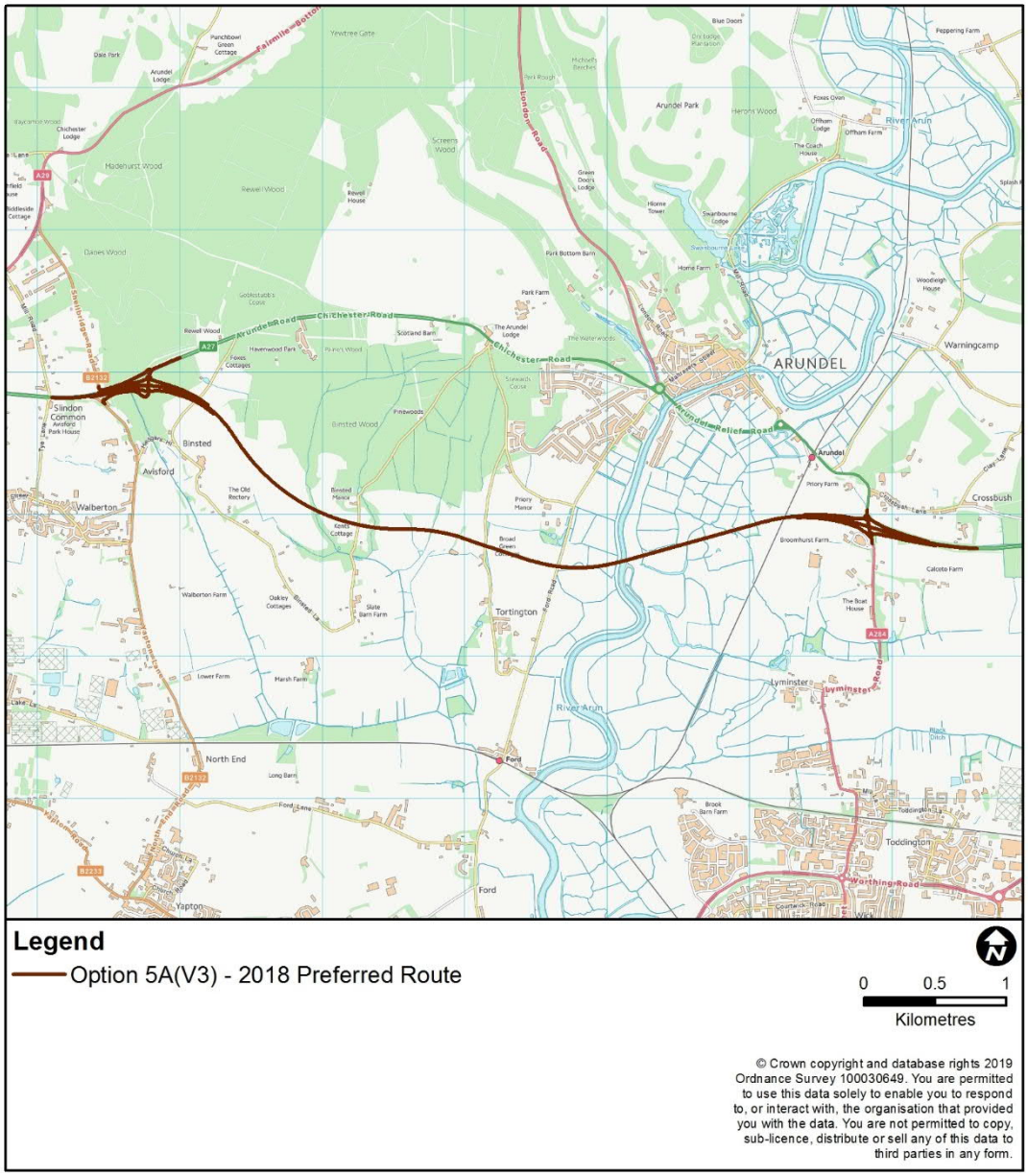


Figure 6-6 - 2018 Preferred Route (Option 5AV3)

6.10 Summary

6.10.1.1 This chapter has described the processes undertaken to identify and select options leading to the announcement of a PR in May 2018. Chapter 7 goes on to describe the initial development of the preferred route following the PRA in May 2018, Highways England's decision in October 2018 to undertake a further non-statutory public consultation and subsequent processes carried out to identify further alternative options for further assessment and presentation at the Further Consultation.

Acronyms

Acronym	Explanation
AST	Appraisal Summary Table
DfT	Department for Transport
DIADEM	Dynamic Integrated Assignment and Demand Modelling
D2UAP	Dual 2 lane urban all-purpose road
D2AP	Dual 2 lane all-purpose road
KSLG	Key Stakeholder Liaison Group
NN NPS	National Network National Planning Statement
PCF	Project Control Framework
PRA	Preferred Route Announcement
PR	Preferred Route
RIS	Road Investment Strategy
SAR	Scheme Assessment Report
SERTM	South East Regional Transport Model
SDNPA	South Downs National Park Authority
SDNP	South Downs National Park
SoS	Secretary of State
TAR	Technical Appraisal Report
WebTAG	Web based Transport Appraisal Guidance

Glossary

Term	Definition
The Scheme	The A27 Arundel Bypass
Dual 2 lane urban all-purpose road	A road in an urban area that has two separated carriageways with 2 lanes in each direction for use by all classes of traffic.
Dual 2 lane all-purpose road	A road that has two separated carriageways with 2 lanes in each direction for use by all classes of traffic.
Grade Separated Junction	A Grade Separated Junction (GSJ) is a junction where the intersecting roads are separated at different heights, usually be a bridge, so that traffic flows do not intersect one another. For the

Term	Definition
	A27 Arundel Bypass only traffic on the proposed A27 would be free flowing
Project Control Framework	A joint Department for Transport and Highways England approach to managing major projects. The Framework comprises a standard project lifecycle; standard project deliverables; project control processes and governance arrangements
WebTAG	WebTAG (Web-based Transport Analysis Guidance) is the Department for Transport's transport appraisal guidance and toolkit. It consists of software tools and guidance on transport modelling and appraisal methods that are applicable for highways and public transport interventions (The word 'interventions' is used to cover the entire range of measures from demand management measures through to major engineering projects).

A27 Arundel Bypass Scheme Assessment Report

Chapter 7 – Further Alternative Options

October 2020

CONTENTS

LIST OF FIGURES

7 Further Alternative Options

7.1 Introduction

7.1.1.1 Chapter 6 summaries the process carried out in Project Control Framework (PCF) Stage 1 and 2 leading to the announcement of a Preferred Route (PR) for the Scheme in May 2018. After the Preferred Route Announcement (PRA) the preliminary design of the Preferred Route started. In October 2018 Highways England announced a further non-statutory consultation (the Further Consultation) would be undertaken on the Scheme. The preliminary design of the Preferred Route therefore stopped and the project returned to PCF Stage 2 (Options Selection).

7.1.1.2 Highways England made a commitment that assessments for the Scheme options previously consulted on (Options 1, 3, and 5A) and additionally Options 4 and 5B considered in Stage 1 but rejected, would be available for the public to consider. The development of these options is described in Chapter 6.

7.1.1.3 This Chapter summaries the initial development of the preferred route following the PRA in May 2018. Plus Highways England's decision in October 2018 to undertake a further non-statutory public consultation and the process carried out since then to identify further alternatives for all options.

7.2 2018 Preferred Route (Option 5AV3) Developments

7.2.1.1 The initial development of the preliminary design was influenced by commitments made at the PRA[1] to consider whether improvements could be made to the junction at the western tie in to reduce the impact on the ancient woodland and by an increasing understanding of the environment as more information became available from ongoing environmental surveys.

7.2.1.2 The alternatives developed are described by segment in the following paragraphs and are illustrated in Figure 7-1.

[1] Highways England, "A27 Arundel Bypass Preferred Route Announcement, Page 4" Spring 2018. [Online]. Available: https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/a27arundelbypassprabrochure-webversion-final-100518.pdf [Accessed 20 June 2019]

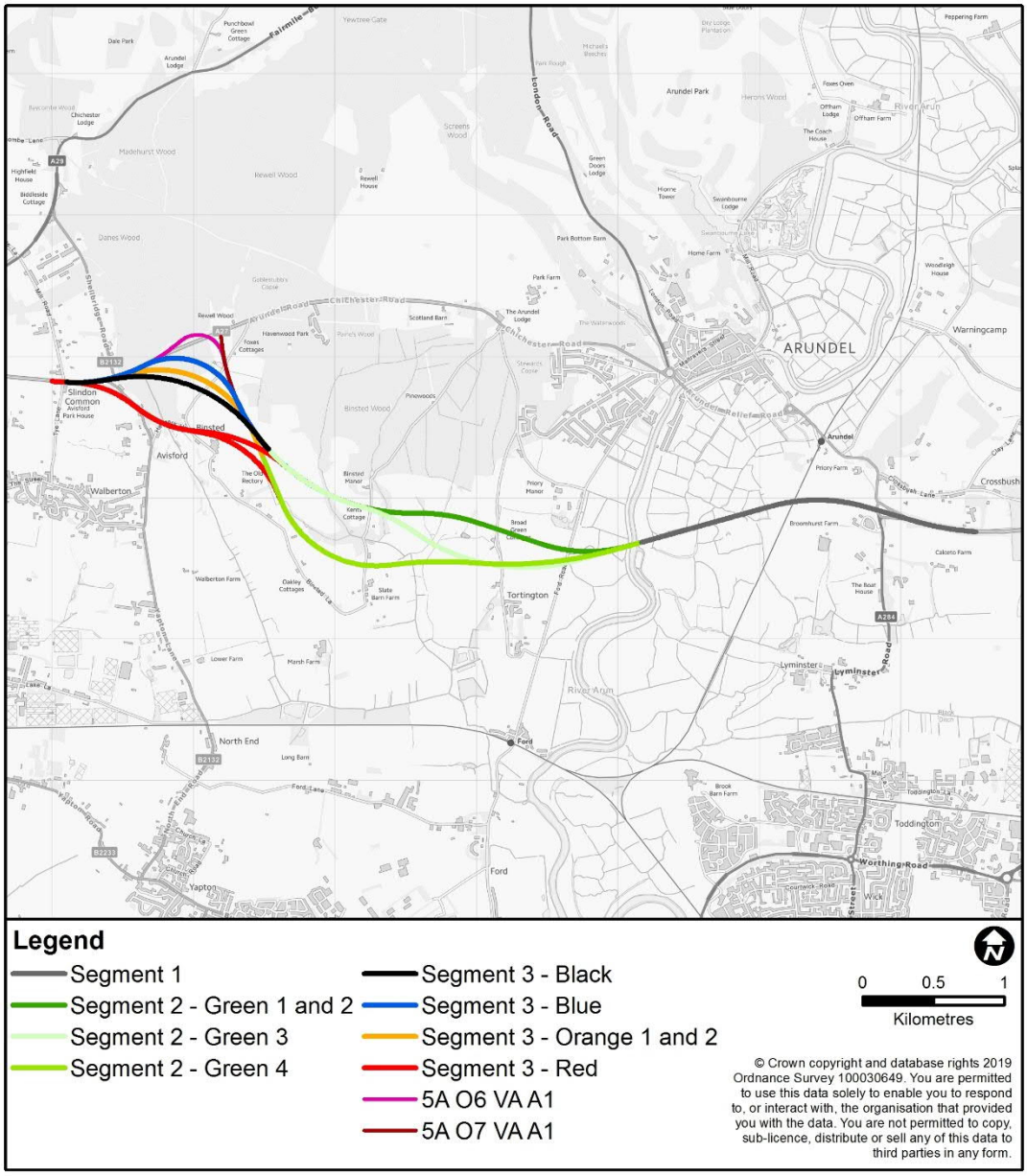


Figure 7-1 - Preferred Route (Option 5AV3) Developments

7.2.2 Segment 1 – Crossbush Junction and Alignment between Crossbush and the River Arun

Position at PRA

7.2.2.1 The design for the Crossbush Junction at PRA comprised a dumbbell arrangement with two roundabouts linked by the existing A27 Lyminster Road bridge to cross the proposed A27 and four slip roads connecting with the proposed A27. The route then crossed the Arun Valley on a low embankment of maximum height of 4.0m and crossed the River Arun to the south of Tortington Priory.

Design Development

7.2.2.2 The form and layout of the Crossbush junction has not been altered but the size of the junction has increased as the design developed.

7.2.2.3 There have been no changes to the horizontal alignment across the Arun valley. The minimum level across the floodplain has been increased to 4.8m because of further flood modelling work. In addition, the vertical alignment has been modified to consider changes in minimum headroom and clearances at the crossing of the Arun Valley Line railway and river Arun as the preliminary design of these two structures progressed.

7.2.3 Segment 2 - Alignment between Tortington Lane and Footpath (FP) 341.

Position at PRA

7.2.3.1 The alignment of the preferred route passed to the north of Broad Green cottages, crossed a series of water courses feeding Tortington Rife and passed through Binsted Park between the ancient woodland at Lakes Copse and Spinning Wheel Copse. In this segment 1.7km of the route would be located within the South Downs National Park (SDNP). The alignment had been lowered following comments received at the 2017 public consultation on the height of the embankment through Binsted Park

7.2.3.2 In this segment the route would avoid direct impact on ancient woodland. However, it would sever the deciduous woodland habitat at the Shaw and the deciduous woodland and woodland pasture and parkland habitats at the Lag and would be located close to residential properties at Binsted Park.

Alternatives (Variants) Considered (see Figure 7-1)

7.2.3.3 Results of ongoing bat surveys confirmed the presence of a population of nationally significant bat species close to the preferred route. They also identified the importance to that bat population of a series of linear landscape elements comprising tree lined water courses, ditches, hedges and tree lined roads as important flyways between their foraging and roosting areas.

7.2.3.4 The preferred route would cross these linear landscape features resulting in severance of the bat flyways. The preferred route had limited opportunities to provide mitigation such as green bridges and underpasses due to its vertical alignment. Therefore, alternative variants to the published preferred route were developed. These are illustrated in Figure 7-1 and described below:

- Green 1 – The Preferred route design provided some opportunities for provision of green bridges and underpasses at known flyways
- Green 2 – The vertical alignment of the preferred route was raised to provide more opportunities to accommodate underpasses at known flyways.
- Green 3 – A route to the south of Broad Green cottages would cross fewer known fly ways and could allow green bridges or underpasses at others.
- Green 4 - A route to the south of Broad Green Cottages and Lake Copse would cross fewer known flyways and could allow green bridges or underpasses where known flyways were crossed. This alternative also avoided Binsted Park and would have a much shorter route within the SDNP. The route would be closer to properties located in Binsted along Binsted Lane.

7.2.4 Segment 3 – Western Tie in Junction and Alignment between FP 341 and existing A27

Position at PRA

7.2.4.1 The preferred route layout at the western tie in is illustrated in Figure 7-1.

7.2.4.2 The junction was located to the east of the existing B2132 Yapton Lane / Shellbridge Road junction to the south of the existing A27 within an area of ancient woodland at Hundredhouse Copse. Connector roads were provided from the junction to both Yapton Lane and Shellbridge Road and the existing A27 providing for local access and all movements.

Variants Considered (see Figure 7-1)

7.2.4.3 As noted in the PRA leaflet[2] Highways England said it would consider alternative junction proposals at the western tie in to reduce the impact on ancient woodland. The National Policy Statement for National Networks (NN NPS) identifies that the planning of the Strategic Road Network (SRN) should encourage routes that avoid ancient woodland[3].

[2] Highways England, "A27 Arundel Bypass Preferred Route Announcement," Spring 2018. [Online]. Available: https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/a27arundelbypassprabrochure-webversion-final-100518.pdf [Accessed 20 June 2019]

[3] NN NPS Para 5.32 "The Secretary of State should not grant development consent for any development that would result in the loss or deterioration of irreplaceable habitats including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the national need for and benefits of the development, in that location, clearly outweigh the loss…"

7.2.4.4 Six variants to the preferred route design were developed. Two variants (Route 5A-06-VA-A1 and Route 5A-07-VA-A1) included alignments that pass through the gap in ancient woodland between Barns Copse and Brick Kiln Copse. Four alternatives (Blue, Orange, Black and Red Routes) were developed that would reduce the impact on ancient woodland by:

- reducing the length of the route through the ancient woodland;
- moving the junction with the existing A27 outside of the woodland; and
- providing structures to reduce the footprint within the ancient woodland.

7.2.4.5 The development of the variants was also informed by the results of ongoing bat surveys which had identified several roosts within the ancient woodland at Hundredhouse Copse and the presence of tree lined linear landscape elements which provide important bat flyways linking woodland blocks.

Route 5A-07-VA-A1

7.2.4.6 This route passed between the ancient woodland at Barns Copse and Brick Kiln Copse. Due to the alignment of the route it connected with the existing A27 with an at grade junction. A variety of junction arrangements were considered but all had either safety or operational issues. This variant was similar to Option 5A+ (see Chapter 6) considered after the 2017 Consultation. This variant was not considered further because the operational performance of the at grade junction would not meet the project objectives in terms of improving capacity and reducing congestion.

Route 5A-06-VA-A1

7.2.4.7 This variant used a horizontal alignment of 180m radius to allow the preferred route to connect with the existing A27 after Barns Copse and reduce direct loss of ancient woodland. A compact junction could be provided at Binsted Lane to provide for access to the existing A27.

Department for Transport (December 2014) “National Policy Statement for National Networks, Para 5.32” [Available online] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387223/npsnn-web.pdf [Accessed August 2019]

7.2.4.8 The 180m radius would represent a 5-step departure in standard for horizontal alignment with a similar departure from standard for visibility located in proximity to a junction. Though departures from standard can be appropriate to avoid significant constraints, such as ancient woodland, in this case suitable measures to manage safety implications could not be identified and therefore the departures were considered very unlikely to be approved by Highways England. This variant was therefore not considered further.

Blue Route

7.2.4.9 This alternative would be located north of the preferred route passing through the ancient woodland at Barns Copse. By using a horizontal radius of 470m it would connect to the existing A27 without having to cross Binsted Rife. This would reduce the impact on Hundredhouse Copse.

7.2.4.10 The use of cut and cover tunnels were discounted due to costs implications. A junction would be provided at Binsted Lane as described for the Orange Route below.

7.2.4.11 Departures from standard would be required for the sub-standard horizontal radius and stopping sight distance. It was considered that the identified departures would require extensive mitigation before acceptance could be achieved. It is considered that this would need to include enforced speed limits.

Orange Route

7.2.4.12 This alternative would have the same horizontal alignment as the preferred route with a horizontal curve of 750m radius. A compact grade separated junction with the existing A27 would be located at Binsted Lane. To minimise the size of the proposed junction as much as possible it would have access to and from the proposed A27 to the west only.

7.2.4.13 The existing gap in central reserve at Yapton Lane and Shellbridge Road would be closed and these movements would be diverted to u-turn at the new junction. Measures would be required on Hedgeshill Road to avoid this becoming a rat run including consideration of closing the road.

7.2.4.14 As with all options the existing Mill Road and Tye Lane junctions would be expected to be closed. Their proximity to the proposed new junction would result in potential road safety concerns.

7.2.4.15 A viaduct would carry the route over the Binsted Rife to reduce the impact on the ancient woodland and reduce severance to bats and other wildlife.

7.2.4.16 The existing A27 between Binsted Lane and Yapton / Shellbridge Lane would become redundant. This would provide an opportunity to reconnect woodland areas north and south of the existing A27.

7.2.4.17 Departures from standard would be required for the combination of below desirable minimum horizontal alignment and reduced stopping sight distance located on the approach to the junction. It was considered that the identified departures would be acceptable.

Black Route

7.2.4.18 This option would be located to the south of the preferred route with a horizontal curve of 1020m radius. This alignment has a shorter length passing through the ancient woodland than the Orange route.

7.2.4.19 A viaduct would carry the route over the Binsted Rife to reduce the impact on the ancient woodland and reduce severance. As the route would pass over a greater length of Binsted Rife it would require a longer viaduct than the Orange route.

7.2.4.20 The existing A27 between Binsted Lane and Yapton / Shellbridge Lane would become redundant. This would provide an opportunity to reconnect woodland areas north and south of the existing A27.

7.2.4.21 A junction would be provided at Binsted Lane as the Orange Route.

7.2.4.22 Some alignment departures from standard may be required for below desirable minimum standard in stopping sight distance at the approach to a junction. These departures would likely to be applied over a short length. It was considered that the identified departures would be acceptable.

Red Route

7.2.4.23 This route follows a curved alignment to pass to the south of ancient woodland at Danes Wood and Hundredhouse Wood and tie into the existing A27 at the existing Yapton Lane / Shellbridge Road Junction.

7.2.4.24 The existing junction at Yapton Lane and Shellbridge Road would be replaced with a compact grade separated junction with a bridge over the proposed A27. Connector roads would link a realigned Yapton Lane, Shellbridge Road and existing A27 with the proposed A27 to provide all movements. The existing Mill Road and Tye Lane junction would be expected to be closed. Their proximity to the proposed new junction would result in potential road safety concerns. A viaduct over Binsted Rife would be provided to reduce the barrier to species movement and to have a lower direct impact on the SDNP and ancient woodland. Moving the alignment further south to avoid ancient woodland and the SDNP completely would result in a route similar to Option 5B.

7.2.4.25 The route would pass close to 6 Grade II listed buildings on Binsted Lane and Yapton Lane and would have a direct impact on the golf course at the Avisford Hotel. The route would also directly impact an area of ancient woodland located within the golf course.

7.2.4.26 The alignment of the route would require departures from standard associated with combinations of below desirable minimum horizontal curves and stopping side distance and below desirable minimum standards on the approach to a junction. It was considered that the identified departures would be acceptable.

7.2.4.27 The variants selected for further assessment and to be presented at the Further Consultation are confirmed in Section 7.9.

7.3 Post Preferred Route Option 1 Developments

Position at PRA

7.3.1.1 At the time of the PRA, both Option 1 (presented at the 2017 Consultation) and Option 1V (developed after the 2017 Consultation) included an at grade signal controlled roundabout to replace the existing Ford Road roundabout (See chapter 6). As explained in the 2018 Scheme Assessment Report (SAR) the proposed junction design was found not to have sufficient capacity and further investigation of alternatives would be required. [4].

Variants Considered

7.3.1.2 Following the PRA Highways England continued to develop the alternative solutions

7.3.1.3 Nine possible variants were developed. Three variants included single carriageway designs and 6 included dual carriageway designs. Section 7.4 summaries the assessment of single carriageway solutions.

7.3.1.4 All 6 dual carriageway variants follow a very similar route to Option 1 / Option 1V with an offline route between Crossbush and Ford Road and an online section west of Ford Road replacing the existing single carriageway A27. The main differences between the variants are the proposed junction arrangements.

[4] Highways England, "A27 Arundel Bypass Scheme Assessment Report, Section 10.5" May 2018. [Online]. Available: https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/sarv1forpublishing.pdf [Accessed 20 June 2019]

7.3.1.5 Four of the variants included the proposed route passing above the Ford Road Junction on a new viaduct with or without a junction at this location. The variants were developed to identify the impacts on local traffic movement and on the environment of different grade separated junction arrangements.

7.3.1.6 To the west of Ford Road Option 1 and Option 1V were designed to appropriate standards for a dual 2 lane urban all-purpose road (D2UAP) and east of Ford Road as dual 2 lane all-purpose road (D2AP) (see Chapter 6). In contrast these variants were designed along their whole length to standards for a D2AP. As a result, all accesses and junctions with minor roads provided in Option 1V have been removed and alternative provision made using local connector roads.

7.3.1.7 The final two variants include for an at grade traffic signal controlled “through about” junction at Ford Road. Variant 5 has been designed as an D2AP. Variant 9 has been designed west of Ford Roads as D2UAP but were possible accesses have been closed and diverted.

7.3.1.8 These two variants were developed to identify whether an at grade solution would still provide sufficient capacity to meet the scheme objectives and to identify whether by adopting a different category of design the impacts of the route could be significantly reduced.

7.3.1.9 All the variants have an almost identical alignment east of Fitzalan Road.

Variant 3 (see Figure 7-2)

7.3.1.10 Variant 3 provided for the proposed A27 to pass over Fitzalan Road, the River Arun and Ford Road roundabout on a new viaduct. No slip roads would be provided at the Ford Road Junction.

7.3.1.11 Instead slip roads would link the proposed A27 to the existing A27 at the Causeway roundabout. Traffic would only be able to leave the proposed A27 eastbound and join the proposed A27 westbound at this location. The west bound on slip would pass under the proposed A27 requiring the mainline A27 to be on higher embankment over the Arun floodplain than the other variants.

7.3.1.12 A grade separated junction would be provided at Crossbush but with only east facing slip roads to allow traffic to leave the existing A27 westbound and join eastbound. The existing A27 between the proposed junction would connect the two junctions allowing for all movements to and from the A27

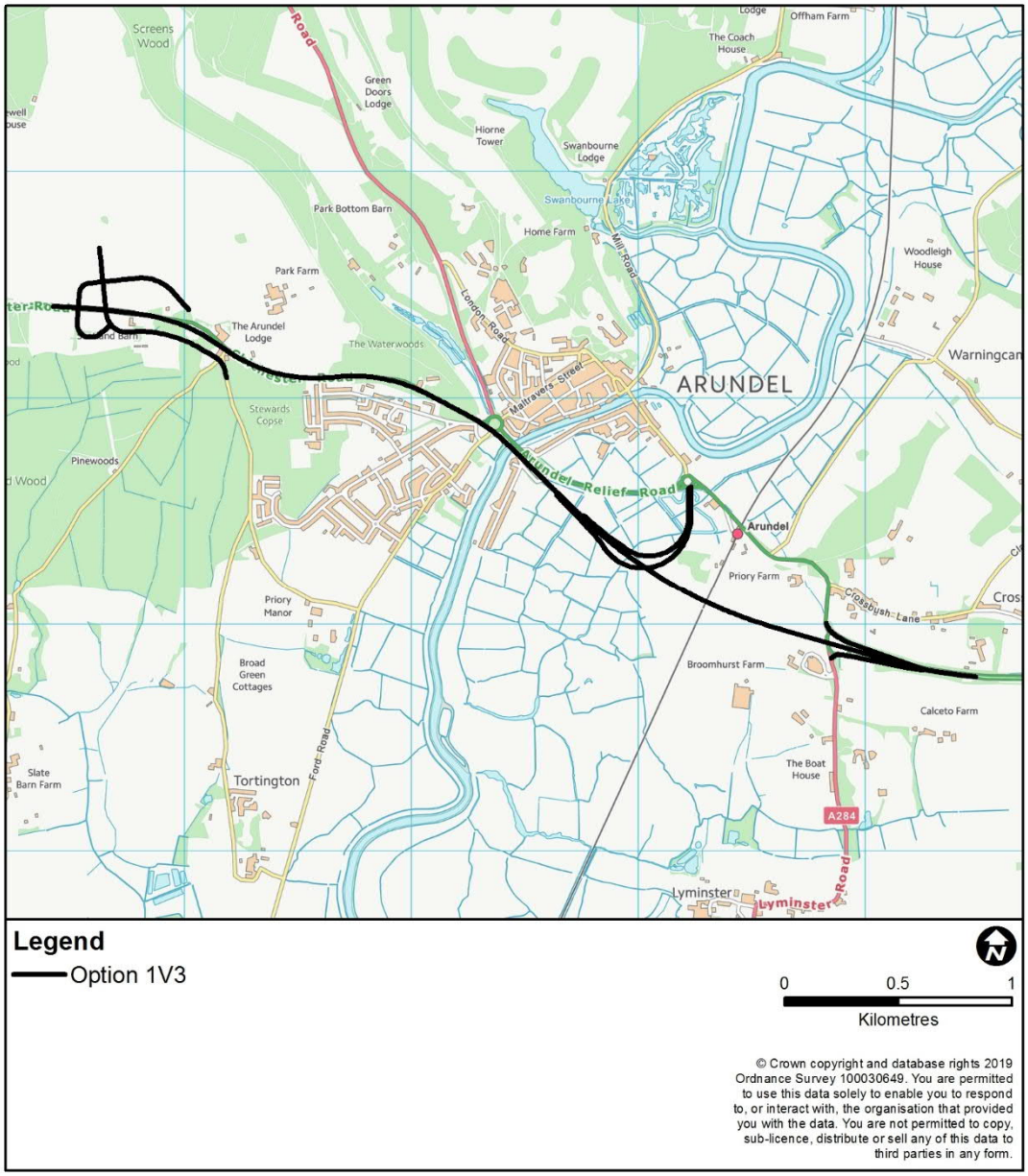


Figure 7-2 - Variant 3

Variant 4 (see Figure 7-3)

7.3.1.13 This variant includes a new viaduct over Fitzalan Road, the River Arun and Ford Road roundabout with east and west facing slip roads provided at the junction accommodating traffic movements between the proposed A27 and the local road network. Ford Road Junction would be enlarged to accommodate the slip roads. The east facing slip roads would pass over Fitzalan Road and the River Arun on separate viaducts and the existing A27 between Causeway junction and Ford Road junction would be closed.

7.3.1.14 A grade separated junction would be provided at Crossbush with both east and west facing slip roads allowing for traffic movements between the A284, existing A27 and proposed A27.

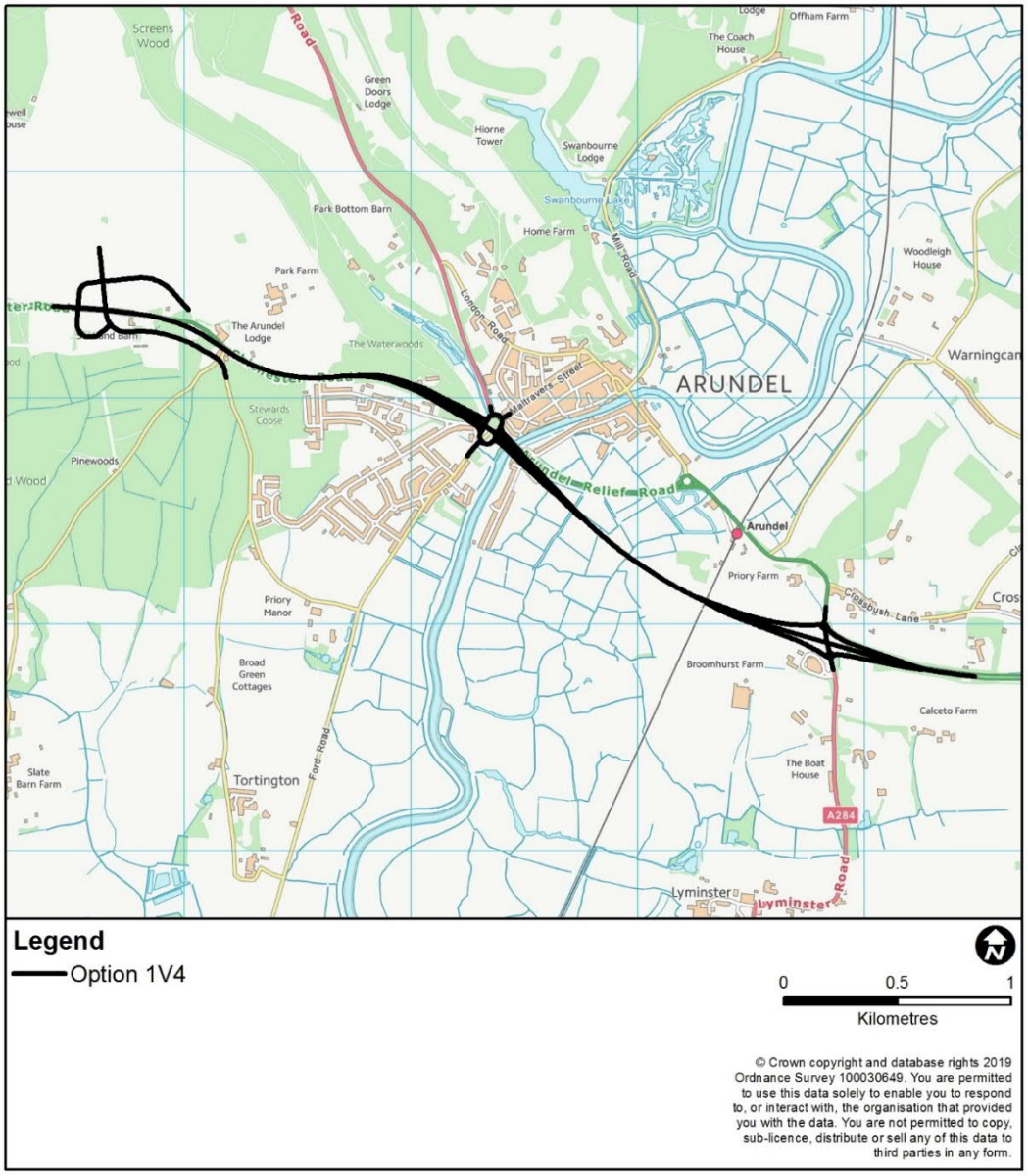


Figure 7-3 - Variant 4

Variant 5 (see Figure 7-4)

7.3.1.15 Variant 5 would provide for the proposed A27 to pass over Fitzalan Road, the River Arun and Ford Road roundabout on a new viaduct. No slip roads would be provided at the Ford Road Junction.

7.3.1.16 A grade separated junction would be provided at Crossbush with both east and west facing slip roads allowing for traffic movements between the A284, existing A27 and proposed A27.

7.3.1.17 The existing A27 between the Ford Road junction and proposed Crossbush Junction would provide access from Arundel to the A27 and for north south traffic movements on the A284.

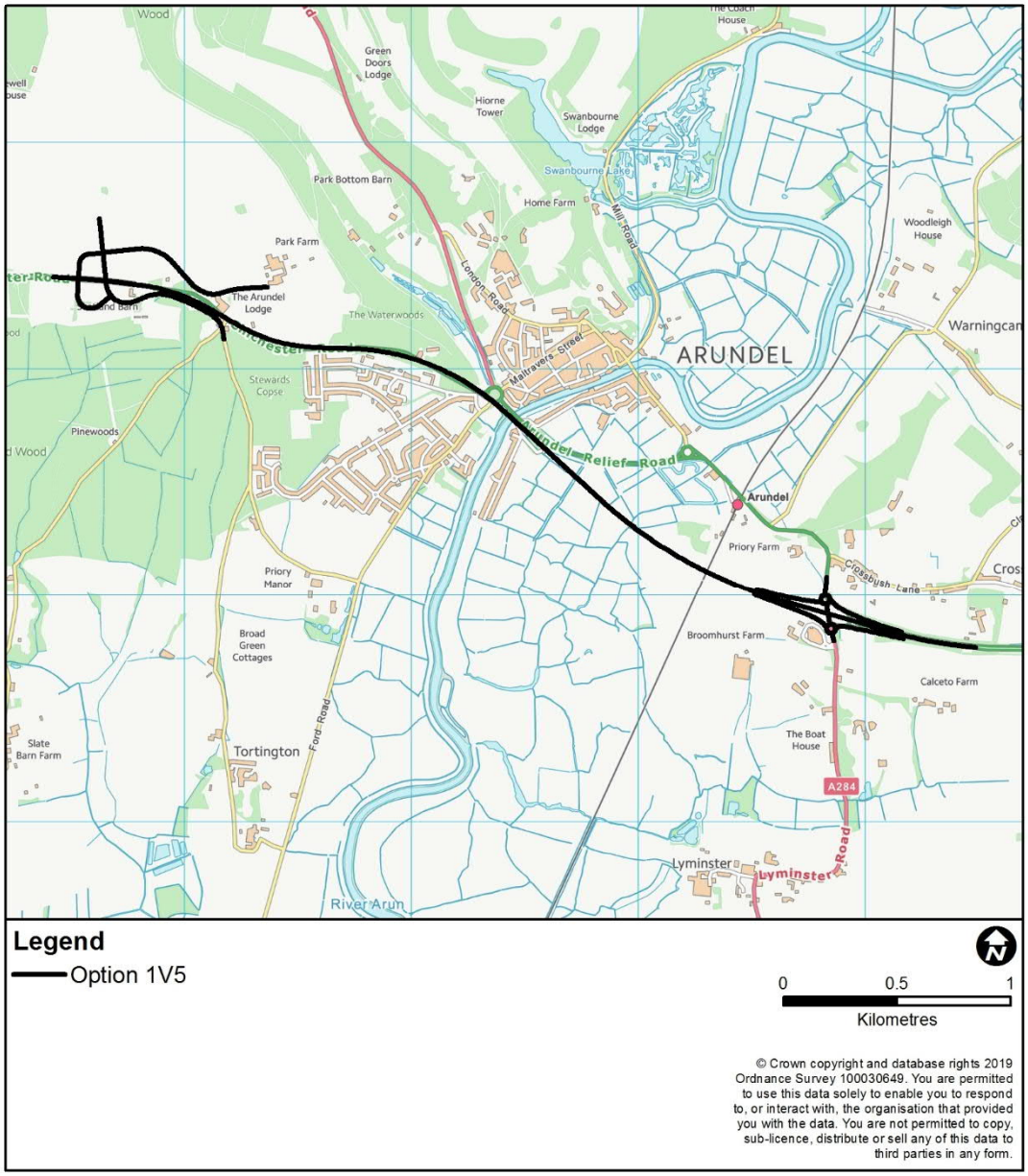


Figure 7-4 - Variant 5

Variant 6 (see Figure 7-5)

7.3.1.18 Variant 6 provided for the proposed A27 to pass over Fitzalan Road, the River Arun and Ford Road roundabout on a new viaduct. West facing slip roads would be provided at Ford Road roundabout to accommodate traffic leaving the eastbound A27 and joining the westbound A27. Ford Road roundabout would be enlarged to accommodate the slip roads and the existing A27 would be retained between Ford Road roundabout and the Causeway roundabout.

7.3.1.19 A grade separated junction would be provided at Crossbush with both east and west facing slip roads allowing for traffic movements between the A284, existing A27 and proposed A27.

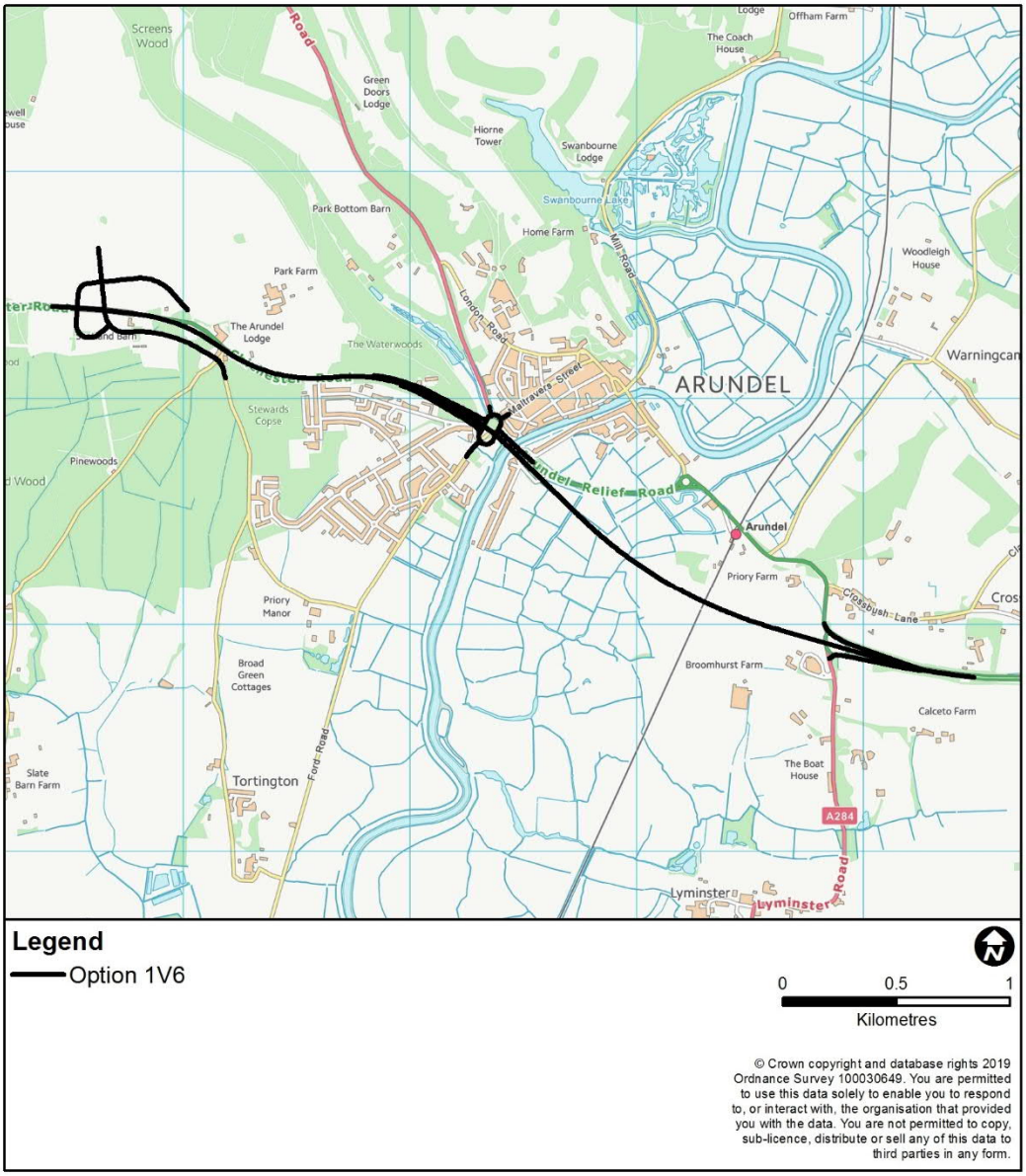


Figure 7-5 - Variant 6

Variant 7 (see Figure 7-6)

7.3.1.20 With this variant an at grade signal controlled "through about" junction would be provided to accommodate traffic movements between the proposed A27 and the local road network. The existing A27 at the existing Fitzalan Arun Bridge would be restricted to eastbound traffic leaving the junction.

7.3.1.21 A grade separated junction would be provided at Crossbush with both east and west facing slip roads allowing for traffic movements between the A284, existing A27 and proposed A27.

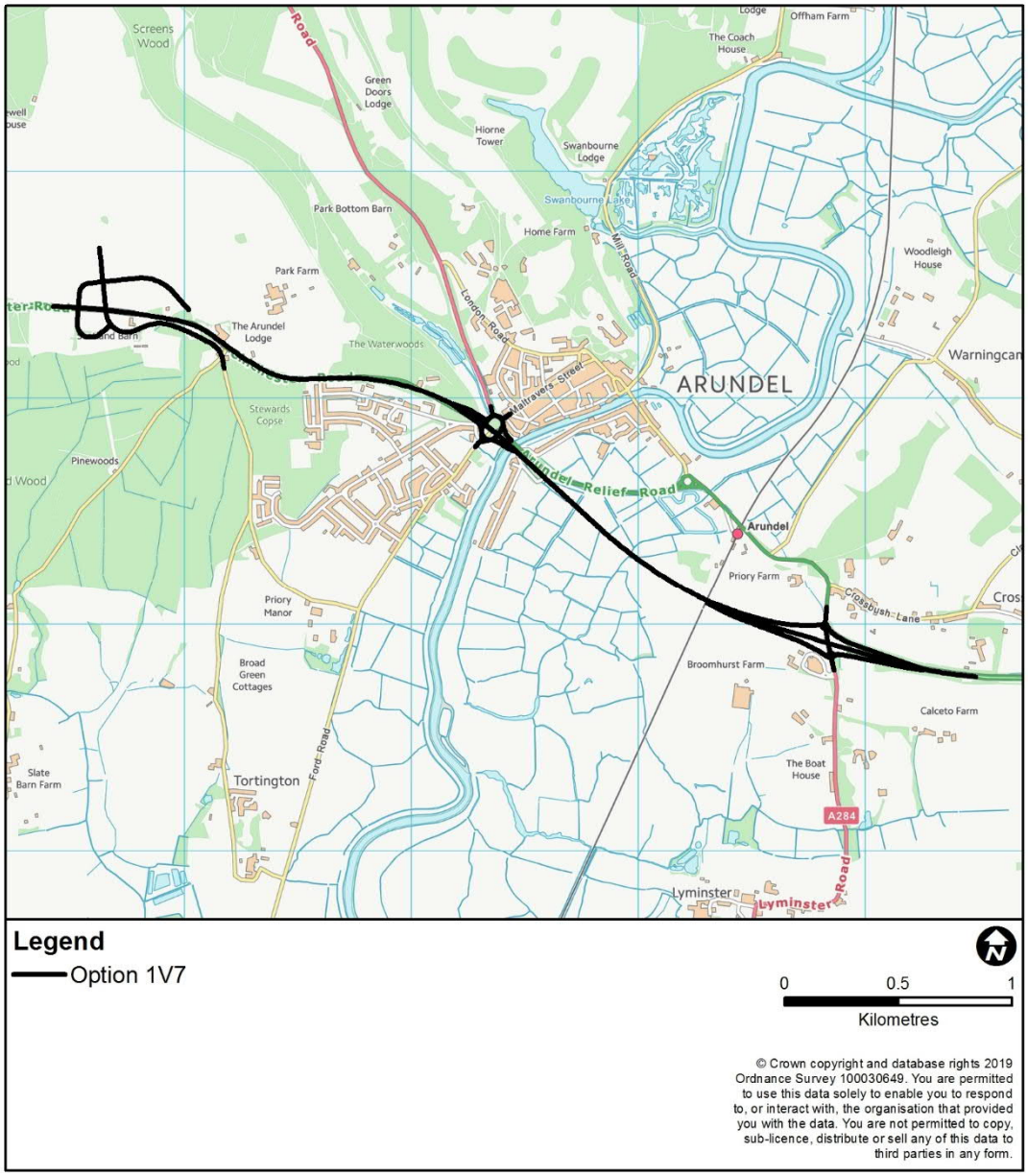


Figure 7-6 - Variant 7

Variant 9 (see Figure 7-7)

7.3.1.22 Variant 9 has the same junction layout at Ford Road roundabout and at Crossbush as Variant 7.

7.3.1.23 The differences with this variant are related to adopting a different standard of design. Option 1 and Option 1V were designed as D2AP east of Fitzalan Road and as D2UAP west of Fitzalan Road. This included a 40mph speed limit, a reduced road cross section, direct access to properties and junctions at minor roads. Gaps in central reserve included in the Option1 design were removed following public consultation with the Option 1V design.

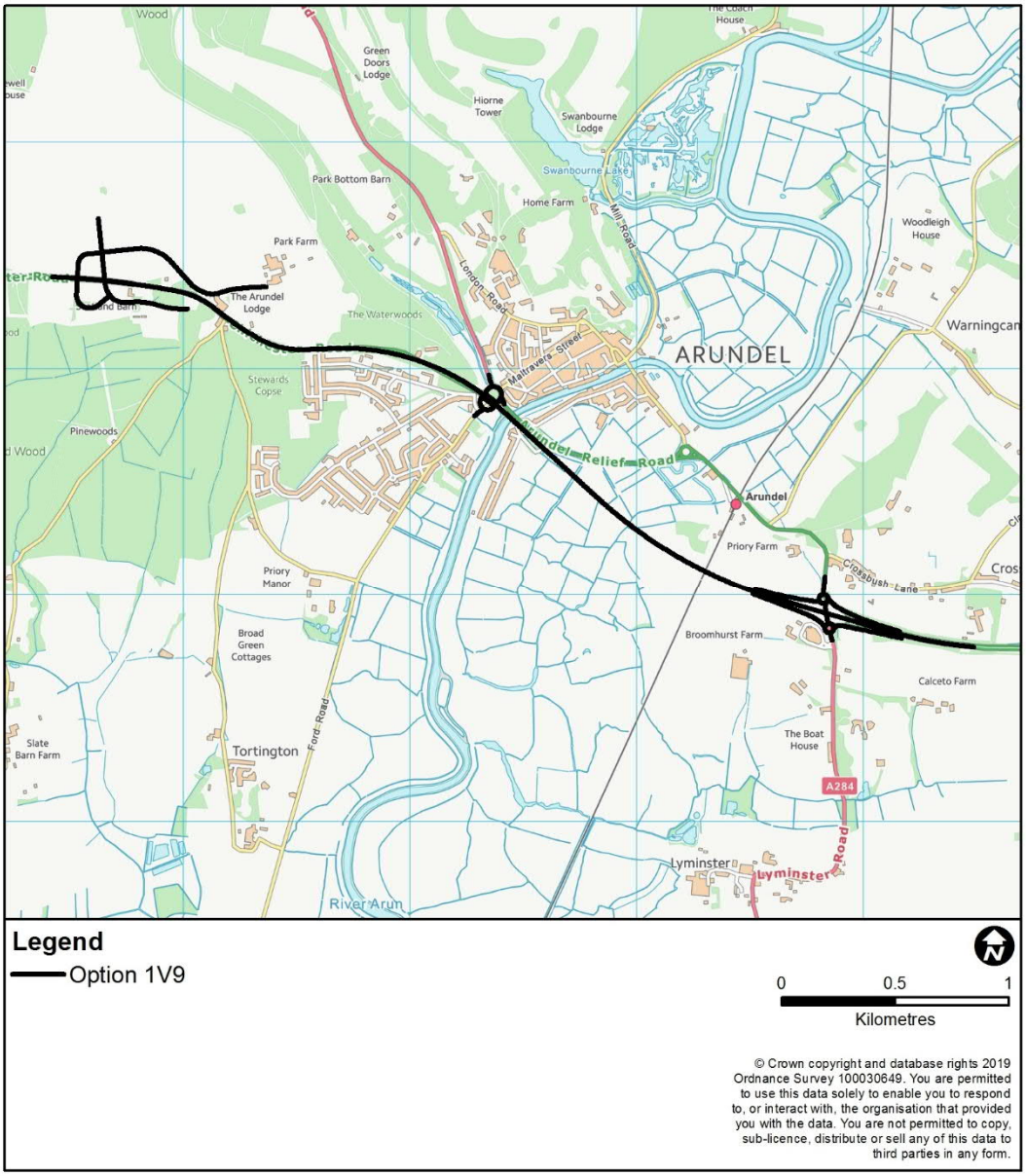


Figure 7-7 - Variant 9

7.3.1.24 The variants 3,4,5, and 7 have adopted a consistent standard of provision to D2AP with national speed limit. Therefore, these variants do not include junctions at minor roads and no direct access. Alternative provision is provided by new local minor roads. Some of these new minor roads would directly impact ancient woodland

7.3.1.25 For Variants 3,4,5 and 7 a new access is provided to the Arundel and District Community Hospital off the A284. The accesses at the White Swan and to the Arundel Cricket ground are closed and replaced by a new minor road following the route of FP 346 to the proposed junction at the western tie in (see paragraph 7.3.1.32). The junction with Tortington Lane is removed and diverted via a new road to the proposed junction at the western tie in. This road would also provide alternative access to properties south of the A27. The junction with Jarvis road would be closed. The junction at Fitzalan Road is also closed and alternative provision provided as described in 7.3.1.28.

7.3.1.26 Variant 9 has been designed to standards appropriate for an D2UAP road west of Ford Road similar to Option 1 and Option 1V. This includes a reduced cross section, a left in left out junction at Tortington Lane and at the Arundel and District Hospital but with the inclusion of taper diverge and parallel merge. A tighter horizontal and vertical alignment has also been used, comparable to a lower speed limit. The aim has been to have a lower impact on ancient woodland. East of the Ford Road the alignment is identical to Variant 7 this is because the same treatment at Fitzalan Road has been adopted for Variant 9 as the other variants (see 7.3.1.28)

Fitzalan Road

7.3.1.27 At present there is a junction on the south side of the A27, east of the river Arun, connecting the A27 with the local road network at Fitzalan Road. This road passes under the existing A27 at The Fitzalan Arun Bridge with limited headroom (2.8m). The existing junction allows for all movements. Vehicles higher than 2.8m can access properties to the north of the existing A27 via other roads for example via the Causeway. With the inclusion of a dual carriageway on the A27 at this location right turns would no longer be desirable. The Option 1 and Option 1V designs included for the provision of a left in left out junction on the westbound carriageway to provide access to vehicles unable to pass under the low bridge using the Crossbush junction to join the A27.

7.3.1.28 Variants 3, 4, 5, 6 and 7 have been designed with no junctions to the local road network therefore the left in left out junction with Fitzalan Road has been removed. To maintain access Fitzalan Road would be realigned to pass under the proposed A27 and connect with the existing A27 with a new priority junction.

7.3.1.29 For Variant 9 the change in the design of the Ford Road Junction would result in a left in left out junction immediately prior to the proposed through about at Ford Road.

7.3.1.30 The left in left out junction would be located at the point where lane numbers are increasing on approach to the proposed throughabout junction and there would be a concern that drivers may not be considering lane choice rather than considering traffic turning off.

7.3.1.31 Therefore, the same treatment at Fitzalan Road has been adopted for Variant 9 as the other variants. This has the advantage of reducing conflicts but does have the disadvantage of increasing the height of the proposed A27 more than it would otherwise need to be.

Other Changes

7.3.1.32 For all variants the roundabout included in Option 1V (see Chapter 6) at Long Lane has been replaced by a compact grade separated junction. This allows the A27 traffic to pass through the junction without having to give way.

7.3.1.33 All the variants included the design developments at the proposed Crossbush junction developed for the PR (see section 7.2.2.2).

7.3.1.34 The variants selected for further assessment and to be presented at the Further Consultation are confirmed in Section 7.9.

7.4 Single Carriageway Variants

7.4.1.1 In response to feedback from the 2017 Consultation, a traffic assessment was carried out to consider whether a wide single 2 lane carriageway (WS2) would provide sufficient capacity and therefore be considered as a potential alternative to a D2AP or D2UAP road. Three alternative designs were prepared based on the information received following the 2017 Consultation.

- Variant 1 – WS2 direct route from Crossbush to Ford Road with a compact grade separated junction at Ford Road.
- Variant 2 – As Variant 1 but with the proposed alignment of the A27 at Ford Road lowered by lowering the level of Ford Road.
- Variant 8 – As Variant 1 but with the proposed alignment of the A27 from Crossbush connecting directly with the existing Ford Road roundabout.

7.4.1.2 The following is based on an assessment of forecast traffic flows reported in the 2018 SAR.

7.4.1.3 Design Manual for Roads and Bridges (DMRB) TA46/97 sets out carriageway standard options for use as a starting point in the design and economic assessment of new rural roads. The guidance indicates the range of traffic flows over which each carriageway standard is likely to be economically justified and operationally acceptable.

7.4.1.4 For a WS2 layout table 2.1 of TA 46/97 indicate economic flow ranges for the opening year AADT of between 6,000 and 21,000. For comparison, the 2018 SAR sets out the existing and forecast traffic volumes (year 2041) for the single carriageway section of road near Arundel as 30,300 and 34,900 respectively (ref Fig 2-4 2018 SAR and Fig 4-2 2018 SAR). The opening year (2023) forecast is 34,100. This level of traffic volume is considerably in excess of the maximum level of flow that the DMRB advises would be economically justified and operationally acceptable for new rural roads.

7.4.1.5 The performance of an existing or new road link can also be considered in terms of its volume and capacity over a typical peak hour. TA46/97 Annex D gives formula for the calculation of the maximum sustainable hourly lane throughput (capacity) for new rural links.

7.4.1.6 Using TA46/97, the capacity for a single carriageway has been estimated as 1,320 vehicles per hour. This compares to peak hour flows of up to 1,343[5] and do nothing forecast year 2041 peak hour flows of up to 1,515 vehicles per hour[6] reported in the May 2018 SAR. These exceed the TA46/97 estimate of capacity for a WS2, and therefore this further indicates that a WS2 road would not be operationally acceptable.

7.4.1.7 The assessment carried out is consistent with the previous conclusions in relation to the limited potential of improved single carriageway road standards on the A27 at Arundel. The data shows that flow forecasts exceed the capacity of a WS2 and that a WS2 road would not be economically justified or operationally acceptable. A WS2 trunk road would therefore not deliver the Scheme objectives. As a result, single carriageway options were not proposed for further consideration.

[5] Highways England, "A27 Arundel Bypass Scheme Assessment Report Figure 2.5," May 2018. [Online]. Available: https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/sarv1forpublishing.pdf [Accessed 20 June 2019

[6] Highways England, "A27 Arundel Bypass Scheme Assessment Report Figure 4-2," May 2018. [Online]. Available: https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/sarv1forpublishing.pdf [Accessed 20 June 2019

7.4.1.8 In addition, evidence indicates that single carriageways in general have poorer accident safety records. A report published by the Road Safety Foundation[7] has revealed that the number of fatal and serious crashes/billion vehicle kilometres on 'A' road single carriageways in England, between 2015 and 2017, were over three times as many as those recorded on 'A' road dual carriageways. The accident rate used by COBALT, the computer program developed by the DfT to assess accident impacts as part of the economic appraisal for a road scheme, for a modern wide single road with hard strip is over twice as high as that of a modern dual carriageway road with hard strip.

7.5 Decision for Further Consultation

7.5.1.1 In October 2018 Highways England announced a further non-statutory consultation would be undertaken on the Scheme. The Preliminary Design of the Preferred Route therefore stopped and the project returned to PCF Stage 2 (Options Selection). Highways England made a commitment that assessment for the Scheme options previously consulted on (Options 1, 3, and 5A) and additionally Options 4 and 5B considered in Stage 1 but rejected (see Chapter 6) would be available for the public to consider.

7.6 Option 3 Developments

7.6.1.1 The Option 3 route presented at the 2017 non-statutory consultation is shown in Figure 7-8. In the 2018 SAR[8] it was recommended that this option should not be considered further as it had the lowest value for money, had the overall highest environmental impact and had the lowest support from the public. However, because of Highways England's commitment to include it in the further consultation it was necessary to undertake a review of the design.

[7] Road Safety Foundation (July 2019) "How Safe are You on Britains Main Road Networks" [Available online] https://roadsafetyfoundation.org/project/how-safe-are-you-on-britains-main-road-networks-eurorap-results-2019/ [accessed August 2019]
[8] Highways England, "A27 Arundel Bypass Scheme Assessment Report," May 2018. [Online]. Available: https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/results/sarv1forpublishing.pdf [Accessed 20 June 2019]

7.6.1.2 The alignment of Option 3 passes through the ancient woodland at Tortington Common. There would be very limited opportunities to reduce the environmental impacts on the ancient woodland to levels comparable to the other options through considering alternative route alignments. However, several design changes have nevertheless been made to the alignment presented at the 2017 consultation, applying a similar approach to that applied to the other route options to try and improve Option 3 and make it more acceptable.

7.6.1.3 These design changes include the following.

- To reduce the scale of the junction within the SDNP and to attempt to eliminate the need for street lighting, the junction layout at the western tie in was modified from a full movement dumbbell layout to a loop arrangement with west facing slip roads only.
- The proposed horizontal alignment of the A27 was modified to provide a more flowing alignment at the western tie in by replacing two short curves separated by a short straight tangent with a continuous long curve. This would improve the visual perspective of the road to the driver and avoid possible problems in providing super elevation.
- To reduce the impact on ancient woodland the proposed vertical alignment of the route was modified to reduce the depth of cutting in the ancient woodland. This required Old Scotland Lane and Binsted Lane to be raised to pass over the revised alignment.
- The route was moved slightly further south to provide greater clearance to the site boundary of Tortington Augustinian Priory Scheduled Monument.
- East of the River Arun the proposed design would adopt the same design as developed for the PR.

7.6.1.4 The revised Option 3 design is shown in Figure 7-8 and has been named Option 3V1.

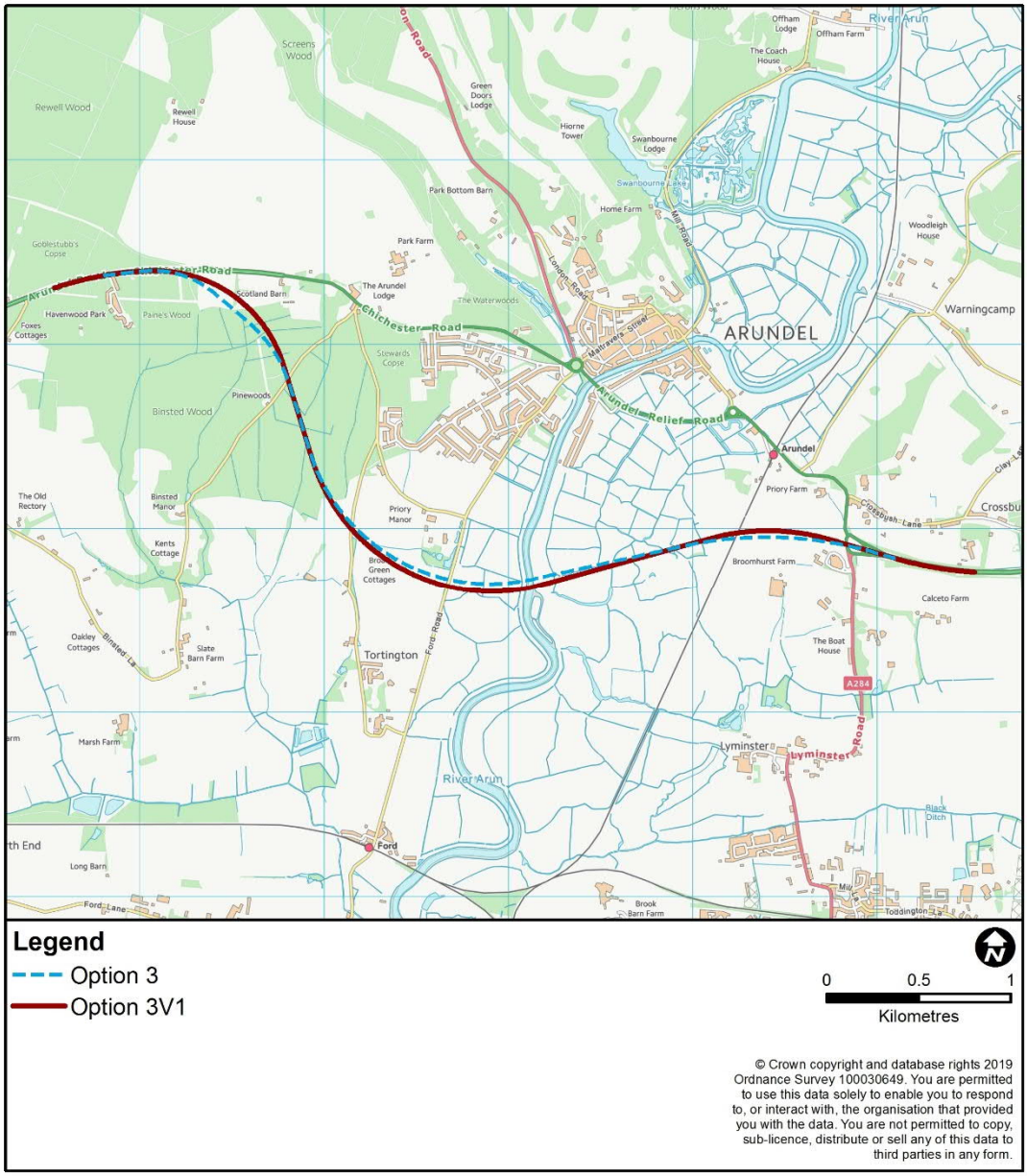


Figure 7-8 - Option 3 and Option 3v1

7.7 Option 4

7.7.1.1 Figure 7-9 shows that the development of variants to the 2018 preferred route had resulted in routes very similar to Option 4 which had been rejected in Stage 1 (see Chapter 6). As a result, it has been combined with the variants proposed for the preferred route.

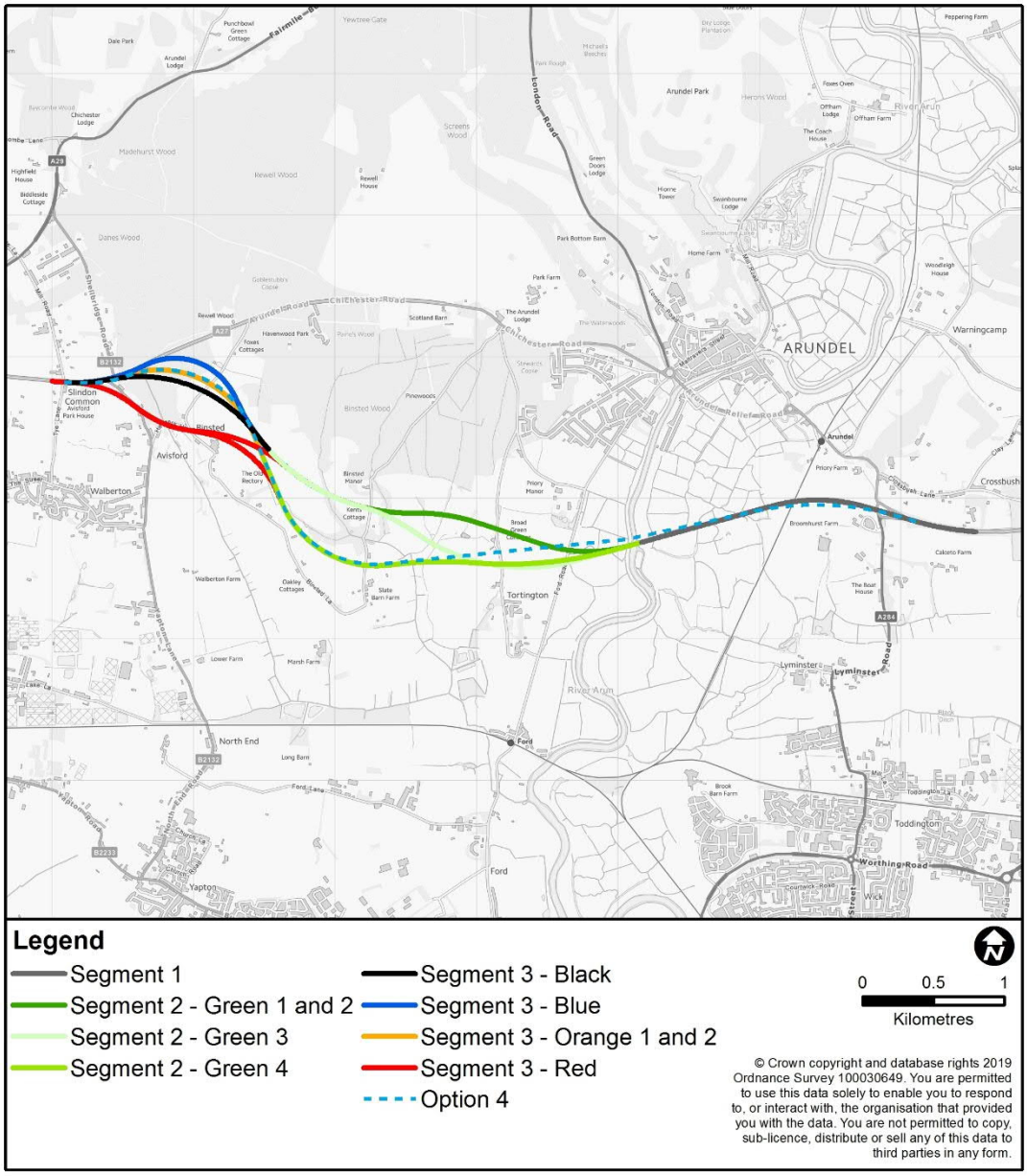


Figure 7-9 - Option 4 and Preferred Route Variants

7.8 Option 5B Developments

7.8.1.1 The Option 5B route presented in the Technical Appraisal Report (TAR)[9] is illustrated in Figure 7-10.

7.8.1.2 Option 5B was rejected prior to the 2017 consultation because it performed least well in terms of value for money, possessing the highest cost to deliver the Scheme. The cost was assessed to be above the Scheme affordability range. This option is the longest route which has been considered and would avoid the SDNP and areas of ancient woodland.

7.8.1.3 To support the proposed further consultation a review of the Option 5B alignment was carried out. The review identified several issues with the junction layout at the western end of the scheme proposed in the PCF Stage 1 (Option Identification) design including:

- Potential impact through edge effects on a small area of ancient woodland at Potwell Copse located to the south of Copse Lane.
- The layout impacts on properties located off Copse Lane.
- The impact on Copse Lane with no alternative access for properties located off Copse Lane.
- Retaining the existing left in left out junction at Arundel Road close to the west bound on slip could result in safety issues which may mean the junction would need to be closed.

7.8.1.4 To address these concerns the junction at the western end of the scheme was relocated further to the west. Three alternative layouts were also developed:

- Full grade separated standard dumbbell layout with east and west facing slip roads.
- Split junction layout with east bound off slip to the existing A27 where the route ties into the existing A27 with westbound on slip at a loop layout located off Tye Lane. No east facing slip roads would be provided to reflect the traffic forecasts.
- Modified compact junction layout providing a left in left out layout on the westbound carriageway with access to Tye Lane.

[9] WSP on behalf of Highways England (August 2017) "A27 Arundel Bypass PCF Stage 1 Technical Appraisal Report Chapter 12" Available [Online] https://highwaysengland.citizenspace.com/he/a27-arundel-bypass/supporting_documents/Technical%20Appraisal%20Report.pdf [Accessed August 2019]

7.8.1.5 The loop junction layout was selected because of its smaller size compared to the dumbbell arrangement and because the compact junction layout provided no additional benefits in terms of avoiding constraints.

7.8.1.6 The Option 5B design was also changed to reflect the development of alternative alignments to the preferred route made following the PRA where the routes would follow almost identical alignments.

7.8.1.7 The vertical alignment of Option 5B was also changed to reduce the amount in cutting to provide a better earthworks balance to the west of the River Arun floodplain.

7.8.1.8 The revised Option 5B design is shown in Figure 7-10 and has been named Option 5BV1.

7.8.1.9 The route would cross part of the site of a new development for 175 houses at land east of Tye Lane to the north of Walberton. Alternative provision would be required for the development if this option was taken forward as the preferred route during PCF Stage 3 (Preliminary Design).

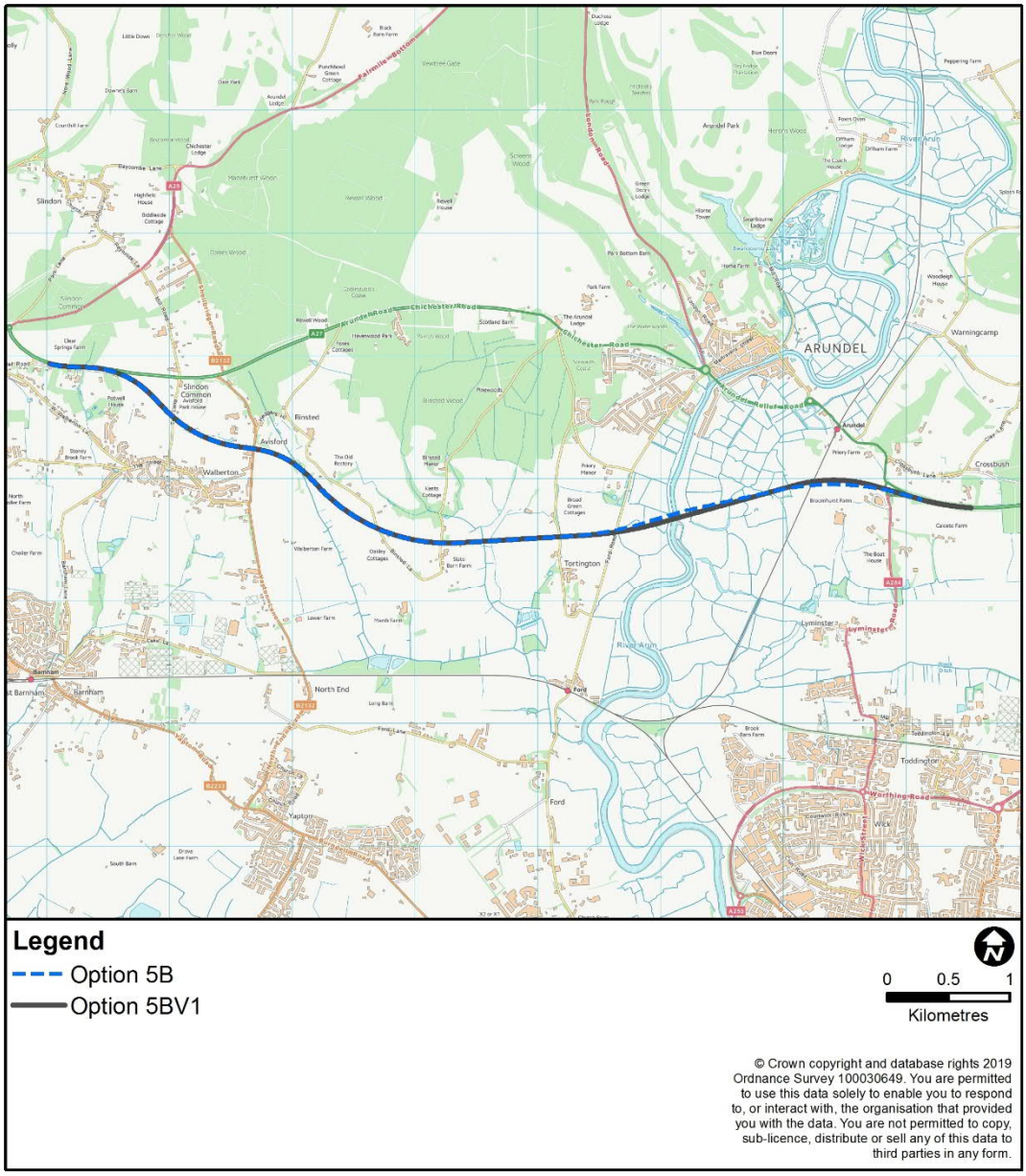


Figure 7-10 - Option 5B and Option 5BV1

7.9 Selected Variants

7.9.1.1 The results of the a pairwise assessment undertaken are provided in Appendix C. A fuller record is contained in the Option Identification Initial Sifting Assessment Report[10]. Due to the geographical proximity of the variants being compared and the similar design features, relatively few differentiating criteria were identified. Higher weight was given to NN NPS policy criteria when making decisions.

Preferred Route Variants

7.9.1.2 The results are summarised below of the pairwise assessment of the variants to the preferred route in Segments 2:

- Green 1 (announced PR) preferred to Green 2
- Green 3 preferred to Green 1
- Green 4 preferred to Green 3

7.9.1.3 Therefore, Green 4 was selected for further assessment.

7.9.1.4 For Segment 1:

- Black route preferred to Orange Route
- Black route preferred to Blue Route
- Black route preferred to the announced Preferred Route
- Red Route preferred to Black route

7.9.1.5 Therefore, the red route was selected for further assessment.

7.9.1.6 The combination of the Red Route, Green 4 and the common alignment in Segment 1 was therefore identified as the best performing alternative to the published preferred route and would be taken forward for further assessment.

7.9.1.7 The combination of the Red and Green 4 routes would result in a route closer to residences in the communities of Binsted and Walberton. This would be contrary to comments received at the 2017 Consultation. Highways England therefore decided to include a second option for further assessment which would have a better performance against the Scheme objective "to ensure that customers and communities are fully considered throughout the design and delivery stages". This is in addition to the commitment made in undertaking the further non-statutory consultation. The second route was identified as the combination of the black and Green 3 routes.

[10] WSP on behalf of Highways England (June 2019) "Option Identification Initial Sifting Assessment"

7.9.1.8 The selected variants were given option references for the further assessment reflecting that they combined both the previous Option 5A and Option 4:

- Option 4/5AV1 – Combination of Red Route and Green 4 and the common alignment in Segment 1
- Option 4/5AV2 – Combination of Black Route and Green 3 and the common alignment in Segment 1

7.9.1.9 Both these would be taken forward to consultation.

Option 1 Variants

7.9.1.10 For the Option 1 Variants the initial sifting was carried out separately for variants 3, 4, 5 and 6, each with grade separated junction layouts at Ford Road, and variants 7 and 9, both with an at-grade junction solution at Ford Road. It was decided that there were sufficient differences, in terms of environmental impacts and operational performance between the grade separated solutions and at-grade solutions to require further assessment of at least one of both.

7.9.1.11 For the grade separated variants, the results were:

- Variant 3 preferred to Variant 6
- Variant 3 and 4 equally preferred
- Variant 5 preferred to Variant 4
- Variant 5 preferred to Variant 3

7.9.1.12 Therefore Variant 5 was selected for further assessment.

7.9.1.13 For the at-grade variants, Variant 9 was preferred to Variant 7 and so was selected for further assessment.

7.9.1.14 The new option references used for the further assessment are as follows:

- Option 1V5
- Option 1V9

7.10 Options for Further Assessment

7.10.1.1 In summary the following variants, illustrated in Figure 7-11, were taken forward for further assessment. For the public consultation colours have been used to aid the identification of the different options:

- Option 1V5 - Cyan
- Option 1V9 - Beige
- Option 3V1 - Crimson
- Option 4/5AV1 - Magenta
- Option 4/5AV2 - Amber
- Option 5BV1 - Grey

7.10.1.2 The findings of assessments are summarised in Chapters 9 to 15.

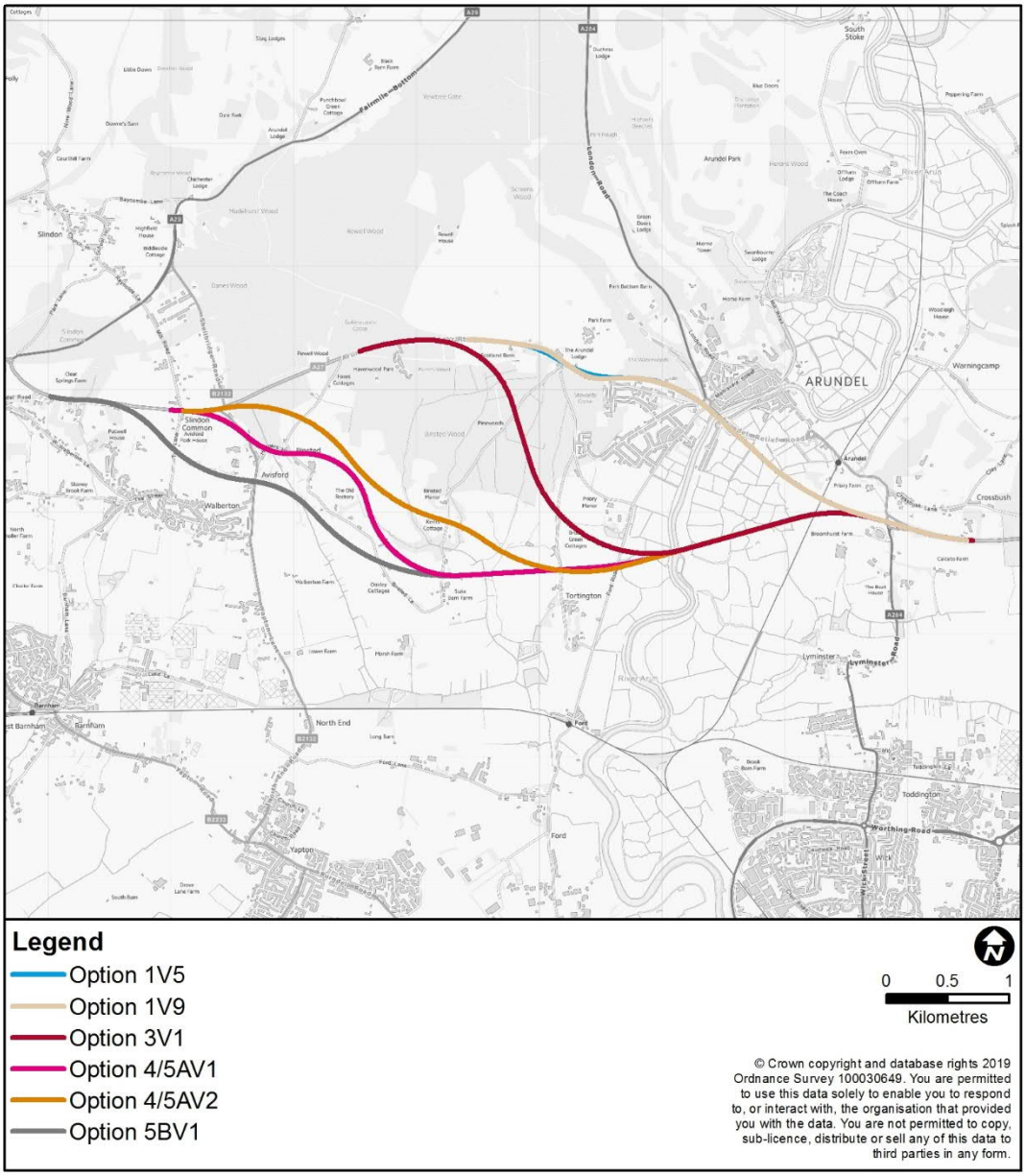


Figure 7-11 - Options for Further Assessment

Abbreviations

Abbreviation	Explanation
D2AP	Dual 2 lane all-purpose road
D2UAP	Dual 2 lane urban all-purpose road
DMRB	Design Manual for Roads and Bridges
NN NPS	National Policy Statement for National Networks
PCF	Project Control Framework
PRA	Preferred Route Announcement
PR	Preferred Route
SAR	Scheme Assessment Report
SRN	Strategic Road Network
TAR	Technical Appraisal Report
WebTAG	Web based Transport appraisal guidance
WS2	Wide single 2 lane carriageway

Glossary

Term	Explanation
Alignment	The alignment is the horizontal and vertical route of a road, defined as a series of horizontal tangents and curves or vertical crest and sag curves, and the gradients connecting them
Compact Grade Separated Junction	A Grade Separated Junction designed to promote low speeds on connector roads and design to the relevant DMRB standard
Departures and Relaxations from Standard	Relaxations are written into design standards to introduce limited flexibility in certain circumstances allowing designers to design to less stringent requirements than those specified in a standard. These need to be agreed with but not approved by the Project Sponsor. A departure from standard is any other variation or waiving from a requirement contained within the design standards and requires formal approval from the Project Sponsor
Design Manual for Roads and Bridges	A series of 15 volumes prepared by the Department for Transport and Highways England that provide standards, advice notes and other published documents relating to the design,

Term	Explanation
	assessment and operation of trunk roads, including motorways, in the United Kingdom.
Dual 2 lane all-purpose road	A road that has two separated carriageways with 2 lanes in each direction for use by all classes of traffic
Dual 2 lane urban all-purpose road	A road in an urban area that has two separated carriageways with 2 lanes in each direction for use by all classes of traffic
The Further Consultation	The non-statutory consultation for the A27 Arundel Bypass (the Scheme) to be carried out by Highways England from 30 August 2019 to 24 October 2019
The Scheme	The A27 Arundel Bypass Scheme
The 2017 Consultation	The non-statutory consultation for the A27 Arundel Bypass (the Scheme) carried out by Highways England from 22 August 2017 to 16 October 2017
Grade Separated Junction	A Grade Separated Junction (GSJ) is a junction where the intersecting roads are separated at different heights, usually be a bridge, so that traffic flows do not intersect one another. For the A27 Arundel Bypass only traffic on the proposed A27 would be free flowing.
Mainline	The through carriageway of a road as opposed to a slip road or a link road at a junction
National Policy Statement for National Networks	Sets out the national roads policy framework, as presented to Parliament in December 2014.
Project Control Framework	A joint Department for Transport and Highways England approach to managing major projects. The Framework comprises a standard project lifecycle; standard project deliverables; project control processes and governance arrangements
Through about Junction	A through-about (or Hamburger) junction is one which allows a straight ahead traffic stream to bypass the circulating roundabout carriageway by crossing through the central island at grade. This is achieved under signal control.
WebTAG	WebTAG (Web-based Transport Analysis Guidance) is the Department for Transport's transport appraisal guidance and toolkit. It consists of software tools and guidance on transport

Term	Explanation
	modelling and appraisal methods that are applicable for highways and public transport interventions (The word 'interventions' is used to cover the entire range of measures from demand management measures through to major engineering projects).
Wide Single Carriageway	A wide single carriageway road with one lane in each direction with cross section defined in DMRB Volume 6 Section 1 Part 2 TD 27/05.

A27 Arundel Bypass Scheme Assessment Report

Chapter 8 Description of Options

October 2020

CONTENTS

LIST OF TABLES

LIST OF FIGURES

8 Description of Options

8.1 Introduction

8.1.1.1 The six route options identified for further assessment are described in detail in this chapter. The options are broadly classified as either online or offline. All routes are described from east to west starting at the end of the existing A27 Crossbush bypass.

8.2 Online Options

8.2.1.1 The two-online options, Option 1V5 and Option 1V9 are described in this section of the report. They follow very similar alignments. From the Crossbush junction they follow an offline route to the south of the existing A27. They then run adjacent to the existing A27 to cross Fitzalan Road, the River Arun and Ford Road Junction. Option 1V5 crosses over Ford Road junction on a viaduct without a junction. Option 1V9 connects with a signal controlled junction which allows all movements. They then both follow similar alignments online of the existing A27 corridor. Ending at the existing transition from single to dual carriageway near Long Lane.

8.2.1.2 The alignment of the existing A27 west of Ford Road to the existing transition between single and dual carriageway is not of sufficient standard to be considered suitable for widening to two lane dual carriageway. The proposed alignments for both Option 1V5 and Option 1V9 therefore follows a higher standard geometric alignment replacing the existing A27 on this section of the route. Option 1V5 has a higher standard alignment compared to Option 1V9.

8.2.2 Option 1V5

8.2.2.1 Option 1V5 comprises approximately 4.5km of new dual two-lane carriageway. Between Crossbush and Ford Road approximately 2.5km would be offline to the south of the existing A27 and with the existing A27 retained. Approximately 2.0km would be online and would replace the existing A27 between Ford Road Junction and the existing transition between single and dual carriageway.

8.2.2.2 Approximately 1.92km of the existing single carriageway A27 within the South Downs National Park (SDNP) would be replaced with dual carriageway. The proposed route would impact approximately 1.95 hectares of ancient woodland. There would be 120 properties within approximately 50m of the option.

8.2.2.3 The centre line of the option is illustrated in Figure 8-1. Illustrative Engineering Layout Drawings for Option 1 V5 are provided in Appendix D.

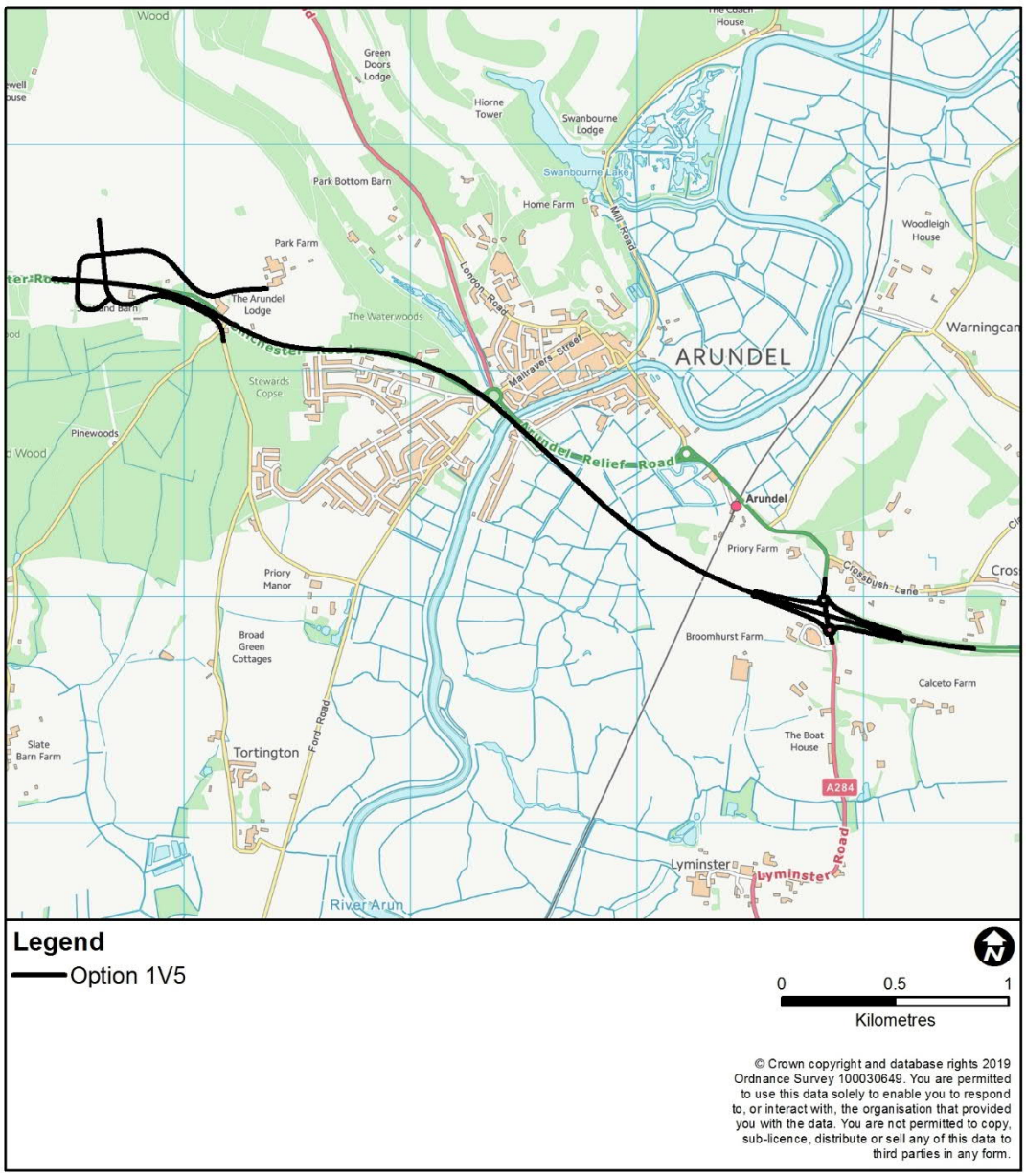


Figure 8-1 - Option 1V5

8.2.2.4 From Crossbush the route would bear in a north-west direction to the south of the existing A27. It would pass over the Arun Valley Railway line to the south of Arundel Station. Continuing north west it crosses the River Arun floodplain on embankment and then runs adjacent to the existing A27 to cross Fitzalan Road, the river Arun and Ford Road junction on a viaduct. With the existing A27 retained.

8.2.2.5 Fitzalan Road would be realigned to pass under the proposed A27 and connect with the existing A27 with a new priority junction. The existing A27 between Ford Road roundabout and the Causeway Roundabout, including the existing Fitzalan Arundel bridge would be retained for local traffic movements both eastbound and westbound.

8.2.2.6 No access to and from the A27 would be provided at the Ford Road junction. Access would be provided only at the Crossbush junction. The layout of the existing Ford Road roundabout may be modified to match revised traffic patterns. This would be considered further in Stage 3 if this option was selected as the preferred route.

8.2.2.7 After passing over Ford Road roundabout the route follows closely the existing alignment of the A27 to the existing transition from single carriageway to dual carriageway. The alignment of the existing A27 is not of sufficient standard to be considered suitable for conversion to two lane dual carriageway. The proposed alignment therefore follows a higher standard geometric alignment replacing the existing A27.

8.2.2.8 All access with the existing A27 would be closed and where possible diverted to local connector roads running parallel to the proposed A27. The Arundel & District Community Hospital would have a new access off the A284. The access to Jarvis Road would be closed.

8.2.2.9 The proposed route is aligned to attempt to balance impacts on adjacent properties and ancient woodland. There would be some direct impact on Arundel Cricket Ground, properties at the junction of Tortington Lane and the existing A27 and White Swan Hotel. There would be a direct impact on approximately 1.95 hectares of ancient woodland.

8.2.2.10 A compact grade separated junction would be provided at Long Lane to connect Tortington Lane to the A27 via a new local road located to the south of the proposed A27. This road would also provide alternative access for the properties located to the south of the A27 which currently have direct access on to the A27. Similarly, a new local road north of the A27 would connect to the junction and provide alternative access to the A27 for Arundel Cricket Ground, White Swan Hotel, Park Farm and other residential properties located north of the A27. The compact grade separated junction would allow for all movements onto and off the proposed A27.

8.2.2.11 The route ends where the existing single carriageway section transitions to a dual carriageway near Long Lane. The existing gap in the central reserve at the access to Havenwood Park would be closed and traffic diverted to the new grade separated junction to do a u-turn.

8.2.3 Option 1V9

8.2.3.1 Option 1V9 comprises approximately 4.5km of new dual two-lane carriageway. Between Crossbush and Ford Road approximately 2.4km would be offline to the south of the existing A27 and with the existing A27 retained. Approximately 2.1km would be online and would replace the existing A27 between Ford Road Junction and the existing transition between single and dual carriageway.

8.2.3.2 Approximately 1.93km of the existing single carriageway A27 within the SDNP would be replaced with dual carriageway. The proposed route would impact approximately 1.09 hectares of ancient woodland. There would be 142 properties within approximately 50m of the option.

8.2.3.3 The centre line of the option is illustrated in Figure 8-2. Illustrative Engineering Layout Drawings for Option 1V9 are provided in Appendix D. It follows almost an identical route as Option 1V5.

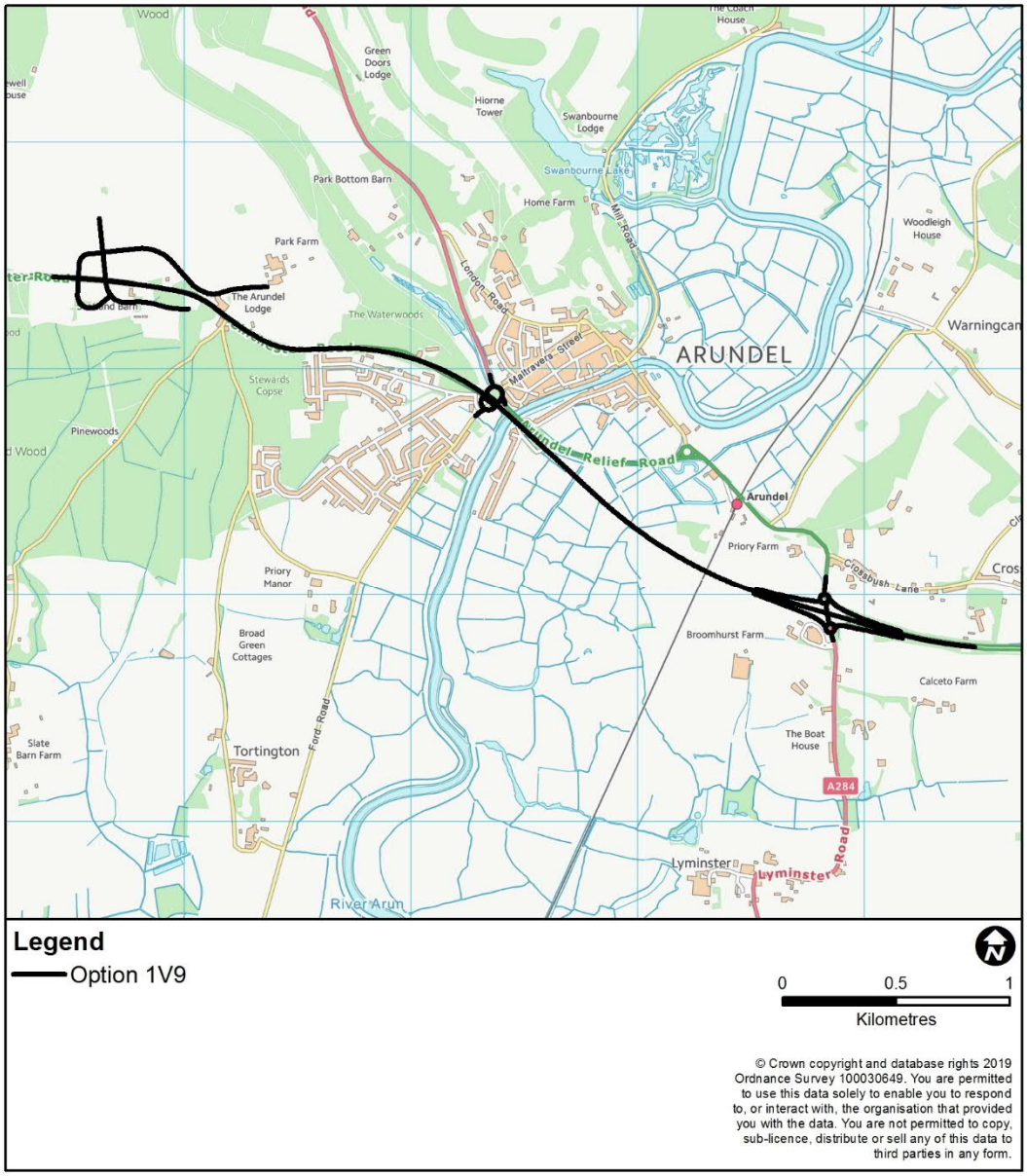


Figure 8-2 - Option 1V9

8.2.3.4 From Crossbush the route would bear north west passing over the Arun Valley Railway line to the south of Arundel Station. Continuing north west it crosses the River Arun floodplain on embankment and then runs adjacent to the existing A27 to cross Fitzalan Road and the river Arun on a viaduct.

8.2.3.5 Fitzalan Road would be realigned to pass under the proposed A27 and connect with the existing A27 with a new priority junction.

8.2.3.6 The proposed route then drops down to existing road level at Ford Road roundabout. Ford Road roundabout is enlarged and converted to a traffic signal controlled “through-about” junction. The proposed junction layout does not provide for eastbound access to the proposed A27 from the side roads. This traffic would use the existing Fitzalan Arun bridge to gain access to existing A27.

8.2.3.7 After passing through the traffic signal controlled “through-about” junction, the route follows closely the existing alignment of the A27 to the existing transition from single carriageway to dual carriageway. The proposed alignment follows a higher standard geometric alignment replacing the existing A27. However, a tighter alignment and a narrower cross section is proposed than for Option 1V5.

8.2.3.8 The proposed route is aligned to attempt to balance impacts on adjacent properties and ancient woodland. The tighter alignment and narrower cross section compared to Option 1V5 is provided to minimise impacts further. There would still be some direct impact on Arundel Cricket Ground, properties at the junction of Tortington Lane and the existing A27 and White Swan Hotel. There would be a direct impact on approximately 1.09 hectares of ancient woodland.

8.2.3.9 To reduce impact on ancient woodland left in left out junctions would be provided at Tortington Lane on the westbound carriageway and at the access to Arundel and Community hospital on the eastbound carriageway. Traffic on the opposite carriageway wishing to gain access would have to u-turn at the next adjacent junction.

8.2.3.10 A compact grade separated junction is provided at Long Lane. This connects, Long Lane, Park Farm and the properties 55, 56, 56A, 57 and 57A Chichester Road and Arundel Arboretum to the proposed A27. The compact grade separated junction allows for all movements onto and off the proposed A27.

8.2.3.11 The route ends where the existing single carriageway section transitions to a dual carriageway near Long Lane. The existing gap in the central reserve at the access to Havenwood Park would be closed and traffic diverted to the new grade separated junction to do a u-turn.

8.3 Offline

8.3.1.1 The four offline routes for further assessment - Option 3V1, Option 4/5AV1, Option 4/5AV2 and Option 5BV1 are described below. They all have a common alignment east of River Arun across River Arun floodplain but extend different lengths west of the river to reduce and ultimately avoid entering the SDNP and direct impact on ancient woodland.

8.3.2 Option 3V1

8.3.2.1 Option 3 V1 comprises approximately 6km of new dual two-lane carriageway bypass located to the south of the existing A27. Starting in the east at the end of the A27 Crossbush Bypass and ending just west of Havenwood Park.

8.3.2.2 Approximately 2.28km of the proposed route would be located within the SDNP. It would impact approximately 9.20 hectares of ancient woodland. There would be 3 properties within approximately 50m of the option.

8.3.2.3 The centre line of the option is illustrated in Figure 8-3. Illustrative Engineering Layout Drawings for Option 3V1 are provided in Appendix D.

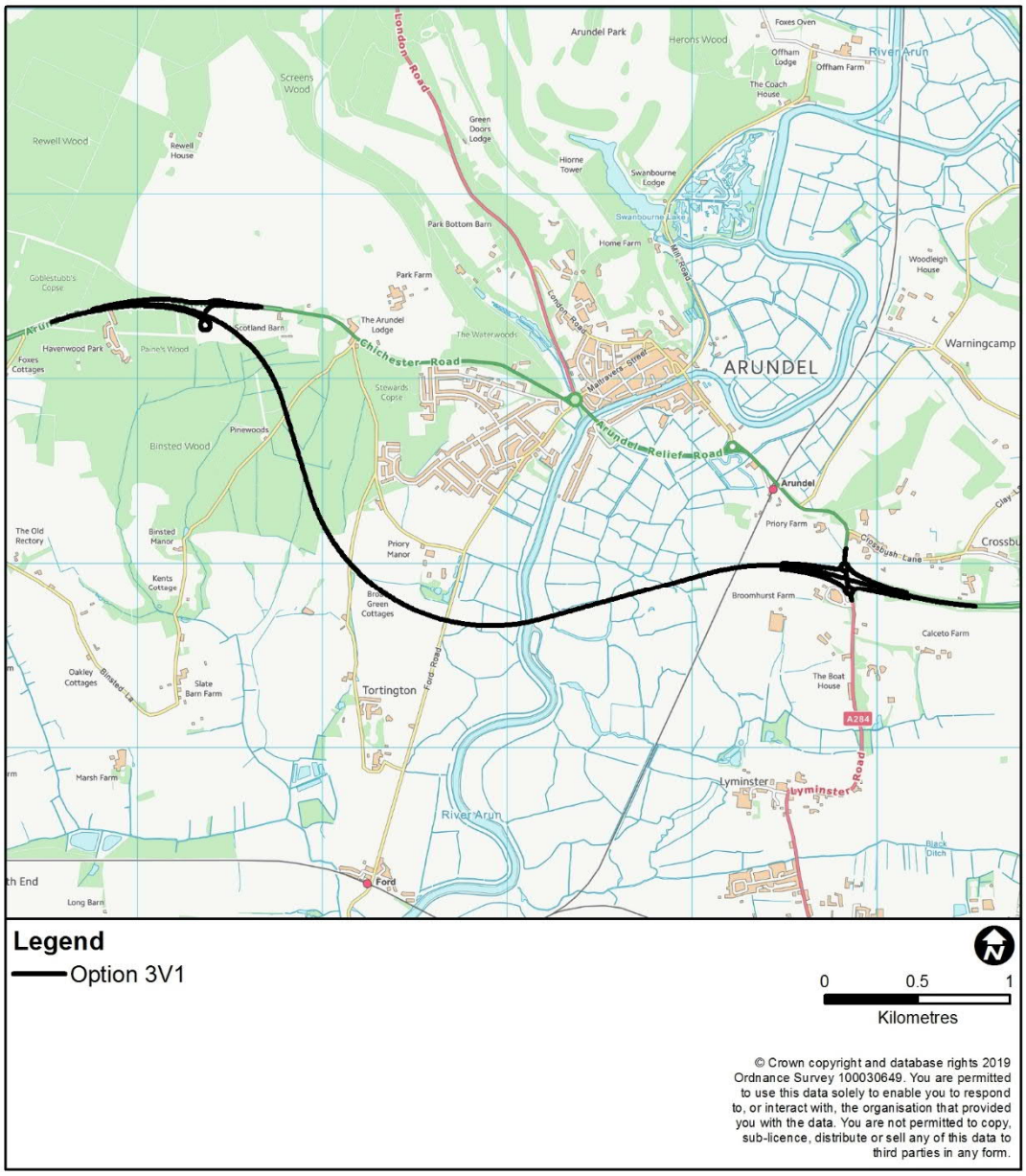


Figure 8-3 - Option 3V1

8.3.2.4 From Crossbush the proposed route bears south west passing over the Arun Valley Railway line. It descends the eastern valley side of the River Arun to cross the Arun floodplain on embankment.

8.3.2.5 As it crosses the River Arun the route starts to curve northwards and crosses over Ford Road just to the south of the scheduled monument at Tortington Priory. It then bears north west, crossing under Tortington Lane, to the north of Broad Green Cottages before entering the SDNP and an area of ancient woodland at Tortington Common. From there the route travel North under Binsted Lane and Old Scotland Lane (BW 338), before bearing west to leave the ancient woodland and to re-join the existing A27 west of the Havenwood Park. There would be a direct impact on approximately 9.20 hectares of ancient woodland.

8.3.2.6 A new grade separated junction to the east of Havenwood Park would be provided. This would allow eastbound traffic to leave the proposed A27 and join the existing A27 eastbound into Arundel. It would also allow westbound traffic on the existing A27 to join the proposed A27 westbound at this location only.

8.3.2.7 The existing access to Havenwood park would be closed as it would be located too close the proposed junction to operate safely. A new access road would be provided linking Havenwood Park to Binsted Lane junction to the west of the park.

8.3.3 Option 4/5AV1

8.3.3.1 Option 4/5AV1 comprises a 7.2km new dual two-lane carriageway bypass located to the south of the existing A27. Starting in the east at the end of the A27 Crossbush bypass and ending just west of the existing B2312 Yapton Lane / Shellbridge Road junction.

8.3.3.2 Approximately 0.74km of the proposed route would be located within the SDNP. It would impact approximately 0.40 hectares of ancient woodland. There would be 29 properties within approximately 50m of the option.

8.3.3.3 The centre line of the option is illustrated in Figure 8-4. Illustrative Engineering Layout Drawings for Option 4/5A V1 are provided in Appendix D.

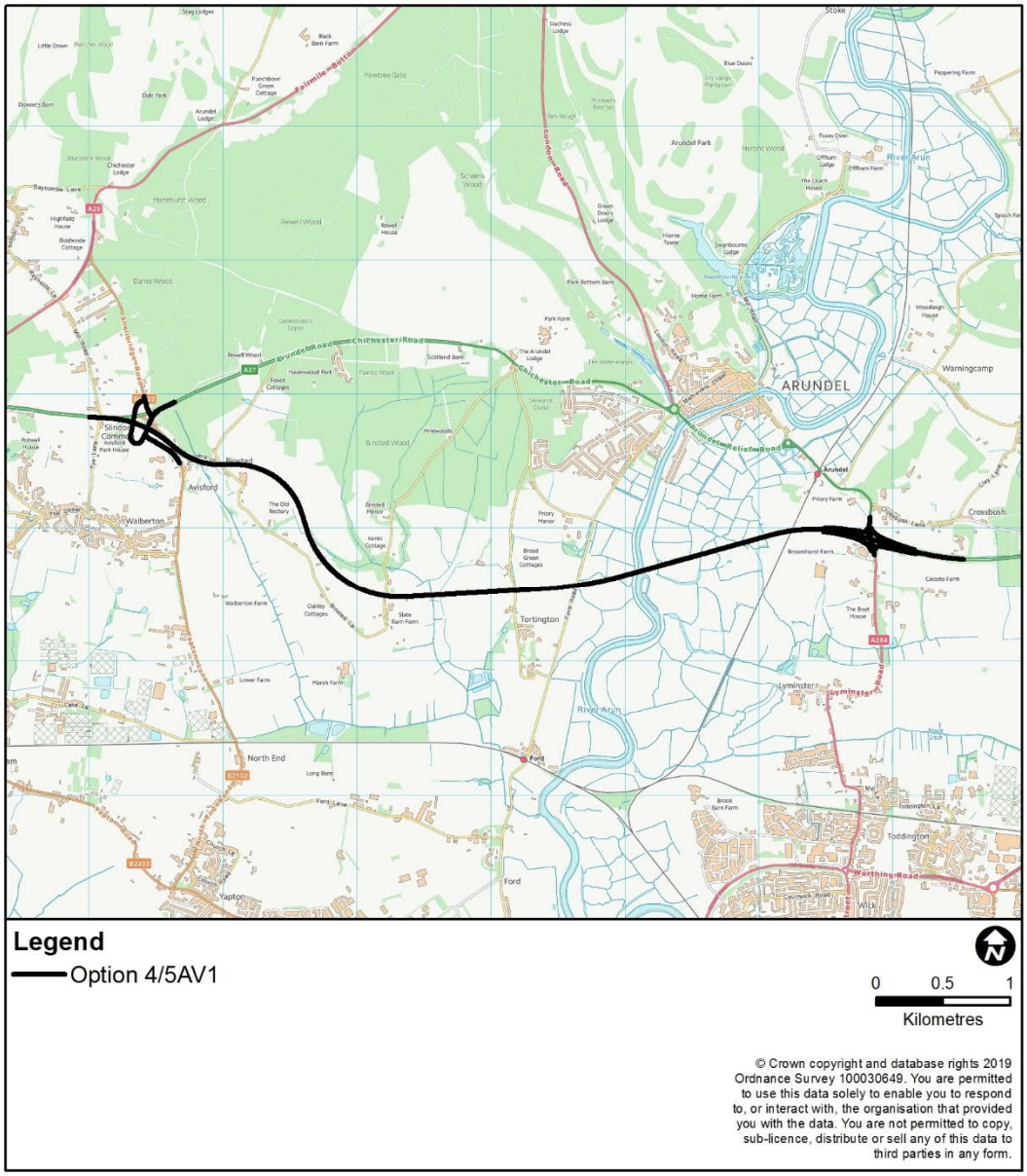


Figure 8-4 - Option 4/5AV1

8.3.3.4 This option follows the same alignment as Option 3V1 up to River Arun.

8.3.3.5 From the Crossbush junction the route bears south west passing over the Arun Valley Railway line and then descending the eastern valley side of the River Arun to cross the Arun floodplain on embankment.

8.3.3.6 The route crosses the River Arun and over Ford Road to the south of the scheduled monument at Tortington Priory. It then bears west, crossing under Tortington Lane between Broad Green cottages and Tortington Manor. It continues westward over Tortington Rife and crosses Binsted Lane south of Binsted Park, near Meadow Lodge. It then bears north west passing to the south of the ancient woodland at Lake Copes and behind residential properties located along Binsted Lane. It passes to the north of Binsted Nursery and briefly enters the SDNP. It then bears north west and passes under Binsted Lane near Manor Farm and just to the north of The Black Horse pub. It continues north west and crosses over Binsted Rife at Hedgers Hill road, which would be closed. It then crosses Yapton Lane and passes through part of the golf course at the Avisford Hotel and small area of ancient woodland. It ties into the existing A27 close to the existing junction with Mill Road and Tye Lane. Mill Road and Tye Lane would be closed at the junction of the existing A27. Yapton Lane would be realigned to the south of the proposed A27. There would be a direct impact on approximately 0.4 hectares of ancient woodland.

8.3.3.7 A new compact grade separated junction would be provided connecting a realigned Yapton Lane, Shellbridge Road and the existing A27 to the proposed A27. This will allow for all movements onto and off the proposed A27.

8.3.4 Option 4/5AV2

8.3.4.1 Option 4/5AV2 comprises approximately 6.9km of new dual two-lane carriageway located to the south of the existing A27. The proposed route starts in the east, at the end of the A27 Crossbush Bypass and would end just east of existing junction with the B2132 at Yapton Lane and Shellbridge Road.

8.3.4.2 Approximately 1.97km of the proposed route would be located within the SDNP. It would impact approximately 1.83 hectares of ancient woodland. There would be 21 properties within approximately 50m of the option.

8.3.4.3 The centre line of the option is illustrated in Figure 8-5. Illustrative Engineering Layout Drawings for Option 4/5AV2 are provided in Appendix D.

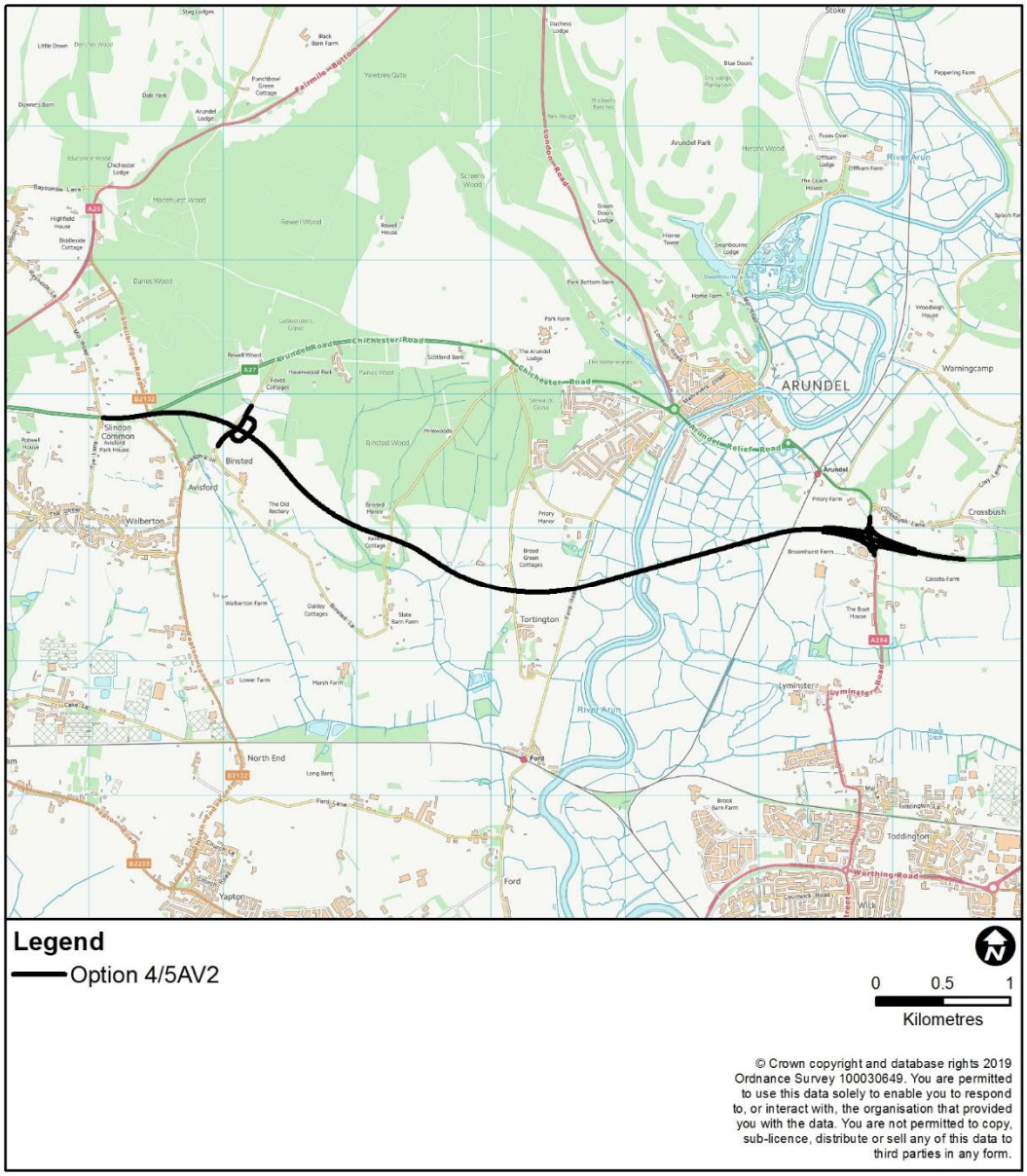


Figure 8-5 - Option 4/5AV2

8.3.4.4 This option follows the same alignment as Option 3V1 and Option 4/5AV1 up to River Arun.

8.3.4.5 From the Crossbush junction the route bears south west passing over the Arun Valley Railway line and then descending the eastern valley side of the River Arun to cross the Arun floodplain on embankment.

8.3.4.6 The route then crosses the River Arun and over Ford Road to the south of the scheduled monument at Tortington Priory. It then bears west, crossing under Tortington Lane between Broad Green cottages and Tortington Manor. After crossing Tortington Lane it bears north west, passes over Tortington Rife and enters the SDNP.

8.3.4.7 The route would pass through wooded valley at The Lag and cross Binsted Park crossing Binsted Lane almost at grade. Binsted Lane would be realigned to pass over the route. The route would then pass through the wooded valley at The Shaw but avoiding the ancient woodland at Lake Copse and Spinningwheel Copse. It continues heading north west passing through agricultural land located between Binsted and woodland to the north. It briefly leaves the SDNP before it re-enters as it passes under Old Scotland Lane (BW 338). It would then pass under Binsted Lane and turn west to enter the ancient woodland at Hundredhouse Copse. It would cross Binsted Rife on a viaduct within in the woodland before it ties back into the existing A27 close to the existing junction with B2132 Yapton Lane and Shellbridge Road. There would be a direct impact on approximately 1.83 hectares of ancient woodland.

8.3.4.8 A new compact grade separated junction would be provided connecting Binsted Lane and the existing A27 to the proposed A27. This will allow for movements from proposed A27 eastbound to the existing A27 and Binsted Lane and from existing A27 westbound and Binsted Lane to proposed A27 westbound only.

8.3.4.9 The existing gaps in the central reserve at Shellbridge Road and Yapton Lane would be closed. Affected movements would be directed to the proposed junction at Binsted Lane or to the existing Fontwell junction to carry out a u-turn. For this option there is a left in left junction at Shellbridge Road and Yapton Lane. Access from Mill Road and Tye Lane to the A27 would be closed.

8.3.5 Option 5BV1

8.3.5.1 Option 5BV1 comprises approximately 8km of new dual two-lane carriageway located to the south of the existing A27. The proposed route would start in the east, at the end of the A27 Crossbush Bypass and end east of the A27 / A29 Fontwell (East) roundabout.

8.3.5.2 All the proposed route would be located outside of the SDNP and it would not impact ancient woodland. There would be 41 properties within approximately 50m of the options.

8.3.5.3 The centre line of the option is illustrated in Figure 8-6. Illustrative Engineering Layout Drawings for Option 5BV1 are provided in Appendix D.

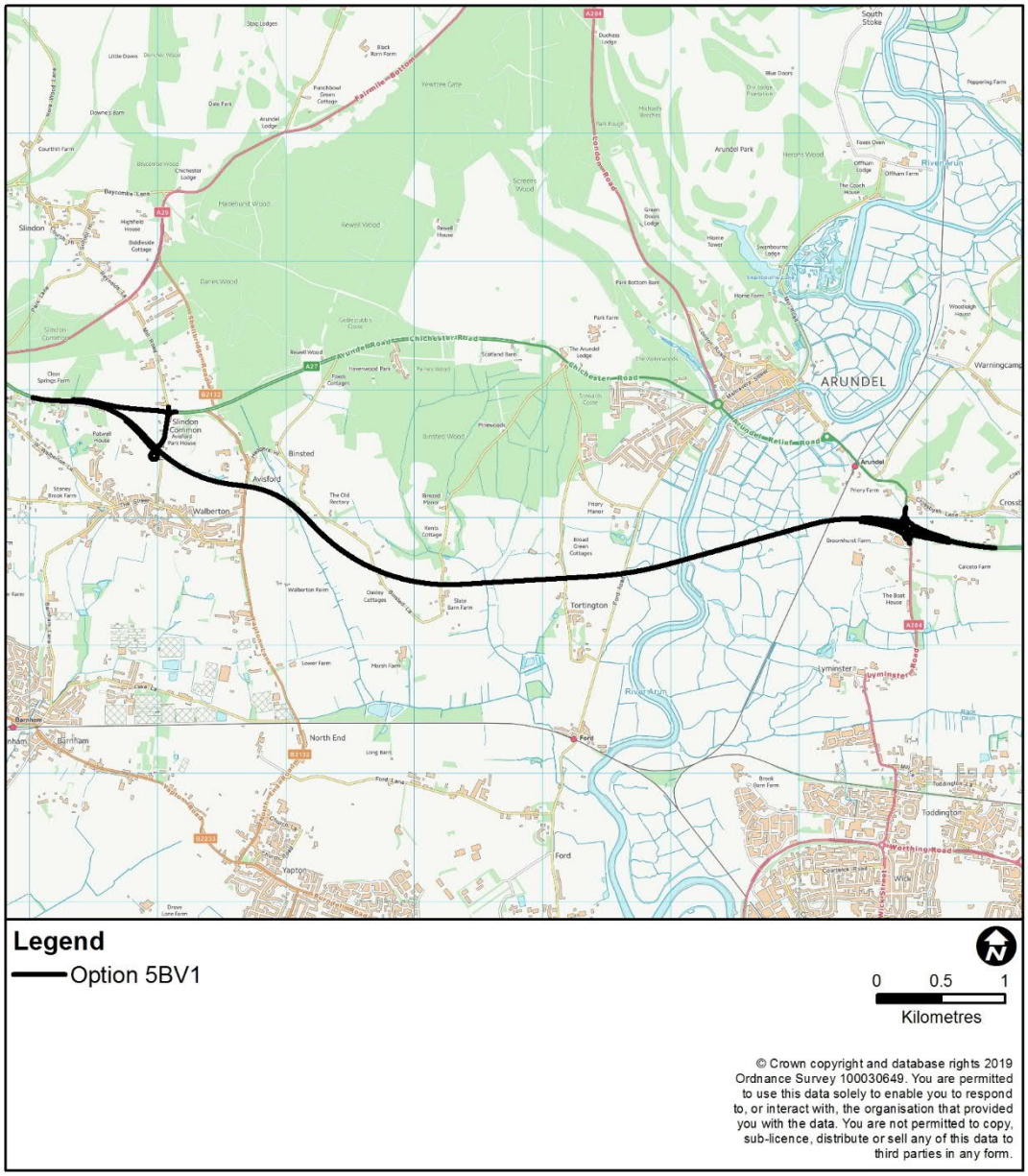


Figure 8-6 - Option 5BV1

8.3.5.4 This option follows the same alignment as Option 4/5AV1 from Crossbush junction to Tortington Rife at which point it starts to diverge.

8.3.5.5 From the Crossbush junction the route bears south west passing over the Arun Valley Railway line and then descends the eastern valley side of the River Arun to cross the Arun floodplain on embankment.

8.3.5.6 The route then crosses the River Arun and over Ford Road to the south of the scheduled monument at Tortington Priory. It then bears west, crossing under Tortington Lane between Broad Green cottages and Tortington Manor. It continues westward over Tortington Rife.

8.3.5.7 It crosses Binsted Lane to the south of Meadow Lodge and turns north west and re-crosses Binsted Lane near Oakleys Barn. The route then would run parallel to Binsted Lane passing just to the south of St Marys Church. It then turns west to cross part of Avisford Golf Course at Binsted Rife on a viaduct.

8.3.5.8 The route then turns west to pass under Yapton Lane. Passing immediately north of properties located on Yapton Lane the route would pass through Avisford Golf Course. It turns north west and crosses under Tye Lane south of Avisfod Park House. It then curves towards the west, passing north of Hooe Farm Industrial Estate to re-join the existing A27 near Potwell Copse east of Fontwell (East) Roundabout. This option has no direct impact on ancient woodland.

8.3.5.9 A new grade separated junction is provided connecting Tye Lane north of the route and the existing A27 to the proposed A27. This would allow for movements from existing A27 westbound to the proposed A27 westbound and from the proposed A27 eastbound to the existing A27 eastbound only. Tye Lane would be closed south of the proposed route to prevent it becoming a cut through to the proposed A27. The existing A27 between Copse Lane and Tye Lane would be retained to provide the eastbound off slip.

8.3.5.10 The existing junction at Copse Lane would be closed. To provide alternative access Copse Lane, to the west of Bridleway 392, would be realigned to the south and parallel to the proposed A27 and would connect to Arundel Road just to the west of the tie in.

8.4 Junction Strategy

8.4.1.1 All the route options include the provision of a grade separated junction with the A284 to replace the existing Crossbush junction. The proposed design comprises a dumbbell arrangement with a roundabout north and south of the junction on the A284 and existing A27 linked by a single road which would cross the A27 using the existing Crossbush bridge (see the illustrative engineering layout drawings contained in Appendix D).

8.4.1.2 The junction would allow traffic from the existing A27 and A284 Lyminster Road to join the proposed A27 in eastbound and westbound directions. It will also allow traffic on the proposed A27 travelling eastbound or westbound to join the existing A27 and A284 Lyminster Road.

8.4.1.3 All the options also include a junction at the western end of the route with the existing A27 to maintain the connectivity of the local road network. The specific junction arrangement for each option would be subject to further assessment and design development. The illustrative proposals at the time of the further consultation are shown on the drawings in Appendix D and described in section 8.2 and 8.3.

8.4.1.4 In response to comments received at the 2017 non-statutory consultation, a preliminary assessment, based on professional judgement, of a possible junction at Ford Road with the offline options has been carried out.

8.4.1.5 High level economic assessments found that inclusion of a junction at Ford Road would increase transport user benefits for the offline options. The environmental assessments found that including a junction would be expected to make worse adverse effects including, noise levels, the setting of historic environment assets and on landscape and visual receptors. The increase in adverse effects were not considered to be significant and would not affect the environmental assessment of the offline corridor options. Inclusion of a junction at Ford Road to the offline options would not change the expected comparative performance of the online and offline corridors

8.4.1.6 The provision of a junction at Ford Road will therefore be considered further in PCF Stage 3 if any of the offline options was selected as the preferred route.

8.4.1.7 With Option 1V9 a junction is provided at the western end, Ford Road and Crossbush Junction. For Option 1V5 access occurs only at the western end and at Crossbush Junction. The initial sifted variants considered both full access at both Ford Road and Crossbush and partial access at Ford Road with full access at Crossbush (see Chapter 7). The choice on the degree of access provided at Ford Road is effectively a balance between increasing the length of diversion and increasing the impact caused by the provision of a junction.

8.5 Treatment of Side Road and Accesses

8.5.1.1 The strategy has been to minimise the number of junctions on the proposed route options. Therefore, it is proposed that minor roads crossed by an option would be accommodated by either an underbridge or an overbridge or be closed and diverted. This strategy has been relaxed for Option 1V9 west of Ford Road to reduce impacts on ancient woodland (see section 8.2.3).

8.5.1.2 The specific treatment at each location would be subject to further assessment and design development. The proposal at the time of the further consultation are illustratively shown on the drawings in Appendix D and briefly described below.

8.5.2 Option 1V5

8.5.2.1 This option will impact on local accesses and side roads as follows.

- Fitzalan Road will be realigned such that the proposed A27 will pass over it. The realigned Fitzalan Road will connect to the existing A27 and

to the existing Fitzalan Road to the north and south of the proposed A27. This new access will not have a restricted headroom and will cater for all vehicles.

- The layout of the existing Ford Road roundabout may be modified to match revised traffic patterns. This would be considered further in Stage 3 if this option was selected as the preferred route.
- A new access from Arundel & District Community Hospital to the A284 will be provided. Shayna Rose Way will connect into this new access.
- Access to and from the following roads and private accesses will be closed to mitigate safety concerns associated with them.

- Jarvis Road
- Park Farm
- Arundel Cricket Club
- Binsted Lane/Tortington Lane
- The White Swan Hotel
- Arundel Arboretum
- 55, 56, 56A, 57 and 57A Chichester Road

This is possible as an existing alternative means of access exists or a new access will be provided via the grade separated junction at Long Lane.

The width of side roads would be consulted with West Sussex County Council (WSCC).

8.5.3 Option 1V9

8.5.3.1 This option will impact on local accesses and side roads as follows.

- Fitzalan Road will be realigned such that the proposed A27 will pass over it. The realigned Fitzalan Road will connect to the existing A27 and to the existing Fitzalan Road to the north and south of the proposed A27. This new access will not have a restricted headroom and will cater for all vehicles.
- Ford Road roundabout will be replaced with a traffic signal controlled through-about
- Arundel & District Community Hospital will access the proposed A27 via a left in left out junction
- Shayna Rose Way will connect to the A284 via a new access.
- Binsted Lane/Tortington Lane will access the proposed A27 via a left in left out junction.
- Access to and from following roads and private accesses will be closed to mitigate safety concerns associated with them.

- Jarvis Road
- Park Farm
- Arundel Cricket Pitch
- The White Swan Pub
- Arundel Arboretum
- 55, 56, 56A, 57 and 57A Chichester Road

This is possible as an existing alternative means of access exists or a new access will be provided via the grade separated junction at Long Lane.

The width of side roads would be consulted with WSCC.

8.5.4 Option 3V1

8.5.4.1 This option will impact on local accesses and side roads as follows.

- The proposed A27 passes over Ford Road which remains on its existing alignment.
- Tortington Lane is retained on the same horizontal alignment and passes over the proposed A27.
- Binsted Lane is retained on the same horizontal alignment and passes over the proposed A27.
- Old Scotland Lane is retained on the same horizontal alignment and passes over the proposed A27.
- A side road parallel to the proposed A27 will be provided from the Cell Site to the east of Havenwood Park to Binsted Lane to west of Havenwood Park.
- The width of side roads would be consulted with WSCC
- For this option there are no direct accesses onto the proposed A27 and the only accesses onto the proposed A27 will be at the grade separated junction at Crossbush and at the Western Tie-in junction.

8.5.5 Option 4/5AV1

8.5.5.1 This option will impact on local accesses and side roads as follows.

- The proposed A27 passes over Ford Road which remains on its existing alignment.
- Tortington Lane has a slightly altered horizontal alignment and passes over the proposed A27. This is to allow the new bridge to be built offline and to keep the existing road open for as long as possible during the construction stage.

- Binsted Lane is realigned so that it runs from east to west and follows footpath 354. It passes over the proposed A27 which is at grade at this location.
- The other part of Binsted Lane is realigned to avoid the steep land near Hedgers Hill and to avoid impacting on the area of ancient woodland to the west. It passes over the proposed A27.
- Yapton Lane is connected to the new grade separated junction at the western tie-in.
- Shellbridge Road and the existing A27 are also connected to the new grade separated junction at the western tie-in.
- Access to and from Mill Road will be closed at the junction of the A27 as an alternative access exists.
- Access to and from Tye Lane will be closed at the junction of the A27 as an alternative access exists.
- The width of side roads would be consulted with WSCC.
- For this option there are no direct accesses onto the proposed A27 and the only accesses onto the proposed A27 will be at the grade separated junction at Crossbush and at the Western Tie-in junction.

8.5.6 Option 4/5AV2

8.5.6.1 This option will impact on local accesses and side roads as follows.

- The proposed A27 passes over Ford Road which remains on its existing alignment.
- Tortington Lane follows an offline route and passes over the proposed A27. This is to allow the new bridge to be built offline and to keep the existing road open for as long as possible during the construction stage.
- Binsted Lane is realigned so that it misses areas of other woodland and allows for it to be constructed offline. It passes over the proposed A27 which is at grade at this location.
- A grade separated junction on the other part of Binsted Lane
- Yapton Lane is connected to the proposed A27 via a left in left out junction
- Shellbridge Lane is connected to the proposed A27 via a left in left out junction
- Access to and from Mill Road will be closed at the junction of the A27 as an alternative access exists.
- Access to and from Tye Lane will be closed at the junction of the A27 as an alternative access exists.

- The width of side roads would be consulted with WSCC.
- For this option there are no direct accesses onto the proposed A27 and the only accesses onto the proposed A27 will be at the grade separated junction at Crossbush and at the Western Tie-in junction.

8.5.7 Option 5BV1

8.5.7.1 This option will impact on local accesses and side roads as follows.

- The proposed A27 passes over Ford Road which remains on its existing alignment.
- Tortington Lane has a slightly altered horizontal alignment and passes over the proposed A27. This is to allow the new bridge to be built offline and to keep the existing road open for as long as possible during the construction stage.
- Binsted Lane is realigned so that it runs from east to west and follows footpath 354. It passes over the proposed A27 which is at grade at this location.
- Where the proposed A27 crosses the other part of Binsted Lane, Binsted Lane is realigned to the east of its existing location. This allows the existing road to remain open for as long as possible during the construction stage. At this location the proposed A27 is at grade and Binsted Lane passes over it.
- Tye Lane to the south of the proposed A27 is closed as there is an alternative route for access. Tye Lane to the North of A27 is used as a connector road for the grade separated junction at the western tie in.
- Mill Road remains open and connects to the Western Tie-in junction via a roundabout.
- Copse Lane to the west of Bridleway 392, will be realigned to the south and parallel to the proposed A27 and will connect to Arundel Road just to the west of the tie in. This will allow the properties to the south of the proposed A27 to retain access.
- The width of side roads would be consulted with WSCC.
- For this option there are no direct accesses onto the proposed A27 and the only the accesses onto the proposed A27 will be at the grade separated junction at Crossbush and at the Western Tie-in junction.

8.6 Highways Alignment and Compliance with Standards

8.6.1 Standards Used

8.6.1.1 The geometric design of the proposed A27 main carriageway and associated junction connector roads for all options has been developed in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 6. In particular, the following Design Standards have been used:

- TD9/93 Highway Link Design (DMRB 6.1.1)
- TD27/05 Cross Sections and Headroom (DMRB 6.1.2)
- TD22/06 Layout of Grade Separated Junctions (DMRB 6.2.1)
- TD 16/07 Geometric Design of Roundabouts (DMRB 6.2.2)
- TD 50/04 The Geometric Layout of Signal-Controlled Junctions and Signalised Roundabouts (DMRB 6.2.2)
- TD 42/95 Geometric Design of Major/Minor Priority Junctions (DMRB 6.2.6)
- TD 41/95 Vehicular Access to All-Purpose Trunk Roads (DMRB 6.2.7)
- TA 86/03 Layout of Large Signal Controlled Junctions (DMRB 6.2.8)

8.6.1.2 Principles of DMRB Volume 6 would also be applied to the design of local roads although this approach would be subject to agreement with the local highway authority, WSCC.

8.6.1.3 Relaxations from the requirements of the DMRB may be necessary along local roads to ensure these works are appropriate to the standard and character of adjacent existing roads.

8.6.2 Design Speed

8.6.2.1 The proposed A27 mainline for all options would be a dual carriageway, subject to the National Speed Limit, with a Design Speed of 120kph in accordance with Figure 1 of TD 9/93.

8.6.2.2 However, for Option 1V9, to the west of Ford Road, the proposed alignment tries to match the existing alignment and there are numerous sub-standard features that require departures from standard. To mitigate these departures there may be a requirement to post a lower speed limit of 50mph. The requirement for a lower speed limit will be confirmed in PCF Stage 3 if this option is chosen as the preferred route. The traffic assessments summarised in Chapter 9 have included for a speed limit.

8.6.2.3 Slip roads and other junction link roads will have a Design Speed of 70kph as per Table 4/1 of TD22/06.

8.6.2.4 Design speeds for local roads will be subject to agreement with the local highway authority.

8.6.2.5 Where compact grade separated junctions have been designed, they are subject to a single design speed of approximately 30kph as per paragraph 6.5 of TD 40/94.

8.6.3 Cross Section

8.6.3.1 For all options, except Option 1V9, the mainline has been designed as Dual 2 lane All-Purpose (D2AP) carriageways as detailed in Figure 4-3a of TD27/05.

8.6.3.2 For Option 1V9, two different cross section standards are proposed for the mainline. From Crossbush Junction to the signalised through-about at Ford Road, the dual carriageway section has been designed as D2AP carriageways as detailed in Figure 4-3a of TD27/05. From the signalised through-about at Ford Road to the western tie in the cross section has been designed as Dual 2 lane Urban All-Purpose Road (D2UAP) as detailed in Figure 4-4a in TD 27/05. This narrower cross section has been selected to reduce the impact on adjacent Ancient Woodland.

8.6.3.3 A rigid (concrete) vehicle restraint system is currently proposed for the central reserve as an alternative to a flexible (steel) system that is conventionally used on D2AP carriageways. This option provides numerous benefits, including reduced maintenance costs and improved road worker safety. The choice of central reserve vehicle restraint system will be confirmed in PCF Stage 3.

8.6.3.4 The cross sections of side roads will need to be consulted with WSCC to ensure works to local roads are appropriate to the standard and character of adjacent existing roads.

8.7 Junction Design

8.7.1.1 The proposed junction at Crossbush has been designed as a fully grade separated junction in accordance with TD22/06 for all options. The junction comprises of a standard dumbbell arrangement with east and west facing slip roads connected to two roundabouts linked by the existing Crossbush overbridge. Access to the service area would be retained as existing.

8.7.1.2 For Option 1V9, the signal controlled through-about at Ford Road has been design as a signal controlled roundabout in accordance with TD 50/04 and TA 86/03 of the DMRB. Where the arm of the junction is un-signalised it has been designed in accordance TD16/07 of the DMRB.

8.7.1.3 The Western Tie-in junction for Option 1V5 and Option 1V9 at Long Lane has been designed as a compact grade separated 4 arm junction in accordance with TD40/94. This design standard has been used, as design speeds are lower, resulting in a smaller footprint than a TD 22/06 grade separated junction

8.7.1.4 For Option 3V1, the proposed junction at the Western Tie-in junction has been designed in accordance with TD22/06 of the DMRB. It allows for a diverge from the proposed A27 eastbound to the existing A27 eastbound. It also allows for a connector road from the existing A27 westbound to the proposed A27 westbound via a bridge over the proposed A27 and a loop, before merging onto the proposed A27.

8.7.1.5 The Western Tie-in junction for Option 4/5AV1 has been designed as a compact grade separated junction in accordance with TD 40/94. It allows for all movements to and from Shellbridge Road, Yapton Lane, the existing A27 and the proposed A27. This design standard has been used, as design speeds are lower, resulting in a smaller footprint than a TD 22/06 grade separated junction

8.7.1.6 The Western Tie-in junction for Option 4/5AV2 has been designed as a compact grade separated junction in accordance with TD 40/94. It allows movements from the proposed A27 eastbound to Binsted Lane and the existing A27 eastbound. It also allows for movements from existing A27 westbound and Binsted Lane to the proposed A27 westbound. This design standard has been used, as design speeds are lower, resulting in a smaller footprint than a TD 22/06 grade separated junction

8.7.1.7 For Option 5BV1, the proposed junction at the Western Tie-in, has been designed in accordance with TD22/06 of the DMRB. It also allows for a connector road from the existing A27 westbound to the proposed A27 westbound via a bridge over the proposed A27 and a loop, before merging onto the proposed A27.

8.8 Departures from Standard

8.8.1.1 The designs of the six options developed for PCF Stage 2 aimed to achieve desirable minimum standards as defined in DMRB. However, relaxations and departures from standard have been incorporated into designs where options are restricted by significant environmental constraints including ancient woodland and the SDNP and where safety would not be compromised. Where departures from standard have the potential to compromise safety then appropriate mitigation would be required to ensure that safety is not compromised.

8.8.1.2 The design speed for the scheme has been determined as an 120B kph (all purpose) and in accordance with TD9/93 to identify desirable minimum standard. The following relaxations below desirable minimum maybe made at the discretion of the designer as follows:

- Stopping Sight Distance – 3 steps below desirable minimum (TD9/93 Para 2.8)
- Horizontal – 4 steps below desirable minimum (TD9/93 Para 3.4)
- Vertical – 3 steps below desirable minimum (TD9/93 Para 4.9)

8.8.1.3 The six options have been assessed against the DMRB and the number of geometric departures from standard have been identified in Table 8-1.

Table 8-1 – Geometric Departures from Standard for each Option

Option	TD9/93	TD22/06 Merge Diverge	TD22/06 (Weaving)	TD27/05	Total
Option 1V5	11	1 2 merge 2 diverge	1	0	13
Option 1V9	16	1 2 merge 2 diverge	3	1	21
Option 3V1	9	0	1	0	10
Option 4/5AV1	14	1 2 merge 2 diverge	1	0	16
Option 4/5AV2	6	1 1 merge 1 diverge	3	0	10
Option 5BV1	5	0	1	0	6

8.8.1.4 These departures should be reviewed at PCF Stage 3 (Preliminary Design) once the Preferred Route Announcement (PRA) has been made. Where departures from standard cannot be removed through design, they may require mitigation to reduce their perceived impacts. Required departures will be risk assessed and formal applications for approvals submitted during future stages of development. It is considered at the current stage of development that the identified departures for all options would be acceptable, but that Option 1V9 would require extensive mitigation before acceptance could be achieved. It is considered that this would need to include enforced speed limits.

8.9 Existing A27

8.9.1.1 The existing A27 between the extents of each option would be retained and de-trunked with WSCC taking over responsibility and maintenance for the road once the Scheme is open.

8.9.1.2 The strategy for the de-trunked A27 would be subject to agreement with WSCC and would vary along the length depending on its future service level and predicted traffic flows. Parts of the existing A27 could also act as part of a temporary diversion route (see Chapter 14) in the event of an incident on the Scheme.

8.9.1.3 WCHR facilities on the existing A27 are poor (see Chapter 3) and as no facilities are proposed along the route options improvements on the de-trunked section of the existing A27 for each option have been investigated. These include provision of a 3.0m wide shared footway cycleway adjacent to the existing A27 between Crossbush Junction and Ford Road roundabout. This would provide for a possible connection to facilities on the proposed A284 Lyminster bypass.

8.9.1.4 With Option 4/5AV1, Option 4/5AV2 and Option 5BV1 a section of the existing dual carriageway A27 would be de-trunked, including sections within the SDNP. The forecast two-way AADT flows for this section (see Chapter 9) would not warrant a dual carriageway and it is possible that this section would be reduced in width and converted to single carriageway with provision of new WCHR facilities with remaining redundant highway removed and planted.

8.9.1.5 There would be additional benefits to removing sections of the existing carriageway within the SDNP and improving WCHR facilities along the existing A27. These have not been considered as part of the assessment at this stage.

8.9.1.6 De-trunking would include an agreement on the condition of assets to be handed over and any maintenance works that may be required. The existing Arundel Station Bridge is known to be in a poor condition. Highways England have confirmed that replacement of the bridge would be considered separately to any de-trunking requirements.

8.10 Walking Cycling and Horse Riding (WCHR) Facilities

8.10.1.1 It is not proposed to include specific provision for WCHR along the proposed mainline A27 for each of the route options.

8.10.1.2 WCHR facilities would be provided at junctions and along connector roads to link to the existing (Public Rights of Way) PRoW network and existing facilities.

8.10.1.3 Where the PRoW network crosses one of the route options it is proposed that these would be accommodated either with an overpass, underpass or be closed and diverted. The specific treatment at each location would be subject of design development, further assessment and stakeholder and public engagement. The illustrative proposals, at the time of the further consultation are shown in the option drawings in Appendix D.

8.10.1.4 A number of opportunities have been identified for the provision of additional WCHR facilities on the existing A27 as part of de-trunking for all route options. These would be subject to further discussion with WSCC and local groups and would be separately funded and delivered.

8.11 Structures

8.11.1.1 The number of new structures for each option are given in Table 8-2. In addition, there would be a number of retaining walls and culverts required for each option. The number, form and type of structures would continue to be refined as the option selected as the preferred route is developed in future stages.

Table 8-2 – New Structures – All Options

Structure type	Option 1V5	Option 1V9	Option 3V1	Option 4/5A V1	Option 4/5A V2	Option 5BV1
Overbridge	1	1	4	4	4	5
Underbridge	2	2	3	5	7	5
Footbridge	1	1	1	1	0	1
Total structures	4	4	8	10	11	11

8.11.2 Option 1V5

8.11.2.1 4 new structures are proposed for Option 1V5 in addition to possible modifications to the existing Crossbush Junction Bridge, Fitzalan bridge and Spring Ditch Culvert. These are listed in Table 8-3.

Table 8-3 – Option 1V5 Proposed Structures

Reference	Name	Carrying / passing under
O1 V5/01	Western Junction Overbridge	Carrying: Western Junction - Passing Under: Proposed A27 By-Pass
O1 V5/02	Footbridge for FP348	Carrying: PRoW - Passing Under: Proposed A27 By-Pass
O1 V5/03	Ford Road Roundabout Flyover	Carrying: Proposed A27 By-Pass - Passing Over: Ford Road Roundabout and Arun River
O1 V5/04	Arun Valley Railway Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: TBH1 Up Main & Down Main Arundel to Littlehampton (3rd rail electrification)

8.11.3 Option 1V9

8.11.3.1 4 new structures are proposed for Option 1 V9 in addition to possible modifications to the existing Crossbush Junction Bridge and Spring Ditch Culvert. These are listed in Table 8-4

Table 8-4 – Option 1V9 Proposed Structures

Reference	Name	Carrying / passing under
O1 V9/01	Western Junction Overbridge	Carrying: Western Junction - Passing Under: Proposed A27 By-Pass
O1 V9/02	Footbridge for FP348	Carrying: PRoW - Passing Under: Proposed A27 By-Pass
O1 V9/03	New River Arun Underbridge	Carrying: Proposed A27 By-Pass - Passing Over: River Arun, landscaped land and local roads
O1 V9/04	Arun Valley Railway Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: TBH1 Up Main & Down Main Arundel to Littlehampton (3rd rail electrification)

8.11.4 Option 3V1

8.11.4.1 8 new structures are proposed for Option 3V1 in addition to possible modifications to the existing Crossbush Junction Bridge. These are listed in Table 8-5.

Table 8-5 – Option 3V1 Proposed Structures

Reference	Name	Carrying / passing under
O3 V1/01	Western Junction Overbridge	Carrying: Western Junction - Passing Under: Proposed A27 By-Pass
O3 V1/02	Old Scotland Lane Overbridge	Carrying: Old Scotland Lane - Passing Under: Proposed A27 By-Pass
O3 V1/03	Binsted Lane Overbridge	Carrying: Binsted Lane - Passing Under: Proposed A27 By-Pass
O3 V1/04	Footbridge for FP 342	Carrying: PRoW - Passing Under: Proposed A27 By-Pass
O3 V1/05	Tortington Lane Overbridge	Carrying: Torrington Lane - Passing Under: Proposed A27 By-Pass
O3 V1/06	Ford Road Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: Ford Road
O3 V1/07	River Arun Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: River Arun
O3 V1/08	Arun Valley Railway Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: TBH1 Up Main & Down Main Arundel to Littlehampton (3rd rail electrification)

8.11.5 Option 4/5AV1

8.11.5.1 10 new structures are proposed for Option 4/5V1 in addition to possible modifications to the existing Crossbush Junction. These are listed in Table 8-6.

Table 8-6 – Option 4/5AV1 Proposed Structures

Reference	Name	Carrying / passing under
O4/5A V1/01	Western Junction Overbridge	Carrying: Western Junction - Passing Under: Proposed A27 By-Pass
O4/5A V1/02	Southern Valley Underbridge	Carrying: Proposed A27 By-Pass - Passing Over: Southern Valley and Hedgers Hill Road
O4/5A V1/03	Binsted Lane Overbridge	Carrying: Binsted Lane - Passing Under: Proposed A27 By-Pass
O4/5A V1/04	Footbridge for FP 342 and 350	Carrying: PRoW - Passing Under: Proposed A27 By-Pass

Reference	Name	Carrying / passing under
O4/5A V1/05	Binsted Lane Overbridge	Carrying: Binsted Lane - Passing Under: Proposed A27 By-Pass
O4/5A V1/06	Tortington Rife Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: Tortington Rife
O4/5A V1/07	Tortington Lane Overbridge	Carrying: Tortington Lane - Passing Under: Proposed A27 By-Pass
O4/5A V1/08	Ford Road Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: Ford Road
O4/5A V1/09	River Arun Underbridge	Carrying: Proposed A27 By-Pass - Passing Over: River Arun
O4/5A V1/10	Arun Valley Railway Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: TBH1 Up Main & Down Main Arundel to Littlehampton (3rd rail electrification)

8.11.6 Option 4/5AV2

8.11.6.1 11 new structures are proposed for Option 4/5AV2 in addition to possible modifications to the existing Crossbush Junction. These are listed in Table 8.

Table 8-7 – Option 4/5AV2 Proposed Structures

Reference	Name	Carrying / passing under
O4/5A V2/01	Western Valley Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: Ancient woodland valley
O4/5A V2/02	Binsted Lane Overbridge	Carrying: Binsted Lane - Passing Under: Proposed A27 By-Pass
O4/5A V2/03	Footbridge for FP341 and FP342	Carrying: PRoW - Passing Under: Proposed A27 By-Pass
O4/5A V2/04	The Shaw Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: Water course.
O4/5A V2/05	Binsted Lane Overbridge	Carrying: Binsted Lane - Passing Under: Proposed A27 By-Pass
O4/5A V2/06	The Lag Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: Watercourse
O4/5A V2/07	Tortington Rife Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: Tortington Rife
O4/5A V2/08	Tortington Lane Overbridge	Carrying: Tortington Lane - Passing Under: Proposed A27 By-Pass

Reference	Name	Carrying / passing under
O4/5A V2/09	Ford Road Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: Ford Road
O4/5A V2/10	River Arun Underbridge	Carrying: Proposed A27 By-Pass - Passing Over: River Arun
O4/5A V2/11	Arun Valley Railway Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: TBH1 Up Main & Down Main Arundel to Littlehampton (3rd rail electrification)

8.11.7 Option 5BV1

8.11.7.1 11 new structures are proposed for Option 5BV1 in addition to possible modifications to the existing Crossbush Junction. These are listed in Table 8-8.

Table 8-8 – Option 5BV1 Proposed Structures

Reference	Name	Carrying / passing under
O5B V1/01	Bridlebridge for BR392	Carrying: Bridleway - Passing Under: Proposed A27 By-Pass
O5B V1/02	Western Junction Overbridge	Carrying: Western Junction - Passing Under: Proposed A27 By-Pass
O5B V1/03	Yapton Lane Overbridge	Carrying: Yapton Lane - Passing Under: Proposed A27 By-Pass
O5B V1/04	Binsted Valley & PROW Underbridge	Carrying: Proposed A27 By-Pass - Passing Over: Southern Valley and Hedgers Hill Road
O5B V1/05	Binsted Lane West Overbridge	Carrying: Binsted Lane - Passing Under: Proposed A27 By-Pass
O5B V1/06	Binsted Lane East Overbridge	Carrying: Binsted Lane - Passing Under: Proposed A27 By-Pass
O5B V1/07	Tortington Rife Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: Tortington Rife (vegetation and watercourse)
O5B V1/08	Tortington Lane Green Overbridge	Carrying: Tortington Lane - Passing Under: Proposed A27 By-Pass
O5B V1/09	Ford Road Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: Ford Road
O5B V1/10	River Arun Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: River Arun

Reference	Name	Carrying / passing under
O5B V1/11	Arun Valley Railway Underbridge	Carrying: Proposed A27 By-Pass - Passing Under: TBH1 Up Main & Down Main Arundel to Littlehampton (3rd rail electrification)

8.12 Green Bridges

8.12.1.1 Proposals for new structures, for all options have considered the potential for including additional functions as green structures at potential wildlife crossing sites.

8.12.1.2 For underbridges this has included consideration of minimum dimensions for clear space underneath structures which would be suitable for different species to cross the Scheme.

8.12.1.3 For overbridges this has included minimum dimensions for wildlife zones on a mixed-use structure and suitable clearances for structural depths to accommodate for suitable planting.

8.12.1.4 Proposals for incorporating wildlife crossings at structures or to include additional single purpose wildlife crossing structures, would be developed further for the chosen option as part of a wider strategy to provide for wildlife connectivity across the Scheme.

8.13 Alternative Viaduct Crossing of River Arun Floodplain

8.13.1.1 All the proposed options cross the River Arun floodplain on an embankment and would reduce the available flood storage and reduce the flood flow conveyance capacity of the flood plain. Given this, all options would require the provision of additional flood flow conveyance capacity and/or flood storage compensation.

8.13.1.2 At this stage, the assessments undertaken for each option have been based on the construction of an embankment across the floodplain to facilitate the crossing of the River Arun floodplain. This is because the evidence available at this stage suggest a viaduct would be more expensive than an embankment; also, the environmental impacts of an embankment arguably represent “worst case” as they are likely to be greater than those for a viaduct. However, alternative solutions to an embankment would include:

- a full viaduct across the floodplain;
- or part viaduct and part embankment across the floodplain.

8.13.1.3 A review was carried out, based on the information available at this PCF Stage 2, to consider whether the implementation of a viaduct (or part viaduct) across the floodplain would affect the relative performance of the options in terms of environmental effects, when compared to the results of the assessments undertaken for the proposed options incorporating a full embankment.

8.13.1.4 The review concluded that:

- all the solutions (i.e. embankment, viaduct or part of each) would have, with mitigation, a neutral impact on flooding, though the level of flood storage compensation required for an embankment would be likely to be greater for the two online options than the four offline options due to the natural constriction in the floodplain at Arundel (although the significance category of impact assessed when comparing a with or without viaduct solution for the options in question does not change);
- other environmental impacts, such as those relating to biodiversity and material volumes, may have the potential to be reduced to a small extent if a viaduct were to be chosen, although, again, the significance category of impact assessed for the topics in question for each option do not change when comparing a with or without viaduct solution);
- a viaduct may result in a slightly lower level of impact on some visual amenity receptors for the offline options compared to the embankment solution, although the overall visual effects would remain in the same significance categories in terms of adverse effects for all options as assessed for an embankment solution.

8.13.1.5 As a result, based on the information available at this PCF Stage 2, it can be reasonably assumed that the implementation of a viaduct (or part viaduct) solution across the River Arun floodplain, instead of an embankment as assessed, would not the change the relative performance of the options in terms of environmental effects

8.14 Geotechnics

8.14.1.1 A Preliminary Sources Study Reports[1] has been produced for the Scheme.

8.14.1.2 A programme of ground investigation would be undertaken in the next stage following a decision on the Preferred Route.

[1] WSP on behalf of Highways England (June 2019) Draft "Preliminary Sources Study Report"

8.14.1.3 All the route options cross the river Arun floodplain on embankment where historical ground investigation data shows that depths of up to 30m of tidal river deposits could be encountered. To support the embankment and to control the amount and duration of settlement a rigid ground improvement solution comprising a load transfer platform founded on deep depth foundation of either precast driven piles or controlled modulus columns has been assumed. An alternative solution could involve staged construction and surcharging with settlements accelerated by band drains. Proposals would be developed in PCF Stage 3 (Preliminary Design) for the selected preferred route following the proposed ground investigation.

8.15 Drainage

8.15.1.1 For all options the drainage system will generally be positive pipe systems (comprising of gullies, surface water channels, filter drains, narrow fin drains and carrier pipes) out falling into the watercourses along the route or connect into existing highway drainage network.

8.15.1.2 Outfalls to watercourses will generally include attenuation basins or oversized pipes to reduce outflows to green field runoff rates. In the Arun valley flood zone 3 no attenuation would be provided. Attenuation basins may include constructed wetland to provide water quality treatment.

8.15.1.3 All outfalls would include pollution control facilities to separate oils from runoff discharging to proposed attenuation ponds and existing watercourses.

8.15.1.4 Pumping stations would be required on all route options as the current alignments include low points in cutting

8.16 Lighting

8.16.1.1 The provision of lighting will be subject to a detailed risk assessment by a Road Safety Engineer, in accordance with TA 49/07, consistent with the industry standard procedure for the introduction of lighting on a scheme. This assessment considers the potential benefits of the introduction of lighting alongside the adverse impacts, with consideration of alternative measures.

8.16.1.2 At this stage in the scheme development, and for the purpose of assessment ahead of the TA 49/07 lighting appraisal, lighting assumptions have been adopted that are in accordance with design standards and common dual carriageway lighting practice throughout the UK. They introduce no departures from standard.

8.16.1.3 For Option 1V9 it is assumed that the proposed A27 would be lit from east of the Ford Road junction to the proposed access to Arundel Community hospital. It is also assumed that the proposed Ford Road Junction would be fully lit. For all the other options it is assumed that the proposed mainline A27 would not be lit.

8.16.1.4 For all route options it is assumed that lighting would be provided on the A284 at the proposed Crossbush junction. This is consistent with the existing lighting. It is also assumed that the tops of the slip roads at the proposed Crossbush would be lit. For all other junctions and side roads it is assumed to be unlit for all route options.

8.17 Technology

8.17.1.1 Expected technology to be provided with the Scheme are outlined in Chapter 14.

8.18 Buildability

8.18.1.1 The services of a Delivery Partner have been commissioned to provide advice regarding the buildability of the six options under consideration. Aspects considered included construction phasing, temporary works considerations, programme constraints, traffic management, potential environmental impacts and constraints, and risks and opportunities.

8.18.2 Temporary Land

8.18.2.1 Land adjacent to the proposed route near the existing Crossbush junction was identified for all options as the most likely area suitable for the main construction compound. A second compound would be required for all options at the western end of each route with smaller compounds along each route particularly at structures. Additional land would be required at structures to allow for suitable working space.

8.18.2.2 Haul roads where possible would be created within the alignment of the new carriageway to minimise the quantity of temporary land take. In areas with significant imported fill requirements, haul roads would be required outside of the embankment footprint. In areas of site which are remote or have restricted access, for example the Arun Valley, temporary haul roads may also be required.

8.18.2.3 Significant areas would be required for topsoil storage along each route. In all areas of temporary land take, additional site clearance works would be required.

8.18.3 Traffic Management

Online Options

8.18.3.1 For the online section west of Fitzalan Road, construction would require complex traffic management layouts and phase switching to allow for sufficient working space while maintaining current capacity during the busy daytime periods. West of Ford Road a temporary diversion of the existing A27 would be required to maintain existing capacity and provide sufficient working space. Much of the work would be undertaken with overnight lane closures and full over-night closures. Existing signed diversion routes would be used. At other times temporary traffic lights and convoy work would be used. There would be a need for permanent reduced speed limits on the existing A27. Existing access would be retained during construction but movements would be likely to be restricted to left in left out only. East of Fitzalan Road much of the work would be built off-line with minimal disruption to traffic.

Offline Options

8.18.3.2 Much of the work would be offline with minimal disruption to existing traffic. Where the route crosses below local, minor roads then new routes could be built offline to minimise disruption. As many of the local roads are narrow some temporary closures would be required to construct the tie-ins.

8.18.3.3 At the western tie in the existing A27 would be reduced to one lane in each direction. Some limited contraflow working may be required. Limited number of overnight lane and full closures would be required. Existing signed diversion routes would be used.

8.18.3.4 For all options traffic management arrangements for the construction of the Crossbush junction would be likely to be identical. As much of the junction would be constructed offline, traffic management disruption would be minimal. It is likely for some periods it would be necessary to convert the existing overbridge to two-way operation with temporary traffic lights.

8.18.4 Construction Durations

8.18.4.1 Anticipated construction durations are shown in Table 8-9. Environmental mitigation would have a significant influence on construction durations for all options. This would include for restrictions related to timing of work within the floodplain, provision for flood compensation, ecological mitigation works and allowance for ancient woodland translocation particularly for Option 3V1. Consideration of seasonal constraints and the number of seasons required to complete works has been made.

8.18.4.2 The construction of the embankment over the Arun Floodplain would also have a significant influence on construction durations for all options due to the need to import large quantities of material for the embankment construction and allowance for settlement periods. Duration of the ground improvement works would be dependent on productivity rates for proposed design solution and the amount of plant used. Construction durations could also be significantly affected by weather conditions.

8.18.4.3 For Option 1V9 and Option 1V5 the construction west of Fitzalan Road would be critical to the overall construction programme. Traffic management would be more complex for this section with many phases required for the construction of the new dual carriageway along-side the existing A27. This would complicate construction as multiple phases would be likely to be required and multiple diversion of statutory undertakers' assets. The number of phases and complexity of construction would be influenced by the differences between existing and proposed road levels which would be greater for Option 1V5 than Option 1V9.

8.18.4.4 The anticipated construction durations were longer than previously identified and therefore a review was undertaken to identify opportunities to achieve programme savings. This was carried as part of the value engineering review of the Schemes costs (see Section 8.19). The following opportunities were identified for all options

- Commencing works early on the flood plain
- Commencing main construction activities earlier
- Commencing works early on the River Arun Bridge
- Increase earthworks import rate (from 1,000m3/day to 1,500m3/day)
- Introducing a 6-day working in critical locations

8.18.4.5 The anticipated construction durations are shown in Table 8-9.

Table 8-9 – Construction Durations

Option	Construction Durations
1V5	36
1V9	34
3V1	36
4/5AV1	32
4/5AV2	32
5BV1	36

8.18.4.6 These durations would be updated again in the preliminary design stage for the preferred route and may change from the durations above, as more information becomes available.

8.19 Costs

8.19.1.1 In accordance with good practice, a value engineering exercise was undertaken to identify opportunities to achieve cost reductions for all options.

8.19.1.2 A series of value engineering workshops were held by the project team, at which a wide range of potential savings were identified for all options. It was agreed that these should be limited to those which would not compromise the Scheme Objectives or if implemented would not negatively impact the environmental assessment of the Scheme.

8.19.1.3 The review concluded the following opportunities.

- Construction durations for all options could be optimised (see section 8.18.4).
- All options should tie into the existing A27 at Crossbush as early as possible. This would reduce the amount of carriageway works east of Crossbush. This may require some additional relaxations in standard but would be justified by the potential cost savings and likely lower environmental impacts.
- Reducing the highway cross section (by 1.0m in each direction) for all options where a standard rural all-purpose dual carriageway cross section is proposed would offer potential significant reductions in cost by reducing the size of structures, reducing the amount of ground improvement needed on the floodplain and reducing the amount of materials required. This would require additional departures from standard but could be justified given the potential cost savings and the potential for reduced environmental impacts.
- All route options involve construction of an embankment across the Arun valley. The review highlighted that the cost estimate was based on very conservative assumptions for ground improvement and that more realistic scenarios were available and if adopted would result in a more realistic estimate.
- On the floodplain there would also be an opportunity to use a 1 in 2 embankment slope compared to a 1 in 3 slope as suitable imported

material would be required. This would reduce the volume of material to be imported and reduce the area of ground improvement needed.

- Available geotechnical information indicates that most of the material excavated to construct the route would need to be treated to make it suitable for re-use in embankments (outside of the floodplain). A typical slope of 1 in 3 for all cut and fill slopes has been assumed. There would be an opportunity to reduce costs by adopting a 1 in 2 slopes for all embankments. This would reduce the quantity of material to be treated. Cut slopes would need to be retained at 1 in 3.
- All route options include many structures including some major structures. The review highlighted that there was considerable scope to reduce the length of structures and the potential to reduce the complexity of the form of the structures without affecting the Scheme Objectives.
- A decision on the form of safety barrier and construction of the central reserve would be made in PCF Stage 3. A hardened central reserve had been assumed for the cost estimate for all options. The review highlighted that costs could be reduced if a soft central reserve were adopted particularly where the central reserve has been widened for visibility and were the scheme is in a sensitive landscape.
- The estimates for all options include for the provision of additional facilities within the de trunked section of the existing A27. It was identified that there could be potentially alternative funding available and there would be opportunities to rationalise the assumptions for de-trunking allowed for in the estimates.
- Contractor efficiencies

8.19.1.4 If adopted some of these refinements would affect the geometric departures for the route options. Therefore, a check was carried out. This highlighted that in some cases the length over which a departures / relaxation is applied and the level of departure may be increased but that this would be only small. In some locations departures / relaxations would be improved. It was therefore concluded that overall the impact on the geometric departures could be justified by the likely cost savings and potential lower environmental impacts.

8.19.1.5 It was concluded that the list of opportunities above would be adopted and Highways England Commercial Services were requested to prepare revised scheme costs. The scheme cost estimates presented in Table 8-10 reflect these changes.

Table 8-10 –Scheme Cost Estimates (2010 price base)

Option	Narrow Range Lower Value	Central Estimate	Narrow Range Upper Value
Option 1V5	£200m	£255m	£295
Option 1V9	£195m	£249m	£290m
Option 3V1	£255m	£320m	£380m
Option 4/5AV1	£280m	£340m	£405m
Option 4/5AV2	£290m	£358m	£420m
Option 5BV1	£320m	£384m	£455m

8.19.1.6 These modifications to options design were identified and agreed after the traffic and environmental assessments were started. Most of these design changes would not affect these assessments. However, there are two areas where the design changes would alter the assessments.

8.19.1.7 Firstly, whereas the traffic modelling assumes an open for traffic date of 2027, the value engineering work identified opportunities to reduce construction duration and bring forward open for traffic date to 2026. The implication of this is that the traffic assessments will underestimate benefits.

8.19.1.8 Secondly, the value engineering work identified opportunities which would reduce the footprint of the scheme. Therefore, the environmental assessments will slightly overestimate impacts as they are based on a greater land take.

8.19.1.9 The costs set out in table 8-11 are higher than costs previously presented at public consultation in 2017 due to a number of factors. For example, new environmental surveys carried out in mid/late 2018 indicated that further environmental mitigation would be needed than had previously been anticipated, while costs associated with constructing an embankment across the floodplain have risen. There has also been an associated increase in construction duration, which adds to costs and inflation.

8.19.1.10 Costs are approximate because these options are at an early stage. As the project progresses, Highways England will seek to reduce costs further via contractual efficiencies and value engineering. For example, further value engineering opportunities identified include the following.

Option 1V5 and Option 1V9

- Optimise further the vertical alignment across Arun Valley floodplain to reduce the quantity of imported materials and reduce the amount of ground improvement required. This would be achieved by considering further relaxations / departures in the vertical alignment and removing the proposed accommodation underbridge and retaining Fitzalan Road on its current alignment under the A27. This would allow the vertical alignment to be retained at a lower level for longer across the floodplain. Removing the Fitzalan Road underbridge would require a left in left out junction to be provided with the westbound carriageway of the proposed A27 to provide an alternative access for high vehicles to Fitzalan Road south of the A27.
- Reducing the size of the Fitzalan Road, Arun, Ford Road viaduct. Retaining Fitzalan Road on its current alignment would allow the viaduct length to be shortened. The span at Ford Road could be reduced by re designing the existing Ford Road junction.
- For Option 1V5 the access to the Hospital could be realigned to run parallel to the proposed A27 to reduce land take.
- The proposed footbridge linking FP 348 could be removed with access for walker, cyclists and equestrians provided across the A27 provided only at the overbridge located at the western tie in junction.

Options 3V1, 4/5AV1, 4/5AV2, 5BV1

- Increasing the length of route at minimum embankment height across the Arun valley floodplain would reduce the quantity of imported materials and reduce the amount of ground improvement required. This would be achieved by adjusting the vertical alignment between the River Arun and Ford Road overbridges and on the eastern side of the floodplain. Further relaxations / departures in standard would be required.
- Optimise the cut fill balance outside of the floodplain by adjusting the vertical alignment. This would be achieved with some modification to proposed structures.
- Reducing the lengths of structures at River Arun, Tortington Rife and Binsted Rife.
- Reduce the length of side road diversions and size of structures were the route would cross minor roads.
- Consider opportunities to close side roads where alternative routes are available and divert public rights of way to avoid structures.

8.20 Programme

8.20.1.1 A scheme programme has been developed. The latest dates of the scheme programme at the time of issue of this report are summarised below.

- Commence Further Consultation – August 2019
- Preferred Route Announcement – early 2020
- Application for Development Consent Order – 2021
- Secretary of State decision – 2022
- Start of construction – Late 2022
- Scheme open to traffic – 2026

Abbreviations

Abbreviation	Explanation
D2AP	Dual 2 lane all-purpose road
D2UAP	Dual 2 lane urban all-purpose road
PRoW	Public Rights of Way
SDNP	South Downs National Park
WCHR	Walking Cycling and Horse Riding
WSCC	West Sussex County Council

Glossary

Term	Explanation
Alignment	The alignment is the horizontal and vertical route of a road, defined as a series of horizontal tangents and curves or vertical crest and sag curves, and the gradients connecting them
All-purpose road	Road for use by all classes of traffic
Compact Grade Separated Junction	A Grade Separated Junction designed to promote low speeds on connector roads and design to the relevant DMRB standard
Departures and Relaxations from Standard	Relaxations are written into design standards to introduce limited flexibility in certain circumstances allowing designers to design to less stringent requirements than those specified in a standard. These need to be agreed with but not approved by the Project Sponsor. A departure from standard is any other variation or waiving from a requirement contained within the design standards and requires formal approval from the Project Sponsor
DMRB	A series of 15 volumes prepared by the Department for Transport and Highways England that provide standards, advice notes and other published documents relating to the design, assessment and operation of trunk roads, including motorways, in the United Kingdom.
De-trunking	De-trunking is the process of transferring a Highways England Road to the Local Highways Authority Control. For the A27 Arundel Bypass Scheme the Local Highways Authority is West

Term	Explanation
	Sussex County Council. As part of the proposed Scheme a section of the existing A27 would be de-trunked. The length to be de-trunked would vary for each route option.
Dual Carriageway road	Road that has two separated carriageways for travel in opposite directions.
Grade Separated Junction	A Grade Separated Junction (GSJ) is a junction where the intersecting roads are separated at different heights, usually be a bridge, so that traffic flows do not intersect one another. For the A27 Arundel Bypass only traffic on the proposed A27 would be free flowing.
Mainline	The through carriageway of a road as opposed to a slip road or a link road at a junction
Through about Junction	A through-about (or Hamburger) junction is one which allows a straight ahead traffic stream to bypass the circulating roundabout carriageway by crossing through the central island at grade. This is achieved under signal control.
Urban all-purpose road	A road in an urban area designed for all types of traffic.

A27 Arundel Bypass Scheme Assessment Report

Chapter 9 – Summary of Traffic Appraisal

October 2020

Table of Contents

LIST OF TABLES

LIST OF FIGURES

9 Summary of Traffic Appraisal

9.1 Introduction

9.1.1.1 This chapter describes the impacts of the A27 Arundel Bypass scheme options in comparison to the do minimum scenario described in chapter 5 of this report. The forecast traffic flows, link capacities and journey times are described for each option. The economic and social impacts of each option is also described.

9.1.1.2 As context for the appraisal, a description of how the A27 transport model has been developed between PCF Stages 1 and 2 is set out below.

9.2 Base year model

9.2.1.1 The PCF Stage 1 model was developed through refinement of the existing West Sussex County Transport Model owned by WSCC. For PCF Stage 2, further development of the model was considered necessary in order to refine the model's representation of observed transport conditions. To inform this, Highways England's South East Regional Transport Model (SERTM, Version DF3) was made available. SERTM is one of five strategic transport models which simulate average peak period traffic conditions across a broad regional area from Norfolk in the north of the model area to the south coast including Hampshire, Sussex and Kent. The development of SERTM enabled Highways England to progress the schemes identified in the Road Investment Strategy (RIS) within the first Road Period (2015-2020).

9.2.1.2 The PCF Stage 2 A27 transport model has been developed by extracting a section of the SERTM network, and the associated zones, representing a geographical coverage that is sufficiently detailed enough to model the Scheme's likely influence. The development of PCF Stage 2 A27 transport model entailed further refinements to the PCF Stage 1 model including:

- the inclusion of a richer set of observed 2015 origin – destination data sourced from the anonymised mobile phone data which informed the demand matrices within SERTM
- extension of the transport model network to reflect a broader geography of routes that may influence or be affected by the scheme
- introduction of further traffic and journey route data for the calibration or validation of a wider set of locations within the study area
- updated generalised cost parameters using the latest Highway England Transport Planning Group (TPG) VoT/VoC spreadsheet

(VoT_and_VOC_from_webTAG_Databook_(July 2017) - release040817V2).

- updated housing development and employment Uncertainty Log using information from West Sussex County Council, Arun District Council and Adur and Worthing Council
- updated car forecast growth factors using NTEM version 7.2 datasets accessed via the TEMPRO version 7.2 program
- updated LGV and HGV growth forecasts taken from NRTF 2015 published by DfT

9.2.1.3 The PCF Stage 2 associated with this Further Consultation stage has utilised the same 2015 base model developed earlier in PCF Stage 2. The traffic count data used for the calibration and validation of the base model was reviewed and considered to be suitable and sufficient for continued use in PCF Stage 2 Further Consultation analysis, considering the age, quality, geographic and temporal coverage of the data. However, the review highlighted a small number of locations where additional further data would provide additional value, and supplement the counts already available.

9.2.1.4 As demonstrated in Table 9-1, the PCF Stage 2 base model fully meets the calibration and validation criteria set out within WebTAG[1]. Additional traffic count data has been processed and used to improve the reporting of the validation of the model in the current stage[2].

Table 9-1 - Performance of base year model

MODEL /PEAK	FLOW CALIBRATION			FLOW VALIDATION			JOURNEY TIME	
	No. of links	%Flow criteria	%GEH	No. of links	%Flow criteria	%GEH	No. of routes	Pass
AM	40	98%	93%	56	93%	88%	16	100%
PM		98%	98%		93%	86%		94%

[1] See section 9.1.10 and 9.1.11 of the PCF Stage 2 Further Consultation Combined Modelling and Appraisal Report (July 2019) for further explanation of the model calibration and validation criteria

[2] HE551523-WSP-GEN-SWI-RP-TR-00017-P03 – A27 Arundel Bypass, PCF Stage 2 Further Consultation Combined Modelling and Appraisal Report (July 2019)

9.3 Forecast year models

9.3.1.1 The PCF Stage 1 model forecasts were produced on the basis of a fixed level of forecast demand, consistent with NTEM forecasts. Commensurate with the stage of analysis, for PCF Stage 2, and subsequently PCF Stage 2 associated with this Further Consultation, a variable demand component to the model has been included using the DfT's DIADEM (Dynamic Integrated Assignment and Demand Modelling) software (version 6.3.3).

9.3.1.2 Variable demand forecasts the travel demand response to changes in the transport system, including the introduction of new highway infrastructure. The variable demand assessment of the A27 Arundel Bypass has included for the impact on trip patterns and the amount of traffic using the Scheme i.e. trip distribution. The PCF Stage 2 A27 transport model is a highway only model therefore only the impact of trip frequency and trip distribution has been undertaken.

9.3.1.3 For the purposes of the A27 Arundel Bypass scheme appraisal no assessment of mode choice (e.g. switch to public transport) has been undertaken as the PCF Stage 2 A27 transport model is a highway only model. Therefore, trips have not been suppressed or induced and only the change in trip patterns and the amount of traffic using the Scheme has been assessed.

9.3.1.4 Further updates have been made to the traffic forecasts, between PCF Stage 2 and the current PCF Stage 2 associated with the Further Consultation, to account for:

- a revised Scheme opening year which has changed from 2023 to 2026
- the latest car forecast growth factors using NTEM version 7.2 datasets, published on 1 March 2017, which present a lower level of traffic growth than previous forecasts
- the updated Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV) forecasts from the National Transport Model (NTM using the latest National Road Traffic Forecasts (NRTF) 2018 (Scenario 1, September 2018), which present a lower level of growth than previous forecasts
- up-to-date information on planned developments obtained from the local authorities (West Sussex County Council, Adur and Worthing Councils, Arun District Council) in 2018
- a change in the level of certainty associated with certain highway infrastructure schemes identified within the uncertainty log

- the latest generalised cost parameters at the time of model development for route assignment in pence per minute (PPM) and pence per kilometre (PPK) using the Highway England Transport Planning Group (TPG) VoT/VoC spreadsheet (VoT_and_VOC_from_webTAG_Databook (Nov 2018)

9.4 Traffic appraisal

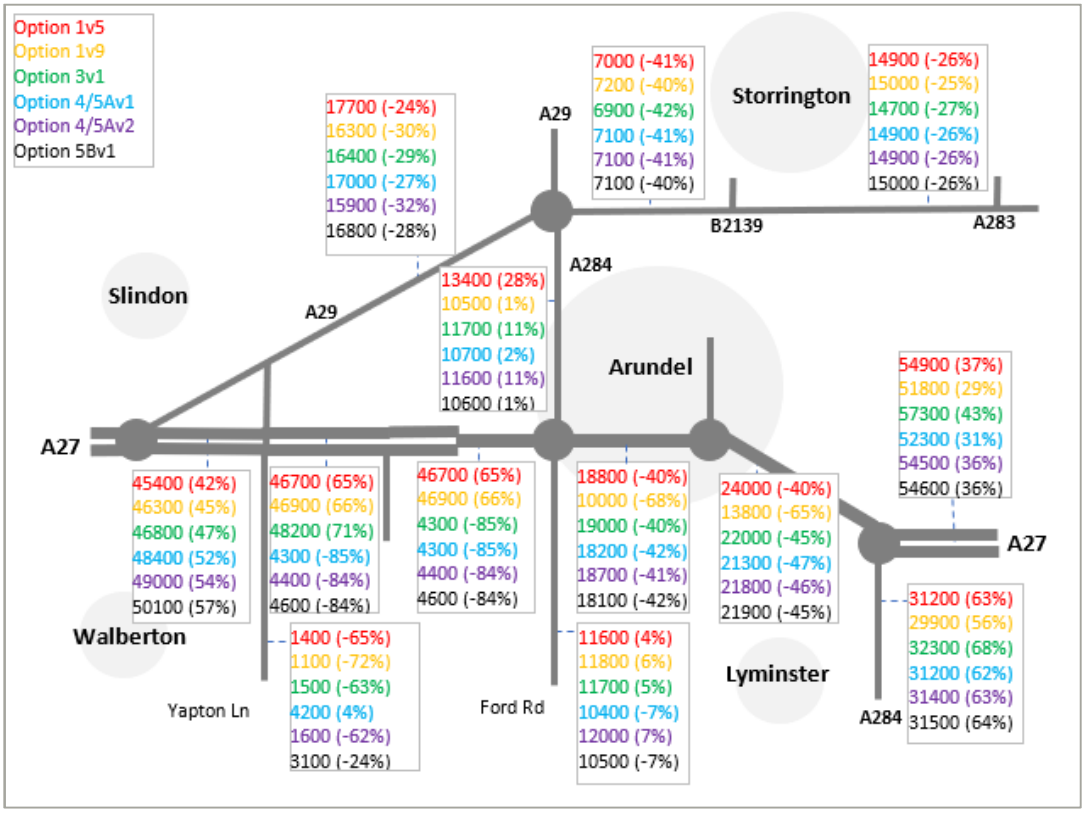
9.4.1.1 The forecast two-way Average Annual Daily Traffic (AADT) volumes on the offline section[3] of the six A27 Arundel Bypass scheme options are set out below. The flows on the offline section of Option 1V9 are higher than the other options as it captures the movement between the A284 (S) and A284 (N).

- Option 1V5 – 46,700
- Option 1V9 – 50,200
- Option 3V1 – 43,700
- Option 4/5AV1 – 46,300
- Option 4/5AV2 – 44,700
- Option 5BV1 – 45,000

9.4.1.2 Figure 9-1 presents the 2041 AADT values and percentage differences, on the existing road network, in comparison to do minimum with the implementation of each of the options. All AADT values presented in Figure 9-1 represent an estimate of the forecast traffic flows derived from the respective PCF Stage 2 Further Consultation 2041 A27 transport models. Figures which show the absolute differences in the AADT on key road sections within the modelled network are presented in Appendix E.

[3] The offline section between Crossbush and Ford Road roundabout in the case of Option 1V5 and Option 1V9. All other options are offline in nature.

Figure 9-1 - 2041 AADT figures and percentage change



9.4.2 Impacts of Option 1V5 (figure in red) and 1V9 (figures in orange)

9.4.2.1 Option 1V5 and Option 1V9 result in an increase in traffic volume along the section of the A27 to the west of Ford Road. The increased capacity provided by the bypass would result in AADT volumes of approximately 47,000 to the west of Ford Road roundabout for Option 1V5 and an increase of over 60% compared to do minimum conditions for Option 1V9.

9.4.2.2 The existing section of the A27 between Ford Road roundabout and Crossbush junction would experience a significant reduction in flows of 40% for Option 1V5 and over 60% for Option 1V9 primarily due to the east – west A27 traffic movement using the new A27 Arundel Bypass. The existing A27 would therefore be used by a greater proportion of local traffic, and movements associated with the A284.

9.4.2.3 Option 1V5 does not achieve a greater reduction in flow on the existing A27 because the scheme does not provide a connection at Ford Road roundabout from the local road network to the A27 Arundel Bypass. Therefore, traffic associated with the A284 for example would remain on the existing A27 between Ford Road roundabout and Crossbush junction.

9.4.2.4 Option 1V9 accommodates a south to north movement, along the A284 between locations to the north and Littlehampton, via Crossbush junction and the Lyminster bypass. The scheme does not provide a connection for traffic travelling from north to south, and therefore those movements are retained on the existing A27.

9.4.2.5 Local roads would see a reduction or minimal increase in traffic volumes in comparison to do minimum, with the exception of the A284 south of Crossbush, which would see an increase in flows of 50–70%. This is due to the combined effect of the capacity improvements provided by Option 1V5 / 1V9 and the Lyminster Bypass.

9.4.2.6 The A284 would see a notable increase in traffic volumes with Option 1V5. This is due to the grade separation of the east – west through movement which reduces delays for local traffic, and further encourages the use of the A284. With Option 1V9 a signalised junction results in some delay for these local movements and makes the route less attractive than with Option 1V5.

9.4.2.7 Yapton Lane would experience reductions in flows of over 60% for Option 1V5 and 1V9 respectively, as a result of reduced rat running.

9.4.2.8 The A259 which runs on an east – west alignment to the south of the A27 is forecast to experience a modest reduction in traffic volume. Options 1V5 and 1V9 achieve a reduction in flow of approximately 10%, from 30,000 in a do minimum scenario to just over 27,000.

9.4.2.9 The current alternative route to the A27 through the South Downs National Park, via the A29 and A283 through Storrington, would see reductions in traffic flows of up to 30% on the A29 and approximately 25% on the A283 as a result of the traffic being diverted on to the proposed A27 Arundel Bypass.

9.4.3 Impacts of Option 3V1 (figures in green)

9.4.3.1 Traffic flows on the existing A27 increase to the west of the new A27 Arundel Bypass, with AADT volumes of over 48,000 between Yapton Lane and Binsted Lane, an increase of approximately 70% in comparison to do minimum.

9.4.3.2 To the east of the new A27 Arundel Bypass junction on the existing sections of the A27, traffic flows reduce significantly, to below 5,000, an 85% reduction in comparison to do minimum. Traffic flows on the existing section of the A27 near Arundel Station are forecast to be around 22,000, a 45% decrease in comparison to the do minimum scenario. The reduction is not as significant as Option 1V9, due to the A284 north – south movement to Littlehampton being retained on the existing A27.

9.4.3.3 Traffic volumes on local roads follow a similar pattern of change to Option 1V5, with an increase in traffic flows along the A284 north of Ford Rd roundabout of around 10%, and a more significant increase in traffic flows along the A284 south of Crossbush of over 60%. Traffic flows decrease along Yapton Lane, on the A29 and through Storrington by similar amounts as the changes described for Options 1V5 and 1V9.

9.4.3.4 The forecast reductions of traffic flow on the A259 are consistent with the levels forecast for Option 1V5 and Option 1V9.

9.4.4 Impacts of Option 4/5AV1 (figures in blue) and 4/5AV2 (figures in purple)

9.4.4.1 The impacts of Option 4/5AV1 and 4/5AV2 are similar to Option 3V1. Traffic volumes increase on the A27 as a result of the provision of additional capacity along the route. To the west of Yapton Lane, traffic flows are forecast to reach almost 50,000 for each option, an increase of over 50%. This results in a significant decrease in traffic flows of around 85% on the existing section of the A27 between Yapton Lane and Ford Road roundabout, for both options. Traffic flows on the A27 to the east of Crossbush are forecast to increase by over 30%.

9.4.4.2 With regard to local roads, traffic flows on the A284 south of Crossbush are forecast to increase by over 60%, a level that is consistent with Option 1V5, Option 1V9 and Option 3V1.

9.4.4.3 Flows along Yapton Lane are forecast to increase slightly with Option 4/5AV1 as a result of the connection provided between Shellbridge Road and Yapton Lane by the western tie-in junction. The impact of Option 4/5AV2 on Yapton Lane is similar to the other options, with a decrease in traffic volume along Yapton Lane of over 60%.

9.4.4.4 Both options 4/5AV1 and 4/5AV2 would result in a decrease in traffic volumes along the A29 and through Storrington of greater than 25%.

9.4.4.5 The A259 is forecast to experience a similar level of reduction in traffic volume with Option 4/5AV1 and Option 4/5AV2 relative to the other options, with flows reducing by approximately 4,000 and reductions of up to around 15%.

9.4.5 Impacts of Option 5BV1 (figures in black)

9.4.5.1 This option results in the greatest absolute increase of traffic along the A27, to the section west of Tye Lane, with flows in excess of 50,000, which represents an increase of almost 60% compared to do minimum at the point at which the new A27 Arundel Bypass ties into the existing A27 alignment. To the east of Tye Lane, traffic flows are similar to the Option 4/5A variants.

9.4.5.2 There are general decreases in traffic flows on local roads, with the exception of A284 south of Crossbush which is forecast to experience a greater than 60% increase in traffic volume, a similar level to the other options.

9.4.5.3 The A259 is predicted to see traffic flow reductions of 10 – 15% which is consistent with levels seen for the other options.

9.5 Traffic flows and capacities

9.5.1.1 The following figures illustrate the 2041 AM and PM peak hour flow changes (by direction) compared with do minimum, the percentage change and the Volume / Capacity[4] (V/C) for selected sections of road. Maximum junction Ratio of Flow to Capacity (RFC[5]) or Degree of Saturation (DoS[6]) is also indicated.

9.5.2 Option 1V5

9.5.2.1 Figure 9-2 and Figure 9-3 present the results for Option 1V5. Network performance metrics including flow changes, V/C values, RFCs and DoS relating to interpeak are not presented since congestion is experienced in the AM and PM peak periods.

[4] Capacity is defined in TA 79/99 as the maximum sustainable flow of traffic passing in one hour, under favourable road and traffic conditions and is measured in one-way hourly flow in each direction

[5] The Ratio of Flow to Capacity (RFC) is a measure of how well roundabout and priority junction approaches perform under varying flow conditions. In the case of roundabouts, the capacity is determined by the entry flows, circulatory flows and the junction geometric parameters. Similarly, for priority junctions, the scale of magnitude of opposed and opposing movements influence capacity, besides geometry. Typically, an RFC of less than 0.85 is considered to indicate satisfactory performance.

[6] Degree of saturation (DoS) is a measure of how well an approach lane to a signalled junction is performing. It is the ratio of the number of vehicles known to be approaching a stopline over an hour (the demand flow), to the number of vehicles which can actually get over the stopline (the capacity). A stopline with a DoS level below 90% is said to have spare capacity, whilst a value above 90% indicates queues and congestion

Figure 9-2 - Flows and capacities, Option 1V5 (AM)

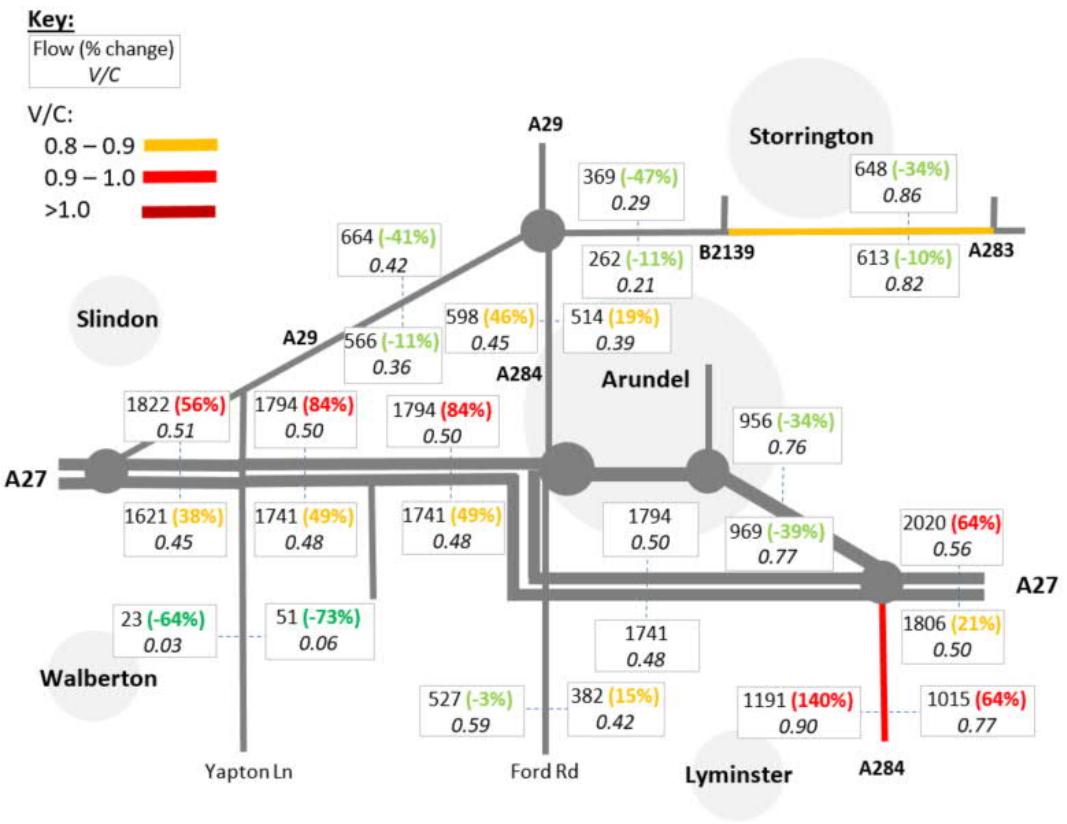
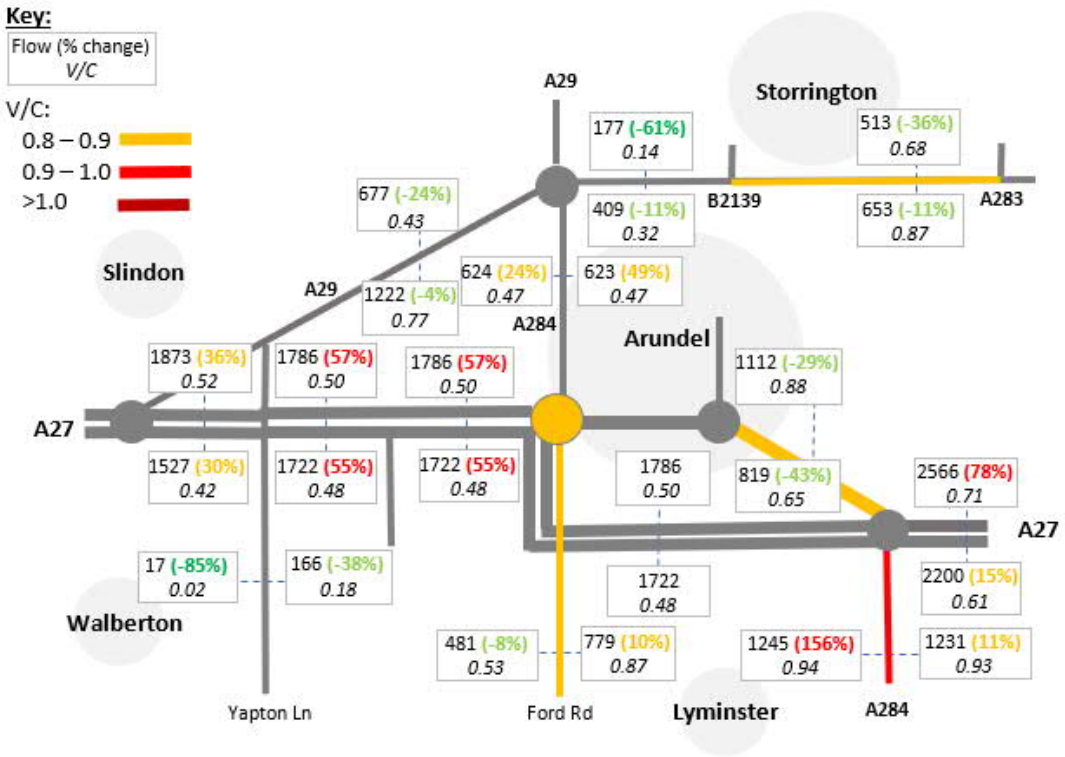


Figure 9-3 - Flows and capacities, Option 1V5 (PM)



9.5.2.2 During peak hours, the traffic flow changes follow a similar pattern to AADT flows and include a significant reduction in traffic between the Crossbush junction and Causeway roundabout, the largest of which is westbound in the PM peak scenario. The V/C data shows that the proposed new A27 Arundel Bypass would operate well within capacity, and the changes in traffic flows on the existing single carriageway of the A27 would result in those sections of road operating within capacity. The section between Causeway roundabout and Crossbush eastbound in the PM peak, would operate near capacity with a V/C approaching 0.9.

9.5.2.3 Along local roads, the highest V/C is found on the A284 in the PM peak. This is by virtue of more traffic being drawn on to the A27, from the local roads, at Crossbush junction. V/C values are high on Ford road, in the PM peak, and the A283 through Storrington in the AM and PM peak, where the level of traffic flow is approaching the capacity of the link. The V/Cs on the A283 are, however, lower when compared to the 'do minimum' scenario.

9.5.3 Option 1V9

9.5.3.1 Figure 9-4 and Figure 9-5 present the results for Option 1V9.

Figure 9-4 - Flows and capacities, Option 1V9 (AM)

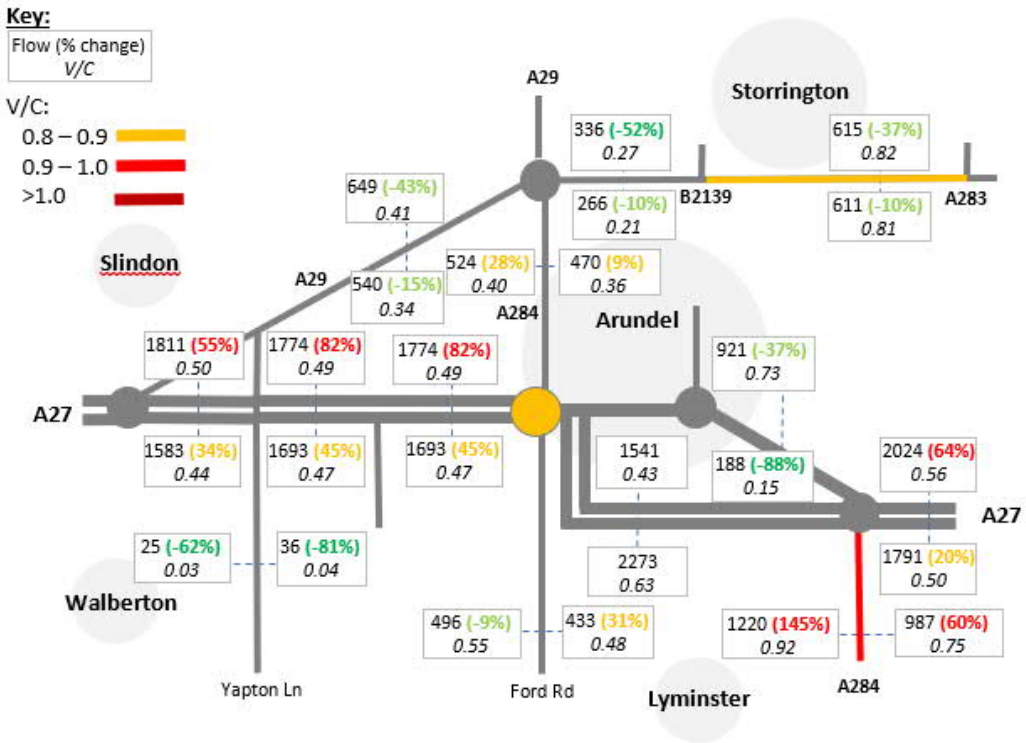
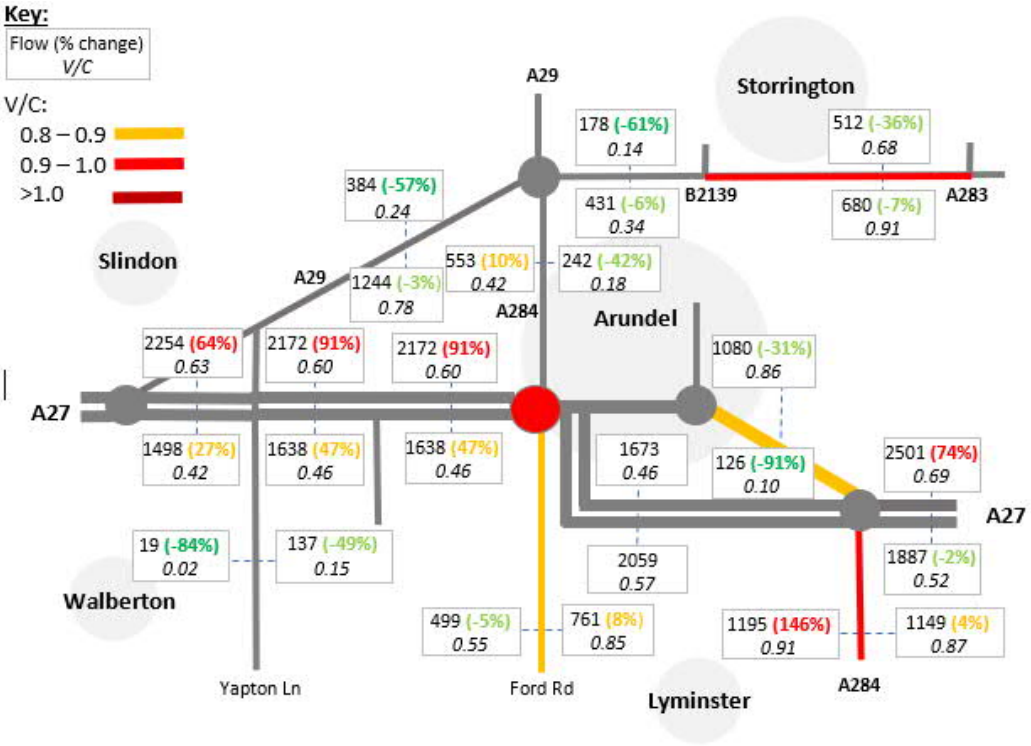


Figure 9-5 - Flows and capacities, Option 1V9 (PM)



9.5.3.2 The changes in peak hour flow for Option 1V9 are similar to Option 1V5, with a reduction in traffic flows between Crossbush junction and Causeway roundabout, although with significantly greater reductions westbound compared to Option 1V5 due to the difference in connectivity at the Ford Road roundabout. Both the new A27 Arundel Bypass section and the existing single carriageway section operate well within capacity, with the exception of the existing A27 eastbound on the approach to Crossbush junction, which operates above 0.8 in the PM peak.

9.5.3.3 The V/Cs on the local roads is consistent with the patterns seen during the AM peak period.

9.5.4 Option 3V1

9.5.4.1 Figure 9-6 and Figure 9-7 present the flow changes and V/C information for Option 3V1 in the AM and PM peaks respectively.

Figure 9-6 - Flows and capacities, Option 3V1 (AM)

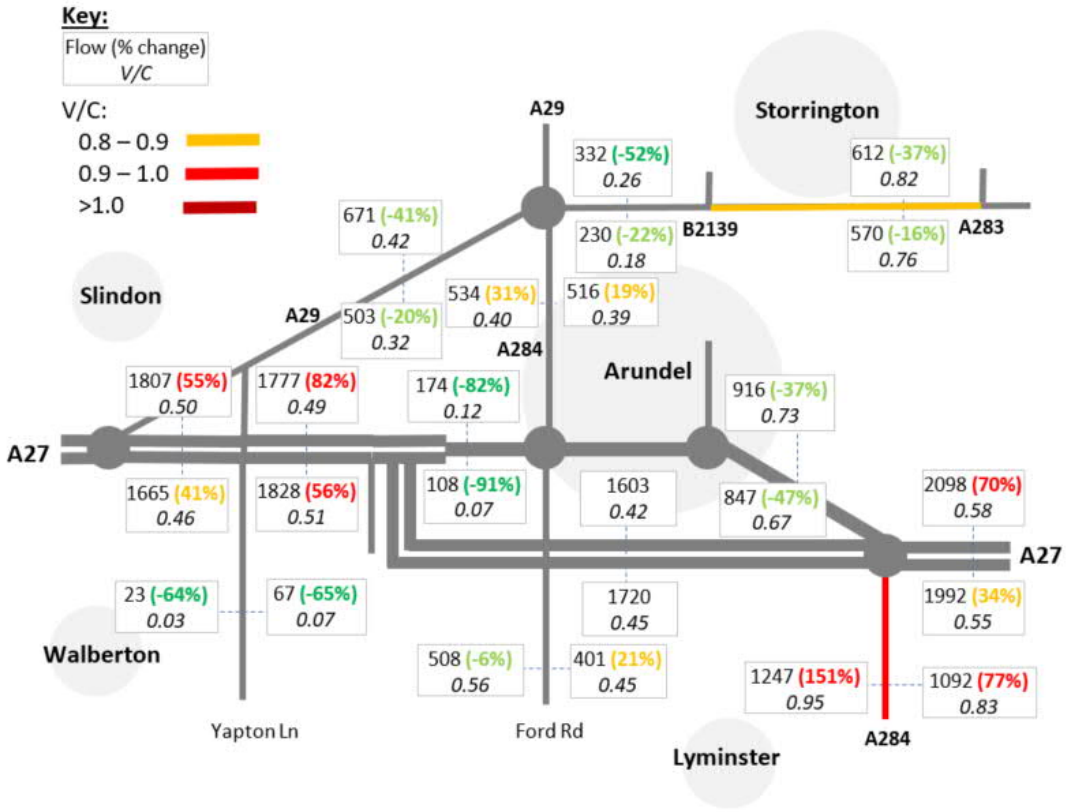
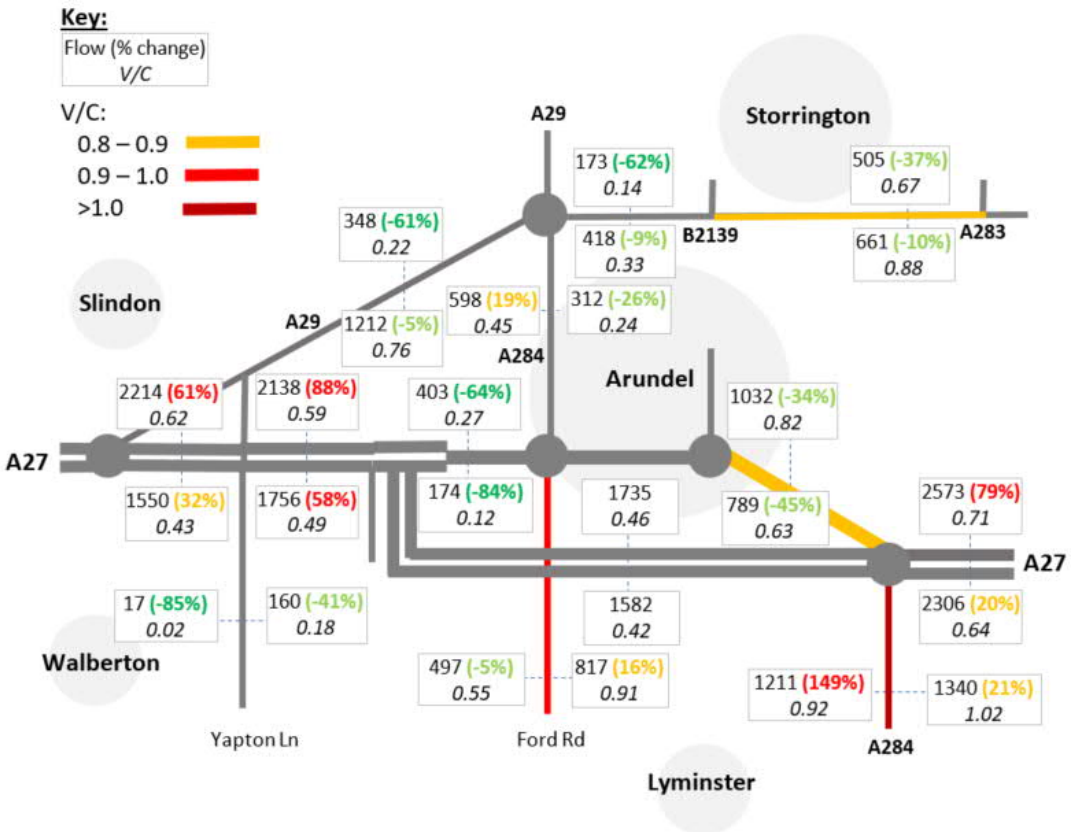


Figure 9-7 - Flows and capacities, Option 3V1 (PM)



9.5.4.2 With the implementation of Option 3V1, peak hour flows will reduce markedly in both the AM and PM peaks through Arundel, as the longer distance, strategic east – west traffic movements transfer to the bypass. Along the existing A27, although the V/Cs are significantly lower in comparison to the do minimum, the existing route eastbound between Causeway roundabout and Crossbush junction operates with a V/C of 0.82. Where the offline bypass ties in to the existing A27, V/C increases to 0.70 in the PM peak, however the road still operates well within capacity. West of Ford Road roundabout, the V/C significantly decreases during both peak periods due to the re-routing of traffic from the existing A27 to the proposed bypass.

9.5.4.3 The flow changes and V/C of surrounding local roads are similar to Option 1V5 and 1V9, with the A284 south of Crossbush having the highest V/C in the PM peak. The pattern of V/C for all other local roads is also consistent with 1V5 and 1V9.

9.5.5 Option 4/5AV1

9.5.5.1 Figure 9-8 and Figure 9-9 shows the 2041 AM and PM peak flow changes in comparison to do minimum and link V/C for Option 4/5AV1.

Figure 9-8 - Flows and capacities, Option 4/5AV1 (AM)

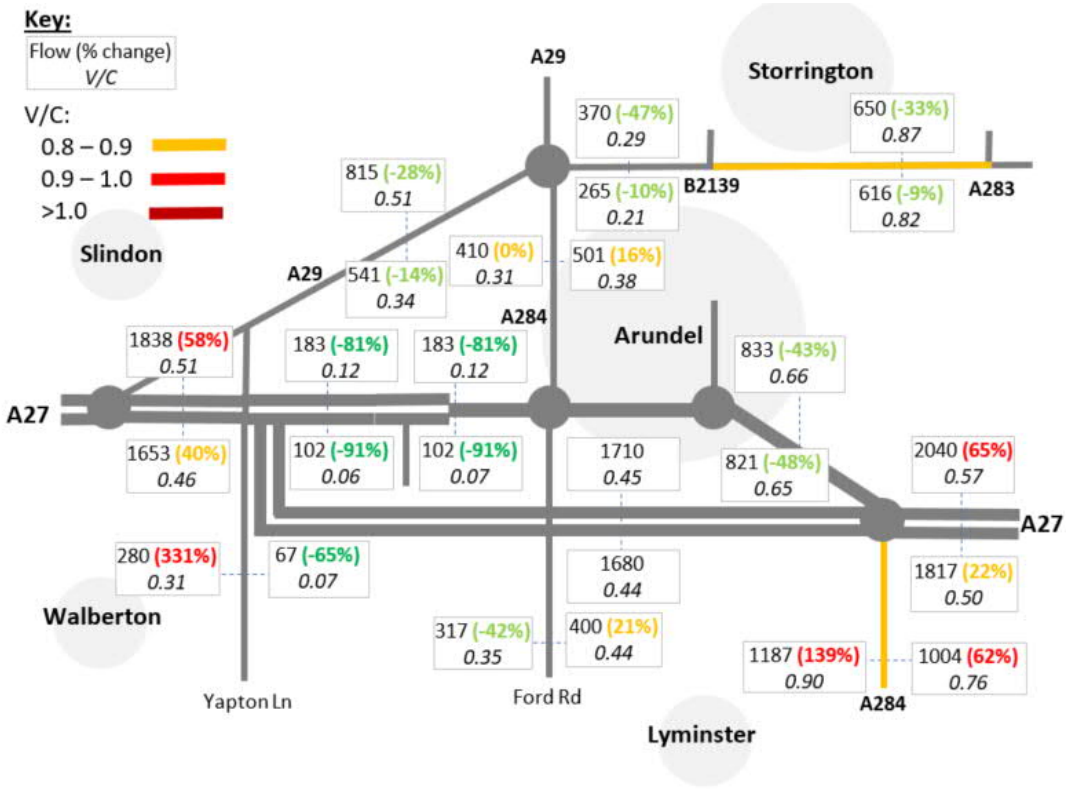
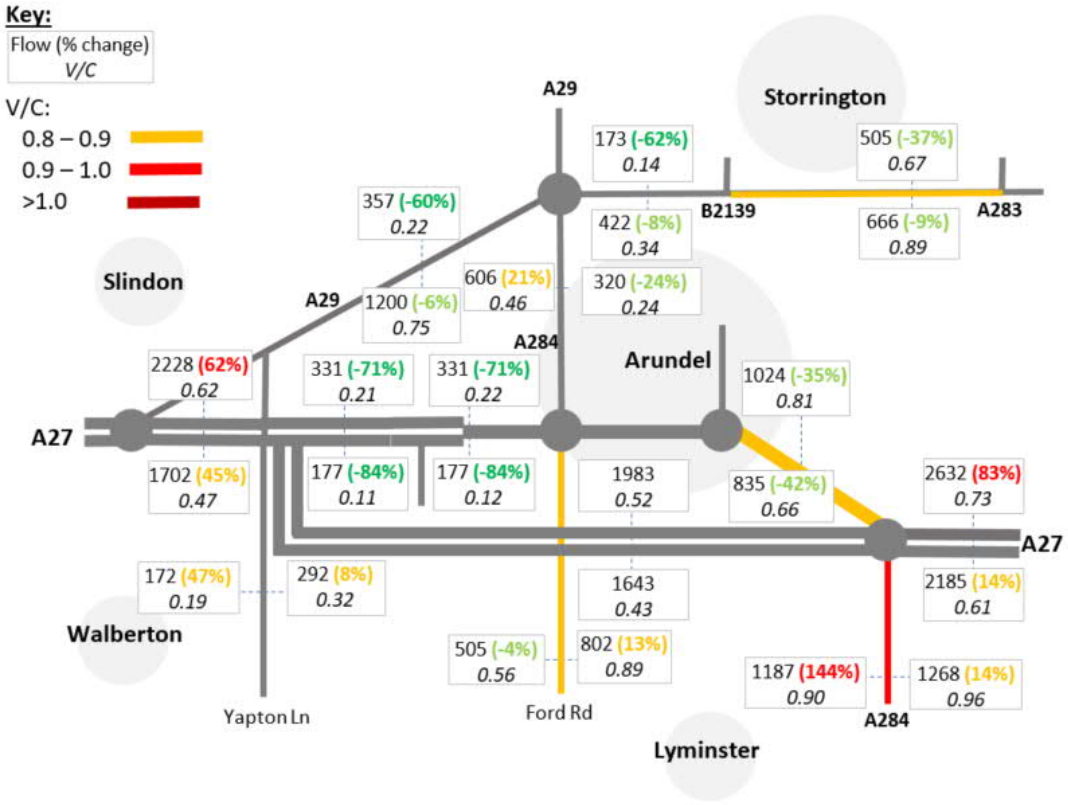


Figure 9-9 - Flows and capacities, Option 4/5AV1 (PM)



9.5.5.2 A slightly greater volume of traffic transfers away from the existing A27 on to the new bypass section compared to Option 3V1, resulting in lower V/Cs on the existing A27 route during the AM peak. In the PM peak, the existing A27 operates with a V/C of around 0.8 between Causeway roundabout and Crossbush junction eastbound, similar to Option 3V1. Local roads would experience conditions that are similar to Option 3V1, with Ford Road south and the A29 with links that operate in excess of 0.8.

9.5.5.3 Flows on Yapton Lane increase with Option 4/5AV1, due to the proposed junction arrangement at the western tie-in, which improves access to the A27 from Yapton Lane and provides a route between Yapton Lane and Shellbridge Road. The pattern of V/C for all other local roads is generally consistent with the previous options.

9.5.6 Option 4/5AV2

9.5.6.1 Figure 9-10 and Figure 9-11 show the 2041 AM and PM peak flow changes in comparison to do minimum and the V/C for Option 4/5AV2.

9.5.6.2 Traffic flow changes and V/Cs in Option 4/5AV2 are fairly consistent with those for Option 4/5AV1. The pattern of V/C for all other local roads is generally consistent with the previous options. The notable differences are on Yapton Lane where there is a decrease in traffic relative to do minimum.

Figure 9-10 - Flows and capacities, Option 4/5AV2 (AM)

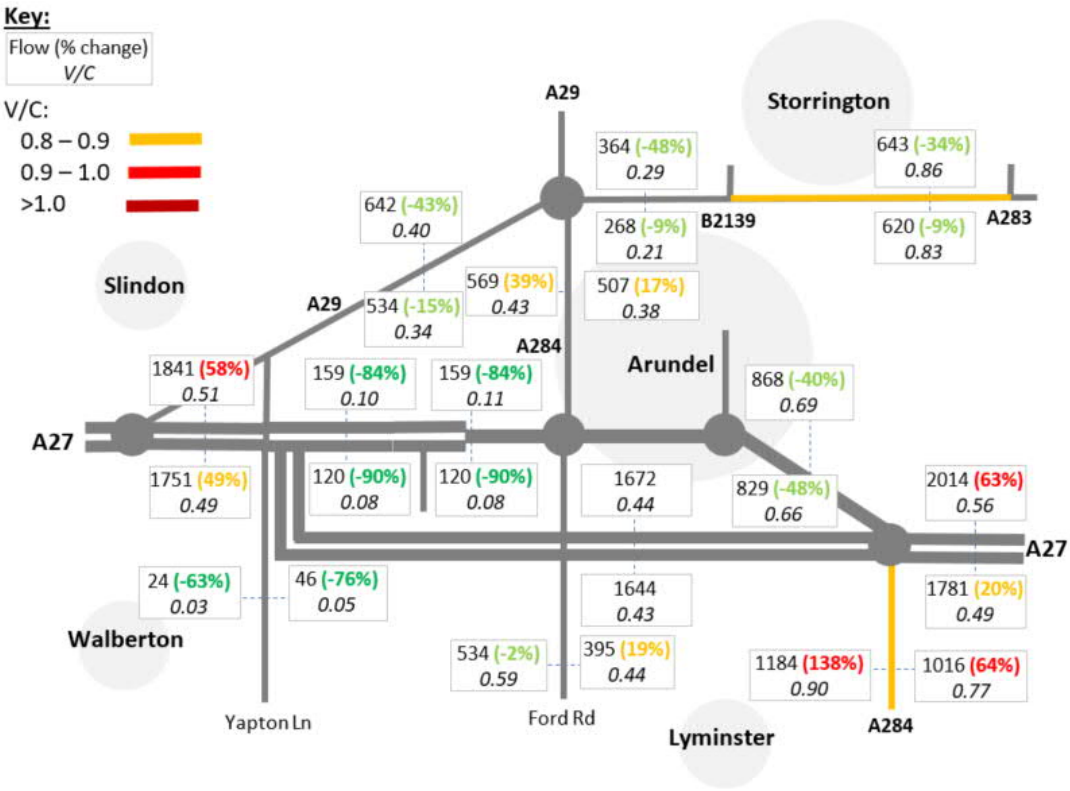
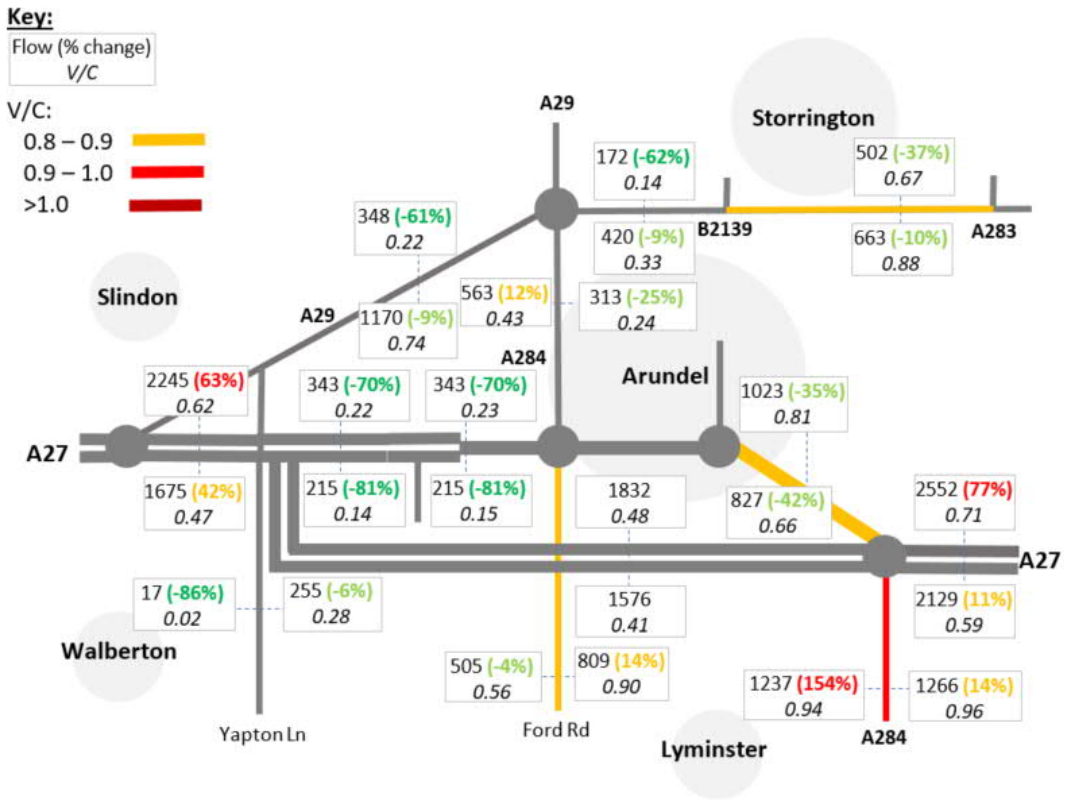


Figure 9-11 - Flows and capacities, Option 4/5AV2 (PM)



9.5.7 Option 5BV1

9.5.7.1 Figure 9-12 and Figure 9-13 shows the 2041 AM and PM peak flow changes in comparison to do minimum and the V/C for Option 5BV1. The effects of Option 5BV1 are broadly similar to that of Options 3V1, 4/5AV1 and 4/5AV2.

Figure 9-12 - Flows and capacities, Option 5BV1 (AM)

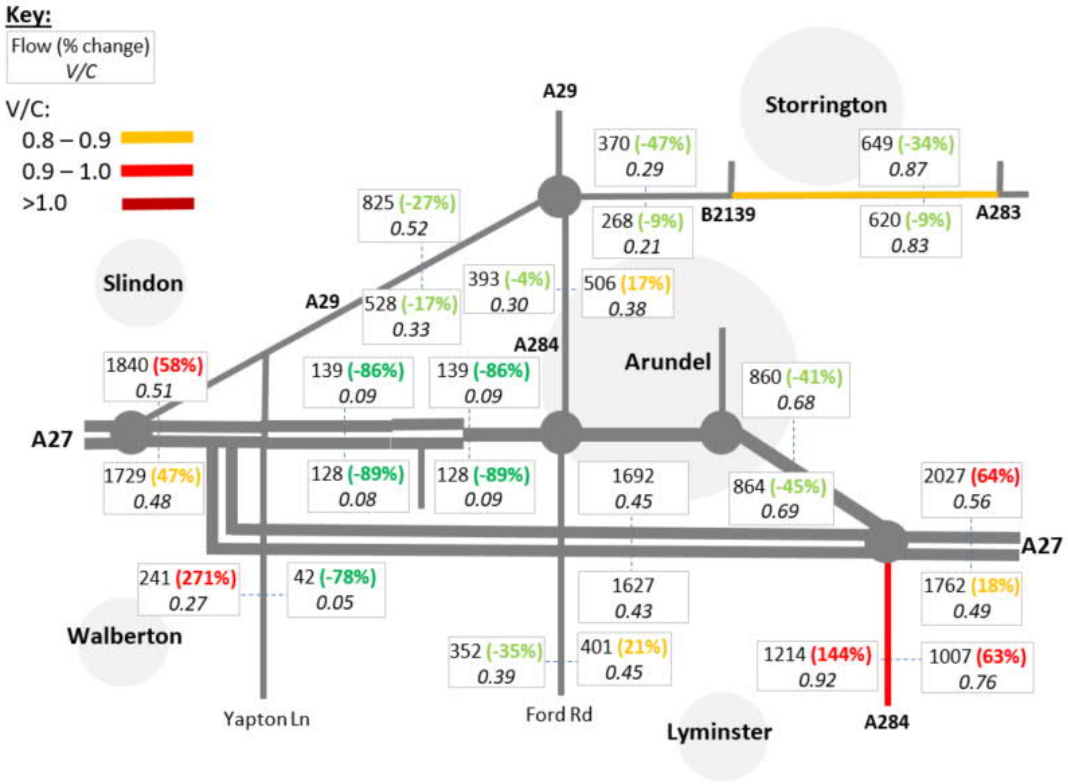
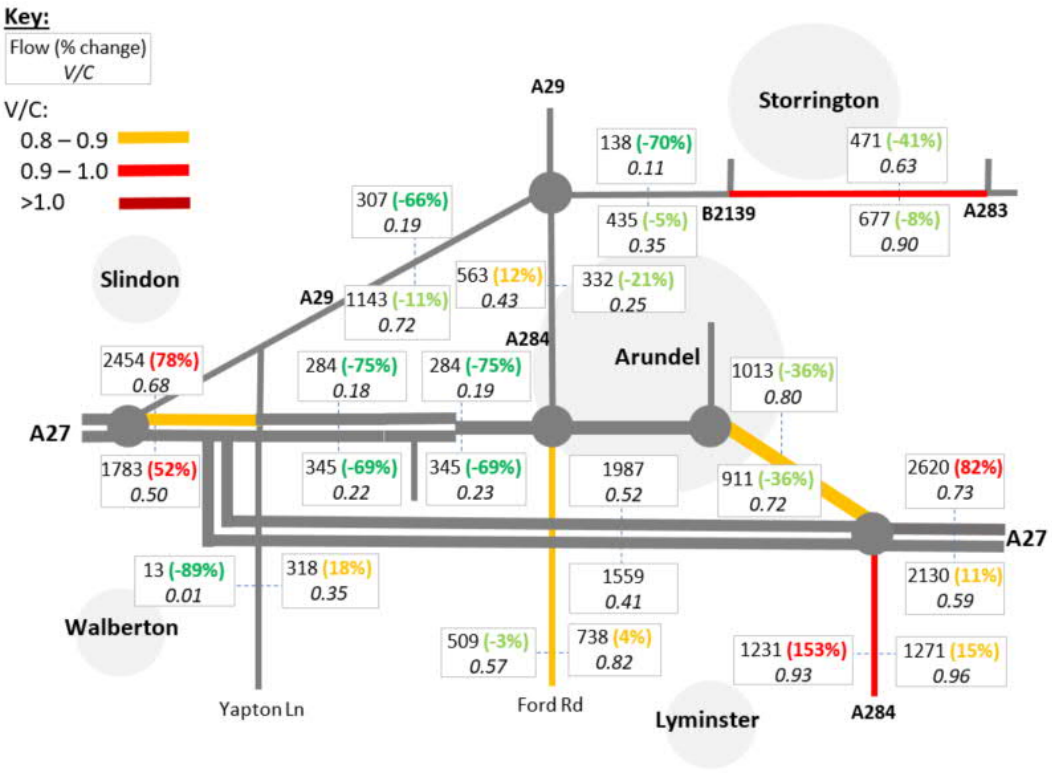


Figure 9-13 - Flows and capacities, Option 5BV1 (PM)



9.6 Operational assessment

9.6.1.1 This section presents an assessment of the performance of the key junctions along the A27 that were also considered in sections 2 and 4. The assessment shows the extent to which the junction operational issues described in Chapter 3 and 5 of this report are resolved by each option.

9.6.1.2 Where an operational model highlights any capacity issues in terms of arms having RFCs over 0.85, for roundabouts, or DoS greater than 90%, for signalised junctions, geometric modifications would be made during further design development stages to mitigate such capacity constraints where feasible.

9.6.2 Option 1V5

9.6.2.1 Table 9-2 and Table 9-3 summarise the modelling results of Ford Road junction and Crossbush junction with the implementation of Option 1V5 for the year 2041. All arms of Ford Road roundabout, except the A284 approach, would operate within capacity with RFCs of less than 0.85 and negligible queuing in the AM peak hour. With an RFC of 0.88, the A284 operates marginally over capacity in the PM peak, albeit with negligible queuing.

Table 9-2 - Ford Road junction assessment (Option 1V5 – 2041 AM and PM)

Junction Arm		AM Peak (2041)			PM Peak (2041)		
		RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
A	A284	0.55	1	5.93	0.88	7	22.05
B	Maltravers Street	0.00	0	0.00	0.00	0	0.00
C	A27 East (Arundel Bypass)	0.51	1	4.58	0.57	1	5.88
D	Ford Road	0.61	2	9.71	0.55	1	8.07

Table 9-3 - Crossbush Junction assessment (Option 1V5 – 2041 AM and PM)

Junction Arm		AM Peak (2041)			PM Peak (2041)		
		RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
North Rbt	The Causeway	0.60	2	5.05	0.68	2	6.19
	Overbridge northbound	0.57	1	3.58	0.59	1	3.69
	A27 eastbound off-slip	0.78	3	23.26	0.44	1	9.00
South Rbt	Overbridge southbound	0.47	1	2.83	0.35	1	2.30
	A27 westbound off-slip	0.23	0	2.75	0.50	1	3.74
	A284 Lyminster Road	0.65	2	5.03	0.69	2	5.86

9.6.2.2 Crossbush junction would operate within capacity with RFCs of less than 0.85 and negligible queuing during both peak periods in 2041.

9.6.3 Option 1V9

9.6.3.1 Of the six options under consideration, Option 1V9 is the only option with a proposed junction, in the form of a signalised through-about, with Ford Road. The proposed junction has therefore been tested for operation performance during the AM and PM peak hours in 2041.

9.6.3.2 Table 9-4 demonstrates that the proposed signalised Ford Road junction, under Option 1V9, operates within capacity in 2041, as indicated by the positive Practical Reserve Capacity[7] (PRC). It should be noted that the junction operates with marginal spare capacity in the PM peak period in 2041 and therefore the junction can be considered to be operating at capacity. Table 9-5 indicates that Crossbush junction operates well within capacity, during both the peak periods, in 2041, under Option 1V9.

Table 9-4 - Ford Road Roundabout (Option 1V9) LinSig Results

Junction Arm	AM Peak (2041)			PM Peak (2041)		
	DoS[6] (%)	MMQ[8] (PCUs)	Delay (s/PCU)	DoS (%)	MMQ (PCUs)	Delay (s/PCU)
A284 SB	49	1	1	60	2	1
Maltravers Street	11	0	0	23	0	0
SB Circulatory A27 Crossing	59	3	1	84	9	1
A27 EB Internal Stopline	64	1	0	90	5	5
A27 WB External Left Turn	45	3	2	56	4	3
A27 WB External Ahead	63	5	3	73	6	5
Ford Road NB	62	2	1	62	2	1
NB Circulatory A27 Crossing	77	6	3	75	5	3
A27 WB Internal Stopline	63	2	2	50	1	1
A27 EB External Left Turn	72	6	4	76	7	5
A27 EB External Ahead	80	7	5	73	7	5
A27 EB Exit (Existing Bridge ped)	44	3	1	40	3	1
Total Delay (PCUhr)	34.9			50.23		
Practical Reserve Capacity (%)	12.1			0.4		

[7] The Practical Reserve Capacity (PRC) of a traffic signal junction is a commonly used measure of its available spare capacity. A positive PRC indicates that the junction has spare capacity.

[8] Mean Maximum Queue or MMQ is the maximum queue predicted by the model for a stop line in each cycle, averaged over a number of cycles.

Table 9-5 - Crossbush junction assessment (Option 1V9 – 2041 AM and PM)

Junction Arm		AM Peak (2041)			PM Peak (2041)		
		RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
North Rbt	The Causeway	0.58	1	4.75	0.66	2	5.87
	Overbridge northbound	0.31	0	2.20	0.30	0	2.17
	A27 eastbound off-slip	0.30	0	4.78	0.21	0	4.13
South Rbt	Overbridge southbound	0.42	1	2.60	0.36	1	2.31
	A27 westbound off-slip	0.10	0	2.25	0.28	0	2.64
	A284 Lyminster Road	0.61	2	4.09	0.60	2	4.06

9.6.3.3 Table 9-6 to Table 9-13 summarise the modelling results of Ford Road roundabout and Crossbush junction with the implementation of Options 3V1, 4/5AV1, 4/5AV2 and 5BV1 for the year 2041. The results demonstrate that both the Ford Road roundabout as well as the Crossbush junction operate well within capacity, for all of these options, in 2041.

Table 9-6 - Ford Road junction assessment (Option 3V1 – 2041 AM and PM)

Junction Arm		AM Peak (2041)			PM Peak (2041)		
		RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
A	A284	0.61	2	7.39	0.72	3	11.37
B	Maltravers Street	0.00	0	0.00	0.00	0	0.00
C	A27 East (Arundel Bypass)	0.52	1	4.80	0.62	2	6.87
D	Ford Road	0.61	2	10.11	0.58	1	9.17
E	A27 West (Chichester Road)	0.25	0	5.71	0.47	1	6.55

Table 9-7 - Crossbush junction assessment (Option 3V1 – 2041 AM and PM)

Junction Arm		AM Peak (2041)			PM Peak (2041)		
		RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
North Rbt	The Causeway	0.59	1	5.10	0.65	2	5.76
	Overbridge northbound	0.63	2	4.14	0.61	2	3.92
	A27 eastbound off-slip	0.54	1	11.88	0.43	1	8.94
South Rbt	Overbridge southbound	0.43	1	2.64	0.32	1	2.21
	A27 westbound off-slip	0.29	0	2.88	0.56	1	4.17
	A284 Lyminster Road	0.67	2	5.25	0.66	2	5.26

Table 9-8 - Ford Road junction assessment (Option 4/5AV1 – 2041 AM and PM)

Junction Arm		AM Peak (2041)			PM Peak (2041)		
		RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
A	A284	0.58	1	6.73	0.71	2	10.41
B	Maltravers Street	0.00	0	0.00	0.00	0	0.00
C	A27 East (Arundel Bypass)	0.50	1	4.63	0.63	2	6.93
D	Ford Road	0.38	1	6.38	0.59	2	9.40
E	A27 West (Chichester Road)	0.24	0	5.15	0.39	1	5.77

Table 9-9 - Crossbush junction assessment (Option 4/5AV1 – 2041 AM and PM)

Junction Arm		AM Peak (2041)			PM Peak (2041)		
		RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
North Rbt	The Causeway	0.52	1	4.16	0.62	2	5.14
	Overbridge northbound	0.58	1	3.60	0.56	1	3.50
	A27 eastbound off-slip	0.50	1	9.94	0.50	1	9.35
South Rbt	Overbridge southbound	0.43	1	2.63	0.34	1	2.27
	A27 westbound off-slip	0.22	0	2.61	0.50	1	3.73
	A284 Lyminster Road	0.63	2	4.65	0.65	2	5.03

Table 9-10 - Ford Road junction assessment (Option 4/5AV2 – 2041 AM and PM)

Junction Arm		AM Peak (2041)			PM Peak (2041)		
		RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
A	A284	0.60	2	7.13	0.74	3	11.94
B	Maltravers Street	0.00	0	0.00	0.00	0	0.00
C	A27 East (Arundel Bypass)	0.51	1	4.69	0.63	2	7.12
D	Ford Road	0.64	2	10.89	0.61	2	9.85
E	A27 West (Chichester Road)	0.23	0	5.56	0.40	1	5.88

Table 9-11 - Crossbush junction assessment (Option 4/5AV2 – 2041 AM and PM)

Junction Arm		AM Peak (2041)			PM Peak (2041)		
		RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
North Rbt	The Causeway	0.54	1	4.44	0.64	2	5.67
	Overbridge northbound	0.58	1	3.60	0.60	2	3.78
	A27 eastbound off-slip	0.55	1	11.00	0.53	1	10.61
South Rbt	Overbridge southbound	0.43	1	2.66	0.35	1	2.28
	A27 westbound off-slip	0.22	0	2.63	0.50	1	3.72
	A284 Lyminster Road	0.63	2	4.64	0.68	2	5.46

Table 9-12 - Ford Road junction assessment (Option 5BV1 – 2041 AM and PM)

Junction Arm		AM Peak (2041)			PM Peak (2041)		
		RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
A	A284	0.60	2	6.99	0.75	3	11.86
B	Maltravers Street	0.00	0	0.00	0.00	0	0.00
C	A27 East (Arundel Bypass)	0.51	1	4.76	0.66	2	7.77
D	Ford Road	0.43	1	6.91	0.65	2	11.75
E	A27 West (Chichester Road)	0.18	0	5.04	0.33	1	5.15

Table 9-13 - Crossbush junction assessment (Option 5BV1 – 2041 AM and PM)

Junction Arm		AM Peak (2041)			PM Peak (2041)		
		RFC	Queue (Veh)	Delay (s/Veh)	RFC	Queue (Veh)	Delay (s/Veh)
North Rbt	The Causeway	0.54	1	4.37	0.64	2	5.62
	Overbridge northbound	0.59	1	3.69	0.60	2	3.82
	A27 eastbound off-slip	0.57	1	11.80	0.68	2	15.83
South Rbt	Overbridge southbound	0.43	1	2.63	0.35	1	2.28
	A27 westbound off-slip	0.22	0	2.62	0.51	1	3.80
	A284 Lyminster Road	0.64	2	4.84	0.67	2	5.47

9.6.3.4 The operational assessments of the western tie-in junctions for options 4/5AV1 and 4/5AV2 indicate that the proposed junction arrangement would operate under capacity in 2041. The western tie-in junction for options 3V1 and 5BV1 is the form of a merge/ diverge arrangement without any conflicting movements, which precluded the need for any operational assessment.

9.7 Journey time

9.7.1.1 Table 9-14 shows the 2041 journey times across the scheme extent for each of the options and compares these to the do minimum scenario. The journey time route is presented in Figure 9-14.

9.7.1.2 Option 1V5 and Option 1V9 would both see reductions in journey times across all time periods and in both directions, compared to do minimum. Option 1V5 provides a greater overall journey time reduction than Option 1V9.

9.7.1.3 The offline options (Option 3V1, 4/5AV1 and 4/5AV2, and 5BV1) all show greater journey time savings than Option 1V5 and Option 1V9. The maximum journey time savings are approximately 9 to 11 minutes compared to do minimum. Option 5BV1 offers the greatest journey time benefit for this route. For all options, the largest reduction in journey time is seen in the PM peak journey eastbound

Figure 9-14 - Journey time route

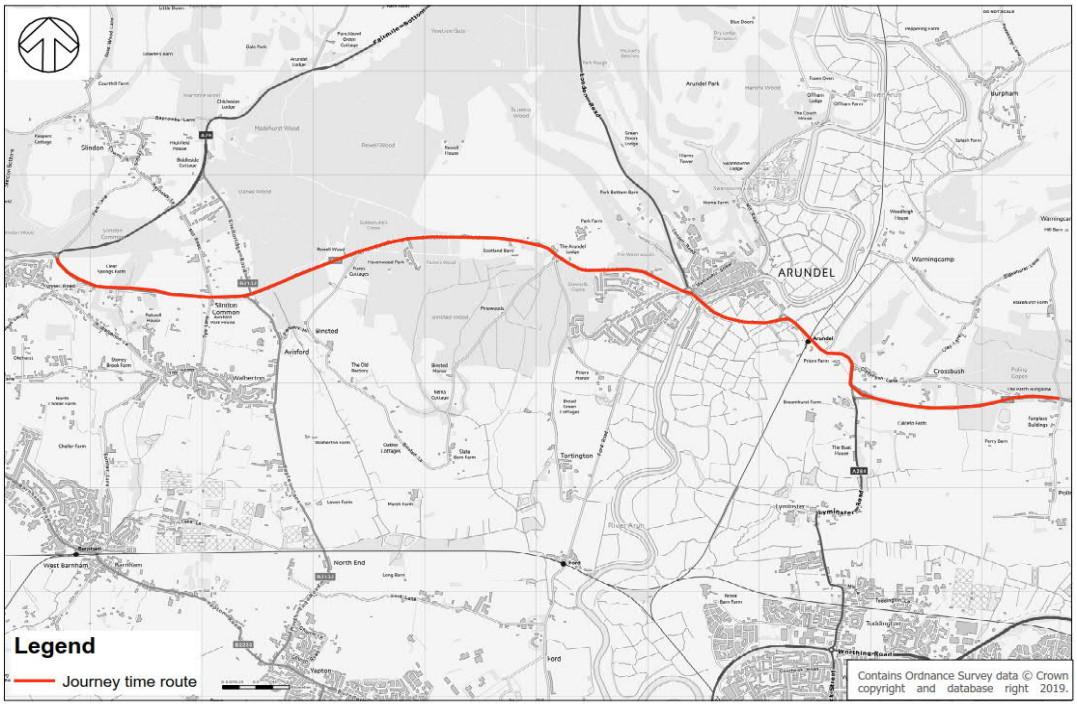


Table 9-14 - 2041 Journey times (mm:ss)

ROUTE	A27 EB			A27 WB		
	AM	IP	PM	AM	IP	PM
DM	11:59	13:06	16:58	13:35	11:48	12:34
1V5	05:42	05:39	09:22	07:19	06:39	06:53
Difference	**-06:17**	**-07:27**	**-07:36**	**-06:16**	**-05:09**	**-05:41**
1V9	06:35	06:32	08:53	08:17	07:54	08:10
Difference	**-05:24**	**-06:34**	**-08:05**	**-05:18**	**-03:54**	**-04:24**
3V1	05:54	05:54	08:00	06:22	06:06	06:12
Difference	**-06:05**	**-07:12**	**-08:58**	**-07:13**	**-05:42**	**-06:22**
4/5AV1	05:33	05:31	07:23	07:12	06:32	06:45
Difference	**-06:26**	**-07:35**	**-09:35**	**-06:23**	**-05:16**	**-05:49**
4/5AV2	05:34	05:31	07:23	07:18	06:36	06:49
Difference	**-06:25**	**-07:35**	**-09:35**	**-06:17**	**-05:12**	**-05:45**
5BV1	05:32	05:29	05:40	07:13	06:33	06:44
Difference	**-06:27**	**-07:37**	**-11:18**	**-06:22**	**-05:15**	**-05:50**

9.8 Summary

9.8.1.1 In summary Option 1V5, Option 1V9, Option 3V1, Option 4/5AV1, Option 4/5AV2 and Option 5BV1 would all operate in 2041 with between approximately 45 to 60% capacity. Option 1V9 would operate with a similar link capacity but overall capacity would be limited by the capacity of Ford Road Junction and would operate up to 85 to 90% capacity.

9.8.1.2 All the options would reduce journey times and improve journey time reliability in the peak hour periods as summarised below.

- Option 1V5 -6 to 8 minutes
- Option 1V9 – 4 to 8 minutes
- Option 3V1 – 6 to 9 minutes
- Option 4/5AV1 – 6 to 10 minutes
- Option 4/5AV1 - 6 to 10 minutes
- Option 5BV1 – 6 to 11 minutes

A27 Arundel Bypass Scheme Assessment Report

Chapter 10 – Summary Economic Appraisal

October 2020

Table of Contents

LIST OF TABLES

LIST OF FIGURES

10 Summary of Economic appraisal

10.1 Introduction

10.1.1.1 The economic appraisal was undertaken in accordance with WebTAG Unit A1-1 Cost-Benefit Analysis. The economic appraisal was informed by data taken from the A27 transport model. Further detail in relation to the methodology and the results of the economic appraisal are presented in the ComMA report.

10.1.1.2 The economic appraisal of the options comprises the following:

- Transport user benefits
- Accident benefits
- Impacts during construction
- Environmental impacts (including greenhouse gases, air and noise)
- Wider economic benefits

10.1.1.3 This economic appraisal produces an 'initial' benefit-cost ratio (BCR) that is then 'adjusted' through the inclusion of wider economic benefits, which are summarised later in this section.

10.2 Transport user benefits

10.2.1.1 Transport User Benefit Appraisal (TUBA) version 1.9.12, with TUBA economics file (version 1.9.12), was used to carry out the economic appraisal of the A27 Arundel Bypass options. The appraisal of the transport user benefits incorporates the effects relating to time savings, vehicle operating cost savings and indirect tax revenue. The economic appraisal reflects the benefits over a standard 60-year appraisal period, from 2026 (opening year) to 2086 informed by trip distance and journey time data by vehicle type and journey purpose from the A27 transport model.

10.2.1.2 Travel time savings are monetised as a perceived benefit, reflecting users' willingness to pay for a quicker journey and expressed in the market price unit of account. The value of those savings differs depending on the reason for the trip, of which three are defined in WebTAG: business users, commuters, and non-commuting consumers.

10.2.1.3 Vehicle operating cost savings accrue in two categories:

- fuel costs, a function of the speed of the vehicle through the network and fuel efficiency; and
- non-fuel costs such as oil, tyres, vehicle maintenance depreciation and business vehicle capital costs, largely a function of the distance travelled by the vehicle.

10.2.1.4 WebTAG 1-1[1] describes indirect taxation as similar to VAT, meaning that different users perceive costs differently. For example, the price of petrol is different for businesses, which can reclaim VAT, and personal travellers, who cannot. Different users are perceiving costs in different units of account. Individual consumers perceive 'market prices', including indirect taxation, while businesses and government perceive costs in the 'factor (or resource) cost' unit of account, net of indirect taxation. They are included in the public accounts table as 'central government funding: non- transport' and are not included in the broad transport budget.

10.2.1.5 Table 10-1 summarises the transport user benefits relating to economic efficiency. Section 3.3 of the PCF Stage 2 Further Consultation ComMA[2] describes the assumptions underpinning the PCF Stage 2 Further Consultation A27 transport model and, by association, the limitations of the results from the economic assessment.

Table 10-1 - Transport User Benefits (£m)

TYPE	1V5	1V9	3V1	4/5AV1	4/5AV2	5BV1
Economic Efficiency Consumer Users (Commuting)	£64.18	£58.29	£72.67	£74.61	£79.99	£76.30
Economic Efficiency Consumer Users (Other)	£85.61	£87.32	£100.97	£104.73	£112.81	£108.37
Economic Efficiency Business Users and Providers	£71.34	£70.02	£82.84	£86.30	£91.89	£85.57
Economic Efficiency Total	**£221.13**	**£215.63**	**£256.48**	**£265.64**	**£284.69**	**£270.24**

[1] https://www.gov.uk/government/publications/webtag-tag-unit-a1-1-cost-benefit-analysis-december-2017

[2] HE551523-WSP-GEN-SWI-RP-TR-00017-P03 – A27 Arundel Bypass, PCF Stage 2 Further Consultation Combined Modelling and Appraisal Report (July 2019

10.2.1.6 The table shows that 4/5AV2 has the largest benefit to consumer users and business users and providers. Options 3V1, 4/5AV1 and 5BV1 provide a similar level of benefit, with approximately £40 - 50m more benefit than Options 1V5 and 1V9.

10.3 Accident benefits

10.3.1.1 Cost and Benefit to Accidents – Light Touch (COBALT) is a computer program used to undertake the analysis of the impact on accidents as part of the economic appraisal for a road scheme. The assessment is based on a comparison of accidents by severity and associated costs across an identified network in the do minimum and do something forecasts using details of link and junction characteristics, relevant accident rates and cost and forecast traffic volumes by link and junction.

10.3.1.2 The accident analysis, in COBALT, is informed by forecast traffic flows from the A27 transport model.

10.3.1.3 Figure 10-1 to Figure 10-6 show the difference in number of accidents between do minimum and each option over the 60-year assessment period. A positive number shows that there is a decrease in the number of accidents between the scheme and do minimum, whereas a negative number shows an increase in the number of accidents as a result of the scheme. Blue indicates a decrease in accidents as a result of the scheme and amber / red an increase.

Figure 10-1 - Option 1V5 accident difference compared with do minimum

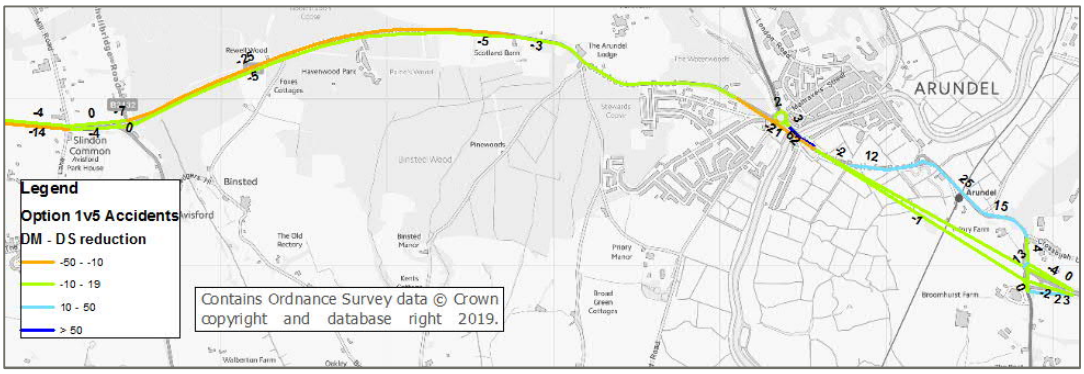


Figure 10-2 - Option 1V9 accident difference compared with do minimum

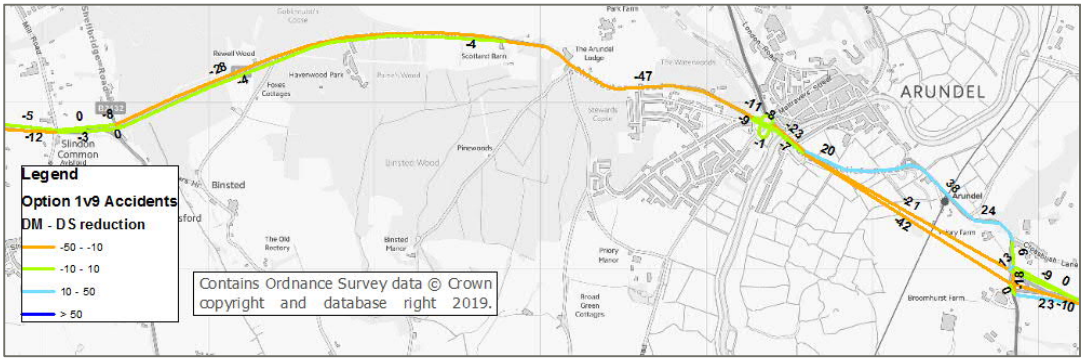


Figure 10-3 - Option 3V1 accident difference compared with do minimum

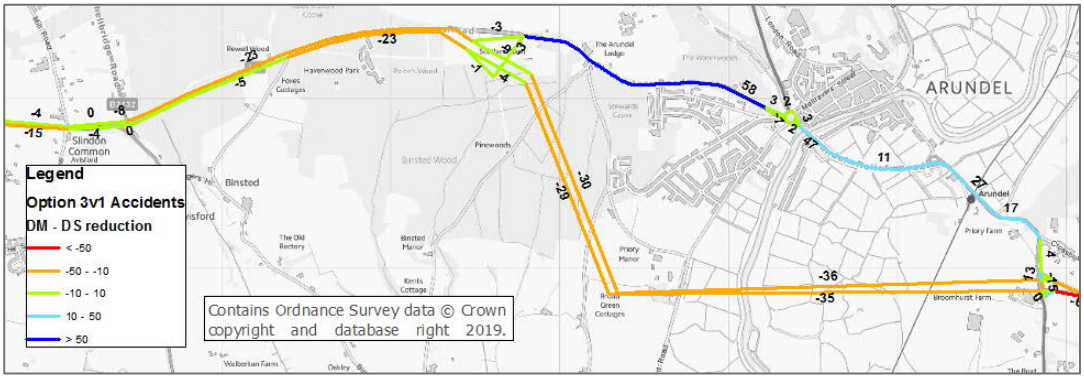


Figure 10-4 - Option 4/5AV1 accident difference compared with do minimum

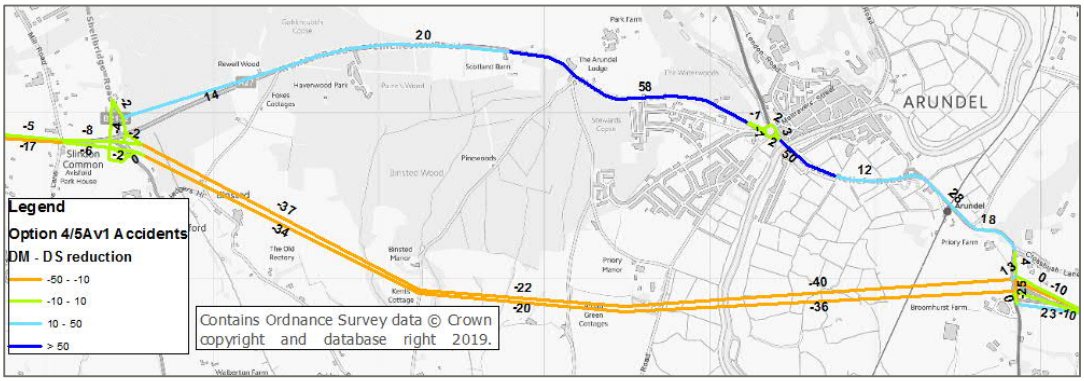


Figure 10-5 - Option 4/5AV2 accident difference compare with do minimum

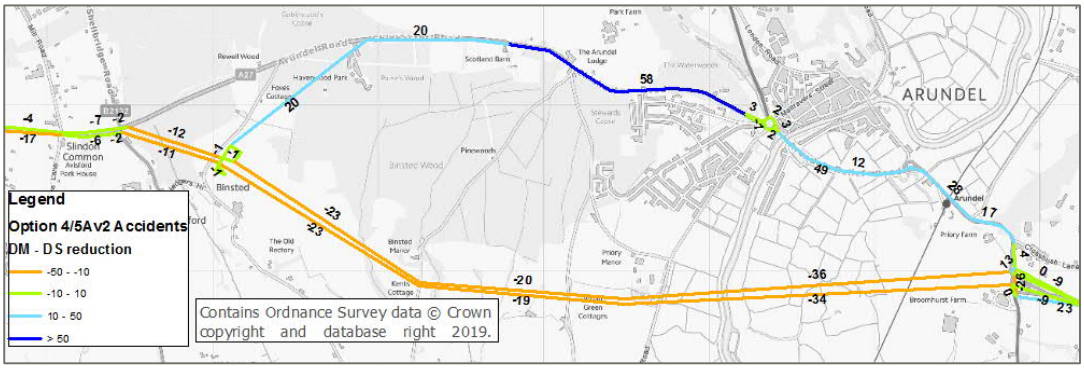
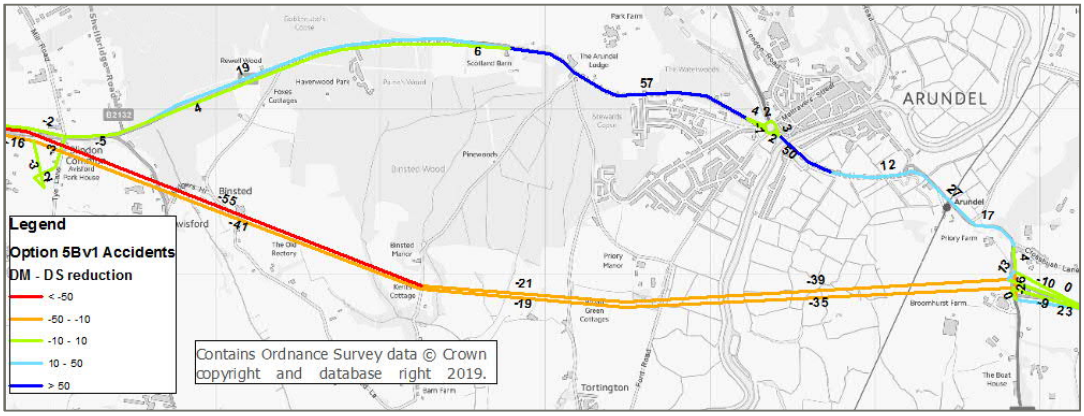


Figure 10-6 - Option 5BV1 accident difference compared with do minimum



10.3.1.4 From the figures above, it can be seen that there are reductions in the number of accidents on the existing A27 that is bypassed by the new sections of the A27, due to reduced traffic flows along these roads. The transfer in traffic to the new bypass sections result in some accidents forecast on the new sections of road.

10.3.1.5 While the number of accidents presented in Figure 10-1 to Figure 10-6 serves to demonstrate the general reduction of accidents on the de-trunked sections of the existing A27, a comparison of the total absolute accident and casualty numbers does not take account of the differences in length between the scheme options, thereby disguising the true savings in accident rates between the options. Therefore, accidents have been represented in terms of billion vehicle kilometres in order to offer a meaningful comparison.

10.3.1.6 Table 10-2 and Table 10-3 sets out the accidents/billion vehicle kilometres and the casualties/billion vehicle kilometres, respectively, on the existing A27 between Mill Road/Tye Lane and Crossbush junction and the Scheme extents. The section representing the existing A27 alignment under a do minimum scenario and also a typical section depicting the Scheme extents are highlighted in Figure 10-7.

Figure 10-7 – Sections of the existing A27 and the scheme extent selected for accident comparison

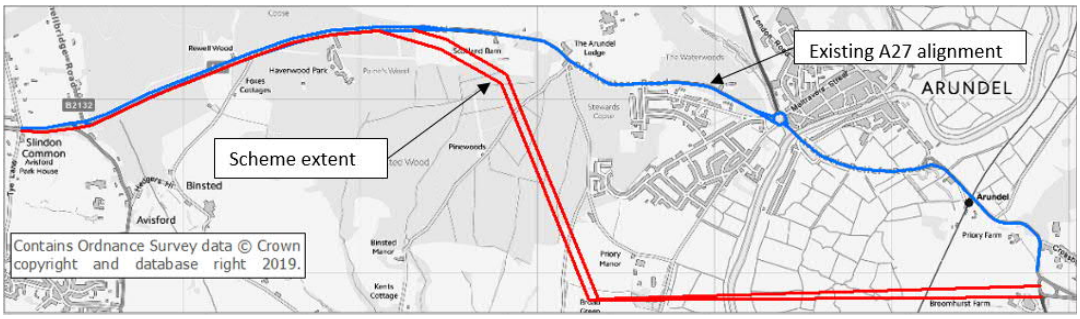


Table 10-2 - Number of accidents/billion vehicle kilometres for the do minimum and each option

	Existing alignment	Existing + New alignments combined					
	A27 DM	Option 1V5	Option 1V9	Option 3V1	Option 4/5AV1	Option 4/5AV2	Option 5BV1
Accident rate per billion vehicle kilometres on the existing and the new A27 alignments	116	64	103	76	80	71	73

Table 10-3 - Number of casualties/billion vehicle kilometres for the do minimum and each option

		Existing alignment	Existing + New alignments combined					
		A27 DM	Option 1V5	Option 1V9	Option 3V1	Option 4/5AV1	Option 4/5AV2	Option 5BV1
Accident rate per billion vehicle kilometres on the existing and the new A27 alignments	Slight	143	93	133	96	102	91	93
	Serious	16	10	15	10	11	10	10
	Fatal	2	1	2	1	1	1	1

10.3.1.7 As demonstrated by Table 10-2 the predicted number of accidents/billion vehicle kilometres along the combined existing and new alignments, for all scheme options, is lower than that on the existing A27 alignment under a do minimum scenario. Option 1V5 is forecast to have the lowest accident rate and Option 1V9 the highest, in comparison to the do minimum scenario.

10.3.1.8 Table 10-4 shows the total number of accidents saved over the 60-year appraisal period across the entire road network.

Table 10-4 - Accident summary

Period	Option 1V5	Option 1V9	Option 3V1	Option 4/5AV1	Option 4/5AV2	Option 5BV1
Total Without-Scheme Accidents	55,484					
Total With-Scheme Accidents	55,073	55,087	55,105	54,957	54,757	54,808
Total Accidents Saved by Scheme	411	397	379	527	727	676

10.3.1.9 A breakdown of the casualties saved across the entire road network is shown in Table 10-5

Table 10-5 – Casualties Saved by Scheme

	Option 1V5	Option 1V9	Option 3V1	Option 4/5AV1	Option 4/5AV2	Option 5BV1
Fatal	4	4	4	8	9	9
Serious	85	78	85	105	133	126
Slight	500	473	457	639	878	817
Total	589	555	545	751	1,019	952

10.3.1.10 The monetised accident benefits of each option which considers the impact of the schemes across the entire road network are presented in Table 10-6.

10.3.1.11 The economic benefits associated with the reduction of accidents is a result of the provision of a higher standard of route. Users that transfer from existing lower standard strategic routes or local roads benefit from driving on a new route with a lower accident rate.

Table 10-6 – Total accident benefit (£m)

Period	Option 1V5	Option 1V9	Option 3V1	Option 4/5AV1	Option 4/5AV2	Option 5BV1
Total Without-Scheme Accident Costs	2396.24					
Total With-Scheme Accident Costs	2373.03	2374.43	2374.27	2367.22	2359.34	2361.22
Total Accident Benefits Saved by Scheme	23.21	21.82	21.97	29.02	36.90	35.03

10.3.1.12 All options provide an overall benefit related to accident savings. Option 1V9 having the lowest accident benefits even though Option 3V1 performs the worst in terms of total accidents saved and total causality saved. This is because Option 3V1 saves more serious casualties than Option 1V9. Option 4/5BV2 having the greatest accident benefits, at around £37m.

10.3.2 Impacts during construction

10.3.2.1 The costs of delays during construction were estimated using traffic management measures provided in a draft buildability report provided by Morgan Sindall (April 2019). These were coded in the A27 transport model do minimum forecast, and the outputs were used in TUBA (1.9.12) to assess the economic impacts of the traffic measures.

10.3.2.2 The economic impacts during construction for each option are presented in Table 10-7.

Table 10-7 – Delays During Construction (£m)

	Option 1V5	Option 1V9	Option 3V1	Option 4/5AV1	Option 4/5AV2	Option 5BV1
User Time	-£7.53	-£7.53	-£5.53	-£6.31	-£6.31	-£5.77
Vehicle Operating Costs Fuel	-£1.12	-£1.12	-£0.84	-£0.93	-£0.93	-£0.89
Vehicle Operating Costs Non-Fuel	-£0.96	-£0.96	-£0.75	-£0.83	-£0.83	-£0.80
Indirect Taxation Revenues	£0.65	£0.65	£0.48	£0.54	£0.54	£0.51
Total	-£8.96	-£8.96	-£6.63	-£7.53	-£7.53	-£6.94

10.3.2.3 Table 10-7 shows that the A27 Arundel Bypass scheme options are forecast to result in economic dis-benefits to traffic as a result of delays associated with construction, with Option 1V5 and Option 1V9 having the highest delay impact and Option 3V1 having the lowest. These results illustrate that the impacts on vehicle delays during construction are greater with the online improvement of Option 1V5 and 1V9 in comparison to the remaining fully offline options.

10.4 Summary of wider impacts

10.4.1.1 Assessment of the wider economic benefits of the A27 Arundel Bypass scheme options has been based on data obtained from the A27 transport model forecasts.

10.4.1.2 Wider impacts are specified to capture the impacts of a transport intervention which are additional to those experienced directly by the transport user (transport user benefits being journey time reductions and fewer accidents etc.). On this basis, three types of wider impact have been assessed:

- Agglomeration improvement benefits
- Labour market supply impacts
- Output change in imperfectly competitive markets

10.4.1.3 The concept of agglomeration reflects that where there is good connectivity, productivity will be higher as workers can access a far greater range of jobs at the same time as businesses and companies have a much broader pool of employees from which to draw their staff from. By effectively bringing firms and employees closer this encourages interactions in the labour market, knowledge spill-overs and linkages which improve productivity[3].

10.4.1.4 Agglomeration can be viewed as the intensity of economic activity in a particular area and is measured by productivity, or GDP per worker in the appraisal guidance. Agglomeration improvements occur under a transport intervention – such as the Arundel Bypass – when the enhanced connectivity translates into productivity improvements from effectively increased density of individuals and firms.

[3] WebTAG Unit A2-4, Chapter 2, pgs 2-3.

10.4.1.5 Labour market impacts may also occur due to the expected increase in jobs from people entering work who would otherwise be inactive due to high commuting costs on the basis that insufficient transport accessibility is a barrier to people entering the labour market and gaining employment[4]. For employment to increase there must be a change in demand also. A transport investment such as the bypass is likely to affect the local demand for and supply of labour simultaneously as reductions in transport costs may encourage firms to invest more and increase output which could lead to increased demand for labour[5].

10.4.1.6 The values of 'increased output in imperfectly competitive markets' are based on a 10% uplift applied to business user benefits from the TUBA appraisal undertaken as part of the economic appraisal, in accordance with TAG Unit A2-2. This represents the additional consumer surplus associated with increased output in imperfectly competitive markets.

10.4.1.7 An adjusted BCR has been calculated by including the wider economic benefits relating to agglomeration, labour market supply and output change in imperfectly competitive markets that are forecast to occur with the introduction of the A27 Arundel Bypass.

10.4.1.8 Table 10-8 outlines a summary of the wider impacts for the bypass options. The fully offline bypass options Option 3V1, Option 4/5AV2, Option 4/5AV1 and Option 5BV1 show the highest wider impact benefits. Option 1V5 and Option 1V9, i.e. the online options, present a reduced level of benefit relative to these options, with Option 1V9 generating the lowest wider economic benefit.

[4] WebTAG Unit A2-3, Chapter 2, pgs 2-3.

[5] WebTAG Unit A2-2, Chapter 4, pgs 16-17.

Table 10-8 - Summary of wider economic impacts (£m)

		Option 1V5	Option 1V9	Option 3V1	Option 4/5AV1	Option 4/5AV2	Option 5BV1
WI1: Agglomeration impacts	Manufacturing	2.67	2.26	3.28	3.00	3.02	3.15
	Construction	2.87	2.57	3.53	3.28	3.27	3.43
	Consumer Services	8.55	7.64	10.91	10.19	10.08	11.20
	Producer Services	40.08	27.76	60.39	47.79	48.91	58.30
	Sub-Total	**54.16**	**40.24**	**78.11**	**64.26**	**65.29**	**76.08**
WI3: Output change in imperfectly competitive markets	Output change in imperfectly competitive markets	4.77	4.54	6.03	5.89	5.91	6.46
WI4: Tax revenues arising from labour market impacts	Labour supply impacts	1.43	1.12	1.79	1.67	1.64	1.86
Total Wider Impact Benefits		**60.36**	**45.89**	**85.93**	**71.82**	**72.84**	**84.40**

10.5 Scheme costs

10.5.1.1 The scheme costs for the A27 Arundel Bypass (Option 1V5, Option 1V9, Option 3V1, Option 4/5AV1, Option 4/5AV2 and Option 5BV1) are produced by Highways England's Commercial Services Division. These prices are then inflated to outturn costs using Highways England projected construction related inflation and then rebased to 2010 calendar year prices for economic calculations using the GDP price deflator as published in the TAG data book. These costs are then input into TUBA, which calculates the present value of costs (PVC).

10.6 Summary of economic impacts[6]

10.6.1.1 A summary of the economic impacts of each option is presented in Table 10-9. An adjusted BCR has been calculated by including the wider economic impacts. The results for all the A27 Arundel Bypass options are presented in Table 10-10.

Table 10-9 - Analysis of Monetised Costs and Benefits (£m)

Type	Option 1V5	Option 1V9	Option 3V1	Option 4/5AV1	Option 4/5AV2	Option 5BV1
Greenhouse Gases	-10.72	-7.72	-13.48	-9.64	-8.11	-6.55
Economic Efficiency: Consumer Users (Commuting)	64.18	58.29	72.67	74.61	79.99	76.30
Economic Efficiency: Consumer Users (Other)	85.61	87.32	100.97	104.73	112.81	108.37
Economic Efficiency: Business Users	71.34	70.02	82.84	86.30	91.89	85.57
Wider Public Finances (Indirect taxation)	13.67	7.99	15.71	11.68	5.87	11.09
Construction delays	-8.96	-8.96	-6.63	-7.53	-7.53	-6.94
Accidents	23.21	21.82	21.97	29.02	36.90	35.03
Air quality	-6.85	-2.66	-7.74	-7.46	-6.63	-7.13
Noise	-5.07	-5.42	-2.00	-0.88	-0.86	-1.67
Present Value of Benefits (PVB)	**226.40**	**220.68**	**264.31**	**280.84**	**304.35**	**294.07**
Broad Transport Budget	132.99	129.65	161.61	174.82	183.06	193.97
Present Value of Costs	**132.99**	**129.65**	**161.61**	**174.82**	**183.06**	**193.97**
Net Present Value	**93.41**	**91.03**	**102.71**	**106.02**	**121.29**	**100.11**
Benefit to Cost Ratio (BCR)	**1.70**	**1.70**	**1.64**	**1.61**	**1.66**	**1.52**

[6] The results set out here are based on central estimate Scheme costs

Table 10-10 – Adjusted BCR

Type	Option 1V5	Option 1V9	Option 3V1	Option 4/5AV1	Option 4/5AV2	Option 5BV1
Present Value of Benefits (excl. wider impacts)	226.40	220.68	264.31	280.84	304.35	294.07
Wider Economic Benefits	60.36	45.89	85.93	71.82	72.84	84.40
Present Value of Benefits (adjusted)	**286.76**	**266.57**	**350.24**	**352.66**	**377.19**	**378.47**
Present Value of Costs (PVC)	**132.99**	**129.65**	**161.61**	**174.82**	**183.06**	**193.97**
Net Present Value (NPV)	**153.77**	**136.92**	**188.64**	**177.84**	**194.13**	**184.50**
Adjusted Benefit to Cost Ratio (BCR)	**2.16**	**2.06**	**2.17**	**2.02**	**2.06**	**1.95**

10.7 Value for Money (VfM)[7]

10.7.1.1 The final VfM assessment includes more than just the BCR and also takes account of all expected effects, risks and uncertainty. Taking into account all impacts, risk and uncertainty, no option significantly outperforms the other options. All six options are considered to have medium VfM.

10.8 Sensitivity tests[8]

10.8.1.1 A range of sensitivity tests have been produced in order to understand how the changes in modelling assumptions may affect the overall economic impact of the A27 Arundel Bypass scheme options. The sensitivity test BCR's are associated with a lower level of confidence than those presented for the core scenario. Details of the sensitivity tests are presented in sections 14.10 – 14.12 of the PCF Stage 2 Further Consultation ComMA.

[7] The results set out here are based on central estimate Scheme costs

[8] The results set out here are based on central estimate Scheme costs

10.8.1.2 The following sensitivity tests were carried out:

- Low traffic growth scenario
- Scenario excluding the A27 Worthing and Lancing junction improvements
- Scenario excluding the Lyminster Bypass

10.8.1.3 An assessment based on optimistic assumptions about highways schemes and demand was carried out. Given that the 2041 models in all three-time periods failed to converge, it was considered that an economic assessment based on these models is likely to have a low analytical assurance. On this basis an economic assessment based on optimistic growth assumptions has not been further progressed.

10.8.1.4 The economic results for the scenario with low traffic growth are presented in Table 10-11.

Table 10-11: Economic impacts (£m) low growth

Total Benefit	Option 1v5	Option 1v9	Option 3v1	Option 4/5Av1	Option 4/5Av2	Option 5Bv1
User Time	181.39	145.19	205.33	225.93	213.05	198.56
VOC fuel	-2.27	1.91	-4.61	3.69	3.27	2.54
VOC non-fuel	-17.37	-12.72	-23.98	-13.35	-12.64	-19.05
Indirect taxation	14.36	10.54	19.21	10.59	10.12	15.23
TUBA Total	176.11	144.92	195.95	226.86	213.79	197.28
Other Impacts	38.97	27.83	56.19	61.62	63.73	68.12
Estimated PVB	**215.09**	**172.76**	**252.14**	**288.48**	**277.53**	**265.40**
PVC	**132.99**	**129.65**	**161.61**	**174.82**	**183.06**	**193.97**
BCR (adjusted)	**1.62**	**1.33**	**1.56**	**1.65**	**1.52**	**1.37**

10.8.1.5 The economic results for the without A27 Worthing and Lancing scenario are presented in Table 10-12.

10.8.1.6 The results of environmental sensitivity tests excluding Worthing and Lancing are set out in the Environmental Sensitivity Testing Technical Note[9]..

[9] Highways England "A27 Arundel Bypass Environmental Sensitivity "Testing Technical Note," September 2019. Online [Available at: https://highwaysengland.citizenspace.com/he/a27-arundel-bypass-further-consultation/supporting_documents/A27%20Arundel%20Bypass%20Sensitivity%20Note.pdf]

Table 10-12: Economic impacts (£m) without A27 Worthing and Lancing

Total Benefit	Option 1V5	Option 1V9	Option 3V1	Option 4/5AV1	Option 4/5AV2	Option 5BV1
User Time	196.02	170.30	227.46	207.45	201.25	207.22
VOC fuel	2.03	6.22	0.38	7.68	7.41	7.02
VOC non-fuel	-19.03	-10.84	-22.36	-16.94	-15.61	-17.83
Indirect taxation	14.54	8.56	17.22	13.26	12.39	13.89
TUBA Total	193.57	174.24	222.70	211.44	205.44	210.30
Other Impacts	42.83	33.46	63.86	57.43	61.25	72.61
Estimated PVB	**236.40**	**207.70**	**286.56**	**268.87**	**266.69**	**282.91**
PVC	**132.99**	**129.65**	**161.61**	**174.82**	**183.06**	**193.97**
BCR (adjusted)	**1.78**	**1.60**	**1.77**	**1.54**	**1.46**	**1.46**
Value for Money	**Low**	**Low**	**Low**	**Low**	**Low**	**Low**

10.8.1.7 The economic results for the scenario excluding Lyminster bypass are presented in Table 10-13.

Table 10-13: Economic impacts (£m) without Lyminster Bypass

Total Benefit	Option 1V5	Option 1V9	Option 3V1	Option 4/5AV1	Option 4/5AV2	Option 5BV1
User Time	164.45	160.33	192.96	194.19	168.91	195.18
VOC fuel	-0.36	4.41	-2.11	5.44	4.54	4.89
VOC non-fuel	-19.74	-11.59	-23.17	-17.53	-17.16	-18.29

https://highwaysengland.citizenspace.com/he/a27-arundel-bypass-further-consultation/supporting_documents/A27%20Arundel%20Bypass%20Sensitivity%20Note.pdf. (Access February 2020).

Indirect taxation	16.21	9.93	18.67	14.50	14.25	14.97
TUBA Total	160.55	163.09	186.36	196.61	170.54	196.74
Other Impacts	35.53	31.32	53.44	53.40	50.84	67.93
Estimated PVB	**196.08**	**194.41**	**239.80**	**250.01**	**221.38**	**264.67**
PVC	**132.99**	**129.65**	**161.61**	**174.82**	**183.06**	**193.97**
BCR (adjusted)	**1.47**	**1.50**	**1.48**	**1.43**	**1.21**	**1.36**

10.8.2 The results of the sensitivity tests illustrate a reduction in TUBA benefits, and a total reduction in PVB of 20 – 40%.

A27 Arundel Bypass Scheme Assessment Report

Chapter 11 – Summary of Social Distributional Impact Appraisal

October 2020

Table of Contents

LIST OF TABLES

11 Summary of Social and Distributional Impact Appraisal

11.1 Introduction

11.1.1.1 The purpose of the Social Impact Assessment (SIA) and Distributional Impact Assessment (DIA) is to identify, predict and help to manage the intended and unintended social and distributional consequences, both positive and negative, of the planned A27 Arundel Bypass scheme. This chapter summaries the key outcomes of the SIA and DIA assessments undertaken for the A27 Arundel Bypass scheme[1].

11.1.1.2 The assessment of social and distributional impacts of the A27 Arundel Bypass scheme is based on two sources of guidance. The first is provided by the Department for Transport (DfT) in WebTAG Units A4-1 (Social Impact Appraisal[2]) and A4-2 (Distributional Impact Appraisal[3]). The second source is Highways England guidance[4] on the scope of distributional impacts for schemes on the Strategic Road Network (SRN). Where methods vary within these guidance documents, the Highways England approach has been followed.

11.1.1.3 The impacts of a scheme may differ across social groups, hence a transport scheme will also have distributional effects. Some users may experience a benefit whilst others will experience a disbenefit. The distributional impacts assessment considers variations in transport intervention impacts across different social groups.

11.1.1.4 In assessing the impacts, a number of social indicators and groupings were used, these included children, young adults, older people, those with a disability and households without access to a car. Income distribution based on the English Indices of Multiple Income Deprivation (IMD) was used, where income profile is mapped to one of five income quintiles.

[1] HE551523-WSP-GEN-SWI-RP-TR-00022, A27 Arundel Bypass PCF Stage 2 Further Consultation – Social and Distributional Impact Assessment, August 2019

[2] TAG Unit A4.1 – Social Impact Appraisal, Department for Transport (December 2017)

[3] TAG Unit A4.2 – Distributional Impact Appraisal, Department for Transport (December 2015)

[4] Distributional Impact Appraisal and the Appraisal Summary Table (V6d), Highways England

11.2 User benefits

11.2.1.1 For all options, time savings from a decrease in congestion will benefit commuters and other users; a significant proportion of users will also have a reduction in journey time by travelling distances at higher average speeds (using the scheme links). Journey time reductions are greatest during the PM peak period, but there are also significant benefits in the inter-peak and AM peak periods.

11.2.1.2 It is also likely that there will be journey time reductions during non-modelled periods, at the weekend and during the off-peak period, and benefits to 'other' users are likely to be significant given the higher proportion of these user related trips during these periods.

11.2.1.3 The distributional impact assessment of each option identified that for each of the income distribution quintiles, a moderate beneficial impact was seen, with no particular quintile being disproportionately impacted.

11.3 Physical activity

11.3.1.1 The Arundel section of the A27 deters vulnerable road users such as cyclists and pedestrians from using the route, resulting in increased levels of car usage.

11.3.1.2 Benefits from increased physical activity due to walking and cycling primarily concern schemes that aim to improve or promote cycling and walking. The A27 Arundel Bypass scheme is a highway improvement scheme within an area of limited walking and cycling activity. This scheme is not expected to have a significant impact on physical activity. Therefore, the impacts of the A27 Arundel Bypass options on walking and cycling have not been explicitly modelled and the appraisal of the social impact of the scheme in terms of physical activity has not been undertaken. However, it is considered that the scheme would present opportunities to enhance walking and cycling facilities, especially along the de-trunked sections of the existing A27, but are not explicitly captured within the scheme proposals.

11.4 Severance

11.4.1.1 As the A27 runs through and close to settlements in Arundel, it presents a physical barrier to movement. The geography of Arundel is such that the residential developments located to the south of the historic town centre are largely ‘severed’ from the centre by the current A27 alignment. Given the volume of traffic on the A27 near Arundel (and the physically large roundabouts on this section of the road), pedestrian crossing opportunities are limited.

11.4.1.2 In order to assess severance fully, non-motorised user count data for the likely areas of impact is required. This data is not currently available, and the modelling undertaken to date has been using a highway-only model and as such public transport or pedestrian modes of travel have not been assessed[5].

11.4.1.3 The qualitative assessment undertaken to appraise severance has concluded that the part-online schemes (option 1V5 and option 1V9) would increase severance through Arundel due to the increased traffic volumes along sections of the route including at Ford Road roundabout. Increased physical highway infrastructure would contribute to an increased level of severance overall. This would be mitigated in part by the grade separation provided in option 1V5 and the signalised crossing facilities provided in option 1V9. Overall, these options are considered to result in a slight adverse effect on severance.

11.4.1.4 For the fully offline bypass routes, it is considered that there would be a slight beneficial impact in terms of severance. The offline routes take traffic away from the centre of Arundel and through relatively sparsely populated areas. The result is reduced traffic flows through Arundel, with existing NMU provision retained. Lower traffic flows through Arundel would contribute to an overall slight beneficial impact.

11.4.1.5 Given the characteristics of the different bypass options, it is likely that some degree of severance would remain an issue for all options. This is because all options retain a route bisecting the centre of Arundel, with the volume of traffic varying by option.

11.5 Accidents

11.5.1.1 COBALT assessment has shown that Options 1V5, 1V9, 3V1, 4/5AV1, 4/5AV2 and 5BV1 would bring about significant accident benefits, with the scale of benefits for Options 4/5AV2 and 5BV1 relatively higher than the other options. All scheme options have been shown to divert existing trips away from local, congested roads resulting in increased safety. A reduction in accidents (see section 9.3) would therefore have a positive impact on Arundel.

[5] The appraisal makes best use of the available information, and is undertaken on an equivalent basis across options. We work with limitations in data across all analysis, and we prioritise data collection to the transport aspects that are likely to be most significantly affected. This is a typical position with major scheme appraisal. It is envisaged that further data would be collected for PCF Stage 3

11.6 Security

11.6.1.1 The proposed A27 Arundel Bypass options do not include measures that will have any impact on security. Hence the analysis of security has not been undertaken.

11.7 Access to services

11.7.1.1 The proposed A27 Arundel Bypass options do not include measures that will substantially change the availability or accessibility of public services in the study area. The options are also not expected to result in any major changes in travel patterns or journey times for pedestrians and cyclists. Hence the analysis of accessibility has not been undertaken.

11.8 Affordability

11.8.1.1 A distributional impact assessment was undertaken for the A27 Arundel Bypass which considers the impact of each option on personal affordability, where affordability is the out-of-pocket non-business user costs of a journey. In this instance this is simply the vehicle operating cost for that journey.

11.8.1.2 For all six options, the results demonstrate 'moderate adverse' benefits to all economic groups. The affordability disbenefits seen are as anticipated as the proposed options result in an increased distance travelled, resulting in increased vehicle operating costs.

11.8.1.3 The proportion of disbenefit seen in each economic quintile is in line with the population proportion of the quintile group of the overall population, meaning no group is disbenefited more than any other group

11.9 Journey quality

11.9.1.1 Journey quality is a measure of the real and perceived environment experienced when travelling, and may affect travel decisions. All options have similar benefits with regards to journey quality and the impacts are moderately beneficial.

11.9.1.2 Different factors can influence the quality of the journey. They can be grouped into:

- Traveller Stress – frustration, fear of potential accidents, route uncertainty
- Traveller Views – views and pleasantness of the surroundings during the journey
- Traveller Care – general transport environment – cleanliness, facilities, information and environment

11.9.1.3 Traveller care is primarily focussed on public transport and transport service provision, as the proposed options are a part on-line improvement or the construction of a bypass route, assessment against traveller care is deemed to be not applicable.

11.9.1.4 In terms of travellers' views, the part-online improvement options are deemed to have a neutral impact; there is likely to be minimal change to the wider views of the surrounding area. For the offline improvement options, a positive benefit is anticipated as the proposed route generally passes through open countryside, avoiding the urban area of Arundel.

11.9.1.5 In terms of traveller stress, the fully offline A27 Arundel Bypass options would offer a higher standard of route and would provide reduced levels of congestion and improved journey times[6] relative to the part-online options, and therefore greater potential for reduced driver stress. The offline routes separate local and strategic traffic, with strategic traffic benefitting from improved carriageway standards which are typically associated with lower accident rates.

11.10 Option and non-use values

11.10.1.1 The scheme will not change the availability of transport services within the study area, hence option values and non-use values are not applicable for this assessment and have therefore not been assessed.

[6] A27 Arundel Bypass, Combined Modelling and Appraisal Report, Highways England (August 2019), section 12.5

11.11 Summary of Social and Distributional Impacts

11.11.1.1 A summary of the social and distributional impact findings is provided in Table 11-1.

Table 11-1 – Summary of Social and Distributional Impacts

Assessment Topic	Option 1V5	Option 1V9	Option 3V1	Option 4/5AV1	Option 4/5AV2	Option 5BV1
User Benefit	Moderate Beneficial	Moderate Beneficial	Moderate Beneficial	Moderate Beneficial	Moderate Beneficial	Moderate Beneficial
Physical Activity	N/A	N/A	N/A	N/A	N/A	N/A
Severance	Slight Adverse	Slight Adverse	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial
Accidents	Slight Beneficial	Slight Beneficial	Slight Beneficial	Moderate Beneficial	Moderate Beneficial	Moderate Beneficial
Security	N/A	N/A	N/A	N/A	N/A	N/A
Access to Services	N/A	N/A	N/A	N/A	N/A	N/A
Affordability	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse
Journey Quality	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial
Option / Non-use Values	N/A	N/A	N/A	N/A	N/A	N/A

A27 Arundel Bypass Scheme Assessment Report

Chapter 12 - Summary of the Environmental Assessment

October 2020

CONTENTS

12 Summary of Environmental Assessments

12.1 Introduction

12.1.1.1 This section summarises the environmental assessments that have been undertaken for the Scheme options.

12.1.1.2 More information on all the environmental specialist topic assessments can be found in the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

12.1.1.3 The summaries presented below take into account design, mitigation and enhancement measures, as described in the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

12.1.1.4 Where applicable, the significance of effect is described (for example, neutral, slight, moderate, large, very large) (in accordance with EAR Chapter 4 – Environmental Assessment Methodology) together with the assessment of whether an effect is *significant*, or *not significant* (in accordance with Chapter 4 – Environmental Assessment Methodology and the EAR Topic Specific Chapters – Chapters 5 to 16).

12.1.1.5 A summary of the baseline conditions is given in Chapter 4.

12.2 Air Quality

12.2.1.1 The assessment of air quality impacts was undertaken following guidance in the DMRB (HA207/07, IAN 170/12V3, IAN 174/13, IAN 175/13 and IAN 185/15) and NN NPS. For further detail on the assessment of air quality impacts see Chapter 5 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

12.2.1.2 The following potential impacts were considered in the assessment:

- Construction
  - Potential impacts due to fugitive dust emissions from construction works.
- Operation
  - Potential impacts on ambient NO_2 concentrations at human receptors
  - Potential impacts on ambient NO_x concentrations and nitrogen deposition levels at designated ecological sites.

12.2.1.3 There is no guidance on determining the significance of effects on either biodiversity, or from impacts on regional emissions of NO_x, PM_{10} or CO_2. There is limited guidance on determining the overall significant effect on human receptors, and the determination process is largely down to professional judgement involving consideration of the scale and likely duration of the impact(s) and the numbers of sensitive receptors affected[1].

12.2.2 All options

12.2.2.1 The construction phase is expected to last between three and four years (depending on option) and could affect local air quality through the generation and subsequent deposition of construction dust arising from construction activities and vehicle movements.

12.2.2.2 The overall outcome from the air quality assessment indicated a potential temporary adverse effect was likely on receptors across all options during construction. With mitigation in place, the overall effect is not expected to be significant.

12.2.2.3 During the operational phase, none of the options give rise to any new or worsened exceedances of air quality thresholds at any modelled receptor. Beneficial effects are expected on the Storrington AQMA from all Scheme options.

12.2.2.4 All Scheme options were likely to have a 'Low Risk' of non-compliance with the European Union Ambient Air Quality Directive 2008/50/EC. No significant adverse effects are expected on ecological designated sites.

12.2.2.5 Overall, with reference to IAN 174/13, no significant effects are likely for human or ecological receptors with any of the options.

12.3 Cultural Heritage

12.3.1.1 The cultural heritage assessment used the assessment methodology set out in the DMRB (Volume 11, Section 3, Part 2[2)].

12.3.1.2 The following potential impacts considered in the assessment comprise:

- Construction and operation
  - Potential impacts on setting of designated assets
  - Potential impacts on below ground archaeology.

[1] Highways Agency Interim Advice Note 174/13 Annex B.

[2] Highways Agency, *Cultural Heritage, Design Manual for Roads and Bridges*, (2007) - Volume 11, Section 3, Part 2 (HA 208/07)

12.3.1.3 When determining significance of an effect, all levels from Moderate to Very Large (beneficial or adverse) are considered to be a significant effect.

12.3.2 All options

12.3.2.1 During the operational phase, Neutral effects (not significant) are likely on below ground archaeology for all heritage assets for all Scheme options.

12.3.3 Option 1V5 and 1V9

12.3.3.1 During the construction phase Option 1V5 and 1V9 are considered to have Moderate Adverse effects (significant) on the setting of numerous heritage assets within the town of Arundel. There is a slight adverse effect (not significant) for 1 Grade II* and 10 Grade II listed buildings outside Arundel. The effect on Lyminster Conservation Area is considered to be neutral. Slight Adverse (not significant) effects are likely on the below ground archaeology of all heritage assets and on historic landscapes (Refer to **EAR Chapter 6 – Cultural Heritage** for details).

12.3.3.2 The residual environmental effects on the setting of heritage assets during the operational phase of Option 1V5 and 1V9 would be as the Construction phase but would be permanent. (Refer to **EAR Chapter 6 – Cultural Heritage** for details).

12.3.4 Option 3V1

12.3.4.1 During construction Large Adverse effects (significant) on the setting of Tortington Augustinian Priory and the adjacent Grade II* listed Tortington Priory Barn due to the close proximity of the footprint of the Scheme option to the assets. Moderate adverse effect (significant) on numerous assets within Arundel. Slight adverse effects (not significant) on the setting of 1 Grade II* and 9 Grade II listed buildings (Refer to **EAR Chapter 6 – Cultural Heritage** for details).

12.3.4.2 Neutral effects (not significant) on the Lyminster Conservation Area and Slight Adverse effects (not significant) on below ground heritage assets and historic landscapes.

12.3.4.3 During the operational phase, the significance of effect on the settings of heritage assets will remain the same as during the construction phase (Refer to **EAR Chapter 6 – Cultural Heritage** for details).

12.3.5 Option 4/5AV1

12.3.5.1 During construction, Moderate Adverse effects (significant) are expected on the setting the Scheduled Monument of Tortington Augustinian Priory and Grade II* Tortington Priory Barn, numerous assets contained within Arundel and 8 Grade II listed buildings outside Arundel. Slight Adverse effects (not significant) are likely on the setting of 1 Grade II* and 13 Grade II listed buildings outside Arundel (Refer to **EAR Chapter 6 – Cultural Heritage** for details).

12.3.5.2 Slight Adverse effects (not significant) are likely on below ground archaeology for all heritage assets and historic landscapes.

12.3.5.3 If, during PCF Stage 3, Option 4/5AV1 is found to directly impact on any curtilage features (the land surrounding a building) of six Grade II listed buildings in Yapton and Binsted, then Moderate Adverse effects (significant) are likely on below ground archaeology for those potentially affected heritage assets.

12.3.5.4 During the operational phase, the significance of effects for all assets in terms of setting will be the same as the construction phase, although they would be permanent (Refer to **EAR Chapter 6 – Cultural Heritage** for details).

12.3.6 Option 4/5AV2

12.3.6.1 Moderate Adverse effects (significant) are likely on the setting for Tortington Augustinian Priory Scheduled Monument and the Grade II* Tortington Priory Barn. Moderate Adverse effect (significant) on numerous assets within Arundel and on 1 Grade II listed building outside Arundel. Slight Adverse effect (not significant) on 1 Grade II* and on 19 Grade II listed buildings outside Arundel (Refer to **EAR Chapter 6 – Cultural Heritage** for details).

12.3.6.2 Slight Adverse effects (not significant) on below ground archaeology and historic landscapes.

12.3.6.3 During the operational phase, the significance of effects for all assets in terms of setting will be the same as the construction phase, although they would be permanent (Refer to **EAR Chapter 6 – Cultural Heritage** for details).

12.3.7 Option 5BV1

12.3.7.1 Moderate Adverse effects (significant) are likely during the construction phase on the setting for Tortington Augustinian Priory and the Grade II* Tortington Priory Barn. Moderate Adverse effects (significant) on numerous assets within Arundel. Moderate Adverse effects (significant) on 7 Grade II listed buildings outside Arundel. Slight Adverse effects (not significant) on 1 Grade II* and 15 Grade II listed buildings outside Arundel. Slight Adverse effects (not significant) are likely on the two Walberton conservation areas. Slight Adverse effects on below ground heritage assets and historic landscapes. (Refer to **EAR Chapter 6 – Cultural Heritage** for details).

12.3.7.2 During the operational phase, the significance of effects for all assets in terms of setting will be the same as the construction phase, although they would be permanent (Refer to **EAR Chapter 6 – Cultural Heritage** for details).

12.4 Landscape and Visual

12.4.1.1 An assessment of likely landscape and visual impacts associated with the Scheme has been undertaken using DMRB guidance (IAN 135/10[3]) and the Guidelines for Landscape and Visual Impact Assessment (GLVIA)[4].

12.4.1.2 The following potential impacts are considered in the assessment:

- Construction and operation (at Year 1 of operation and Year 15 of operation to take account of growth of mitigation planting)
  - Change in landscape character and perception of the landscape within LCAs 1 to 10
  - Change in visual amenity.
- Potential effects on the SDNP
- Potential effects on the International Dark Sky Reserve.

12.4.1.3 When determining the significance of an effect, all levels from Moderate to Very Large (beneficial or adverse) are considered to be a significant effect.

12.4.1.4 Where there are decreases in the number of significant effects on visual amenity during the operational phase (by Year 15) compared to the construction phase, this is due to the proposed replacement woodland and field boundary planting and other screening planting maturing. The larger,

[3] Highways Agency, *Interim Advice Note 135/10 Landscape and Visual Effects Assessment* (2010)

[4] Landscape Institute and Institute of Environmental Management & Assessment, Guidelines for Landscape and Visual Impact Assessment, 3rd Edition, Routledge

more mature vegetation would offer an enhanced capability to screen road traffic from observers.

12.4.1.5 One receptor (Viewpoint 42) may experience a slight beneficial effect (applicable to results of all the options) due to the likely reduction in traffic using the existing A27 route corridor (which is clearly visible in the view) – none of the Scheme options are visible in the view. The viewpoint location is shown in Chapter 7 Figure 7-10 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) and included in Appendix A of this report.

12.4.1.6 The character areas described below for each Scheme option are shown in Chapter 7, Figure 7-2 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) and included in Appendix A of this report.

12.4.1.7 The representative viewpoint receptor locations described below for each Scheme option are shown in Chapter 7 Figure 7-9 and 7-10 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

12.4.2 Option 1V5

12.4.2.1 Construction activity would materially change the existing A27 corridor through the town of Arundel and the landscape of the floodplain to the east.

12.4.2.2 During construction, the following effects on landscape character are likely:

- Large Adverse effect (significant) on LCA 4: This would be the result of building a new road across the floodplain.
- Very Large Adverse effect (significant) on LCA 5: This is due to the localised disruption caused by removal of vegetation and scale of construction activity at Ford Road roundabout and on Chichester Road.

12.4.2.3 Landscape character effects on other LCAs would not be significant during either construction or operation Year 1 or Year 15.

12.4.2.4 All effects on LCA 4 and 5 would remain significant post construction. The adverse effects on LCA 4 and LCA 5 would decrease to Moderate and Large Adverse respectively by Year 1 and Year 15.

12.4.2.5 Effects on potential changes in visual amenity during construction would primarily relate to visual receptors within and around Arundel and Crossbush. Of the 58 representative viewpoints, 12 would experience an impact of Slight Adverse (not significant), 5 of Moderate Adverse (significant) and 4 of Large Adverse (significant).

12.4.2.6 By Year 1 of the operational phase these effects would diminish, with 3 experiencing an impact of Neutral (not significant), 10 of Slight Adverse (not significant), 1 of Slight Beneficial (not significant), 4 of Moderate Adverse (significant) and 3 of Large Adverse (significant).

12.4.2.7 By Year 15 of the operational phase these effects would further diminish, with 4 experiencing an impact of Neutral (not significant), 10 of Slight Adverse (not significant), 1 of Slight Beneficial (not significant) and 5 of Moderate Adverse (significant).

12.4.2.8 Effects on all other viewpoints had either no change or a Neutral change to the view (not significant) during construction and operation (Year 1 and Year 15).

12.4.3 Option 1V9

12.4.3.1 Effects on landscape character areas during construction and operational phases (Year 1 and Year 15) are the same as those identified for Option 1V5.

12.4.3.2 Effects on potential changes in visual amenity during construction would primarily relate to visual receptors within and around Arundel and Crossbush. Of the 58 representative viewpoints, 11 would experience an impact of Slight Adverse (not significant), 5 of Moderate Adverse (significant) and 4 of Large Adverse (significant).

12.4.3.3 By Year 1 of the operational phase these effects would diminish, with 2 experiencing an impact of Neutral (not significant), 11 of Slight Adverse (not significant), 1 of Slight Beneficial (not significant), 3 of Moderate Adverse (significant) and 3 of Large Adverse (significant).

12.4.3.4 By Year 15 of the operational phase these effects would further diminish, with 3 experiencing an impact of Neutral (not significant), 11 of Slight Adverse (not significant), 1 of Slight Beneficial (not significant) and 5 of Moderate Adverse (significant).

12.4.3.5 Effects on all other viewpoints had either no change or a Neutral change to the view (not significant) during construction and operation (Year 1 and Year 15).

12.4.4 Option 3V1

12.4.4.1 During construction, the following effects on landscape character are likely:

- Large Adverse effect (significant) on LCA 2: This is due to the potential removal of existing mature ancient woodland, and major earthworks and road construction at Tortington Common.
- Very Large Adverse effect (significant) on LCA 4: This is due to the building of a new elevated road across the open landscape, within what is currently a largely static landscape.
- Large Adverse effect (significant) on LCA 5: This would be due to the adverse change to the important interrelationship between the town and it's setting.

12.4.4.2 Effects on other LCAs would not be significant during either construction or operation Year 1 or Year 15.

12.4.4.3 All effects on LCA 2, LCA 4 and LCA 5 would remain significant post construction. The adverse effects on LCA 4 would decrease to Large Adverse, with the effects on LCA 2 and 5 decreasing to Moderate Adverse in Year 1 and 15.

12.4.4.4 Effects on potential changes in visual amenity during construction would primarily relate to visual receptors within and around Binsted, Tortington and Crossbush. Of the 58 representative viewpoints, 7 would experience an impact of Slight Adverse (not significant), 5 of Moderate Adverse (significant) and 18 of Large Adverse (significant).

12.4.4.5 By Year 1 of the operational phase these effects would diminish, with 7 experiencing an impact of Slight Adverse (not significant), 1 of Slight Beneficial (not significant), 10 of Moderate Adverse (significant) and 12 of Large Adverse (significant).

12.4.4.6 By Year 15 of the operational phase these effects would further diminish, with 1 experiencing an impact of Neutral (not significant), 6 of Slight Adverse (not significant), 1 of Slight Beneficial (not significant), 14 of Moderate Adverse (significant) and 8 of Large Adverse (significant).

12.4.4.7 Effects on all other viewpoints had either no change or a neutral change to the view (not significant) during construction and operation (Year 1 and Year 15).

12.4.5 Option 4/5AV1

12.4.5.1 During construction, the following effects on landscape character are likely:

- Large Adverse effect (significant) on LCA 2: Construction activity may disrupt the tranquillity of the settled landscapes around Binsted and the character of the dispersed village itself, with the loss of field pattern, woods, trees and the fragmentation of the village.
- Very Large Adverse effect (significant) on LCA 4: This would be due to the potential fragmentation and degradation of the landscape character.
- Large Adverse effect (significant) on LCA 5: This would be due to the fragmentation and degradation of the landscape character.

12.4.5.2 Effects on other LCAs would not be significant during either construction or operation (Year 1 or Year 15).

12.4.5.3 All effects on LCA 2, LCA 4 and LCA 5 would remain significant post construction. The adverse effects on LCA 2 would remain as Large Adverse in Year 1 and 15. Adverse effects on LCA 4 and LCA 5 would decrease to

Large and Moderate Adverse effects, respectively in Year 1 and 15.

12.4.5.4 Effects on potential changes in visual amenity during construction would primarily relate to visual receptors within and around Walberton, Binsted, Tortington and Crossbush. Of the 58 representative viewpoints, 10 would experience an impact of Slight Adverse (not significant), 6 of Moderate Adverse (significant), 23 of Large Adverse (significant) and 5 of Very Large Adverse (significant).

12.4.5.5 By Year 1 of the operational phase these effects would diminish, with 11 experiencing an impact of Slight Adverse (not significant), 1 of Slight Beneficial (not significant), 10 of Moderate Adverse (significant), 21 of Large Adverse (significant) and 1 of Very Large Adverse (significant).

12.4.5.6 By Year 15 of the operational phase these effects would further diminish, with 3 experiencing an impact of Neutral (not significant), 9 of Slight Adverse (not significant), 1 of Slight Beneficial (not significant), 15 of Moderate Adverse (significant) and 17 of Large Adverse (significant).

12.4.5.7 Effects on all other viewpoints had either no change or a Neutral change to the view (not significant) during construction and operation (Year 1 and Year 15).

12.4.6 Option 4/5AV2

12.4.6.1 During construction, the following effects on landscape character are likely:

- Large Adverse effect (significant) on LCA 2: Construction activity may disrupt the tranquillity of the settled landscapes around Binsted and the character of the dispersed village itself, with the loss of field pattern, woods, trees and the fragmentation of the village.
- Very Large Adverse effect (significant) on LCA 4: This would be due to the potential fragmentation and degradation of the landscape character.
- Large Adverse effect (significant) on LCA 5: This would be due to the fragmentation and degradation of the landscape character.

12.4.6.2 Effects on other LCAs would not be significant during either construction or operation (Year 1 or Year 15).

12.4.6.3 All effects on LCA 2, LCA 4 and LCA 5 would remain significant post construction. The adverse effects on LCA 2 would remain as Large Adverse in Year 1 and 15. Adverse effects on LCA 4 and LCA 5 would decrease to Large and Moderate Adverse effects, respectively in Year 1 and 15.

12.4.6.4 Effects on potential changes in visual amenity during construction would primarily relate to visual receptors within and around Binsted, Tortington and Crossbush. Of the 58 representative viewpoints, 11 would experience an

impact of Slight Adverse (not significant), 6 of Moderate Adverse (significant), 20 of Large Adverse (significant) and 5 of Very Large Adverse (significant).

12.4.6.5 By Year 1 of the operational phase these effects would diminish, with 3 experiencing an impact of Neutral (not significant), 10 of slight adverse (not significant), 1 of Slight Beneficial (not significant), 8 of Moderate Adverse (significant), 18 of Large Adverse (significant) and 3 of Very Large Adverse (significant).

12.4.6.6 By Year 15 of the operational phase these effects would further diminish, with 4 experiencing an impact of Neutral (not significant), 8 of Slight Adverse (not significant), 1 of Slight Beneficial (not significant), 15 of Moderate Adverse (significant) and 14 of Large Adverse (significant).

12.4.6.7 Effects on all other viewpoints had either no change or a Neutral change to the view (not significant) during construction and operation (Year 1 and Year 15).

12.4.7 Option 5BV1

12.4.7.1 Option 5BV1 would be the longest of the Scheme options.

12.4.7.2 During construction, the following effects on landscape character are likely:

- Large Adverse effect (significant) on LCA 2: Construction activity may disrupt the tranquillity of the settled landscapes around Binsted and the character of the dispersed village itself, with the loss of field pattern, woods, trees and the fragmentation of the village
- Very Large Adverse effect (significant) on LCA 4: This would be due to the potential fragmentation and degradation of the landscape character.
- Large Adverse effect (significant) on LCA 5: This would be due to the fragmentation and degradation of the landscape character.

12.4.7.3 Effects on other LCAs would not be significant during either construction or operation (Year 1 or Year 15).

12.4.7.4 All effects on LCA 2, LCA 4 and LCA 5 would remain significant post construction. The adverse effects on LCA 2 would reduce to a moderate adverse effect by Year 15. Adverse effects on LCA 4 and LCA 5 would decrease to large and moderate adverse effects, respectively in Year 1 and 15.

12.4.7.5 Effects on potential changes in visual amenity during construction would primarily relate to visual receptors within and around Walberton, Binsted, Tortington and Crossbush. Of the 58 representative viewpoints, 9 would experience an impact of Slight Adverse (not significant), 6 of Moderate Adverse (significant), 24 of Large Adverse (significant) and 3 of Very Large

Adverse (significant).

12.4.7.6 By Year 1 of the operational phase these effects would diminish, with 1 experiencing an impact of Neutral (not significant), 9 of Slight Adverse (not significant), 1 of Slight Beneficial (not significant), 10 of Moderate Adverse (significant), 20 of Large Adverse (significant) and 1 of Very Large Adverse (significant).

12.4.7.7 By Year 15 of the operational phase these effects would further diminish, with 2 experiencing an impact of Neutral (not significant), 8 of Slight Adverse (not significant), 1 of Slight Beneficial (not significant), 19 of Moderate Adverse (significant), 11 of Large Adverse (significant) and 1 of Very Large Adverse (significant).

12.4.7.8 Effects on all other viewpoints had either no change or a Neutral change to the view (not significant) during construction and operation (Year 1 and Year 15).

12.4.8 Effects on the South Downs National Park

12.4.8.1 All options would have a significant adverse effect on views towards, and from, the SDNP.

12.4.8.2 Option 1V5 and Option 1V9 would not create a new component within the SDNP itself. However, these options would increase the existing influence the A27 has on the experiential qualities of the SDNP west of Arundel where it shares the existing alignment.

12.4.8.3 Options 3V1 and 4/5AV2 would introduce new and extensive detractions both to the setting of the SDNP and within the SDNP itself. Option 4/5AV1 would introduce new and extensive detractions primarily to the setting of the SDNP, but would intrude directly into the SDNP itself at Binsted (Hedger's Hill and Binsted Park). Option 5BV1 would introduce new and extensive detractions to the setting of the SDNP only.

12.4.8.4 Direct impacts on the experiential qualities of the SDNP are likely to be significant for Options 3V1, 4/5AV1 and 4/5AV2, but not significant for Options 1V5, 1V9 or 5BV1.

12.4.9 Potential Dark Sky Impacts

12.4.9.1 None of the Options are anticipated to substantially increase light levels or impact on the integrity of the designated Dark Sky reserve or its two-kilometre buffer zone. However, Options 3V1, 4/5AV1 and 4/5AV2 would create a major new component within the SDNP, introducing traffic headlights into areas currently experiencing low lighting levels and very few/no vehicle headlights.

12.5 Biodiversity

12.5.1.1 The biodiversity assessment is based on the DMRB (Volume 10 and 11 and IAN 130/10) and CIEEM guidance.

12.5.1.2 The following potential impacts were considered in the assessment:

- Construction
  - Habitat loss, habitat severance and loss of supporting habitat
  - Disturbance from construction related noise, vibration, lighting and human presence
  - Indirect impacts caused by changes to hydrological and air quality conditions
  - Indirect 'edge' effects leading to exposure to altered humidity, wind and additional sunlight
  - Mortality and injury of notable and protected animals.
- Operational phase
  - Disturbance from operational noise, vibration, lighting and human presence
  - Indirect impacts caused by changes to hydrological, air quality and exposure to altered humidity, wind and sunlight
  - Mortality and injury of notable and protected animals.

12.5.1.3 During the operational phase, slight beneficial effects are likely at Fairmile Bottom SSSI and Arundel Park SSSI for all options. This is because all of the Scheme options would result in a decrease in nitrogen oxide concentrations on Fairmile Bottom SSSI and Arundel Park SSSI.

12.5.1.4 When determining the significance of an effect for Biodiversity, all levels from Slight to Very Large (beneficial or adverse) are considered to be a significant effect. Only Neutral effects are considered to be not significant.

12.5.1.5 Baseline information for ecological features and an impact assessment is provided in Chapter 8 of the PCF Stage 2 A27 Arundel Bypass (August 2019).

12.5.2 Option 1V5 and 1V9

12.5.2.1 During construction, Very Large Adverse effects (significant) are likely on ancient and veteran trees. Large Adverse effects (significant) are likely on Binsted Wood Complex LWS, Rewell Wood Complex LWS, ancient woodland and Deciduous woodland HPI. Moderate Adverse effects (significant) are likely on Wood pasture and parkland HPI and Coastal and floodplain grazing marsh HPI.

12.5.2.2 During construction, Moderate Adverse effects (significant) are likely on bats, barn owls, hazel dormouse, terrestrial invertebrates and protected or notable plants. Slight Adverse effects (significant) are likely on breeding birds (woodland).

12.5.2.3 During the operational phase, a Moderate Adverse effect (significant) on bats is likely and a Slight Adverse effect (significant) on barn owl is likely. Neutral effects (not significant) are likely on other identified ecological features.

12.5.3 Option 3V1

12.5.3.1 During construction, Very Large Adverse effects (significant) are likely on Binsted Wood Complex LWS, ancient woodland and Deciduous woodland HPI. Rewell Wood Complex LWS and Coastal and floodplain grazing marsh HPI are likely to experience Large Adverse effects (significant). Slight Adverse effects (significant) are likely on the Avisford Notable Road Verge.

12.5.3.2 During construction, bats and terrestrial invertebrates are likely to experience Very Large Adverse effects (significant) as a result of Option 3V1. Large Adverse effects (significant) are likely on breeding birds (woodland), hazel dormouse, and protected or notable plant species. Moderate Adverse effects (significant) are likely on water vole and barn owl. Slight Adverse effects (significant) are likely on other notable mammals.

12.5.3.3 During the operational phase, a Large Adverse effect (significant) on Binsted Woods Complex LWS, a Very Large Adverse effect (significant) on bats is likely. A Moderate Adverse effect (significant) on barn owl is likely. Neutral effects (not significant) are likely on other identified ecological features.

12.5.4 Option 4/5AV1

12.5.4.1 During construction, a Very Large Adverse effect (significant) is likely on ancient and veteran trees. Large Adverse effects (significant) are likely on Binsted Wood Complex LWS and Coastal and floodplain grazing marsh HPI. Ancient woodland and Traditional orchard HPI are likely to experience Moderate Adverse effects (significant). Slight Adverse effects (significant) are likely on the Avisford Notable Road Verge and Deciduous woodland HPI.

12.5.4.2 During construction, bats and protected or notable plant species are likely to experience Large Adverse effects (significant). Moderate Adverse effects (significant) are likely on aquatic ecology, barn owl, hazel dormouse and water vole. Slight Adverse effects (significant) are likely on breeding birds (woodland) and terrestrial invertebrates.

12.5.4.3 During the operational phase, a Large Adverse effect (significant) on bats is likely. A Moderate Adverse effect (significant) on barn owls is likely. A Slight Adverse effect (significant) on Binsted Wood Complex LWS is likely. Neutral effects (not significant) are likely on other identified ecological features.

12.5.5 Option 4/5AV2

12.5.5.1 During construction, Very Large Adverse effects (significant) are likely on Binsted Wood Complex LWS, ancient woodland, Wood pasture and parkland HPI, ancient and veteran trees and Deciduous woodland HPI. Coastal and floodplain grazing marsh HPI and the Avisford Notable Road Verge are likely to experience Large and Slight Adverse effects (both significant), respectively.

12.5.5.2 During construction, bats and terrestrial invertebrates are likely to experience Very Large Adverse effects (significant) as a result of Option 4/5AV2. Large Adverse effects (significant) are likely on hazel dormouse and protected or notable plant species. Breeding birds (woodland), barn owl, aquatic ecology and water vole are likely to experience Moderate Adverse effects (significant).

12.5.5.3 During the operational phase, a Very Large Adverse effect (significant) on bats is likely. A Large Adverse effect (significant) on Binsted Woods Complex LWS and a Moderate Adverse effect (significant) on barn owls is likely. Neutral effects (not significant) are likely on other identified ecological features.

12.5.6 Option 5BV1

12.5.6.1 During construction, Very Large Adverse effects (significant) are likely on ancient and veteran trees. Large Adverse effects (significant) are likely on Coastal and floodplain grazing marsh HPI. Deciduous Woodland HPI is likely to experience a Slight Adverse effect (significant).

12.5.6.2 During construction, Large Adverse effects (significant) are likely on protected or notable plant species. Aquatic ecology, bats, barn owl, hazel dormouse and water vole are likely to experience Moderate Adverse effects (significant) as a result of this option. Terrestrial invertebrates are likely to experience Slight Adverse effects (significant).

12.5.6.3 During the operational phase, a Moderate Adverse effect (significant) on bats and barn owl are likely. Neutral effects (not significant) are likely on other identified ecological features.

12.6 Geology and Soils

12.6.1.1 An assessment has been conducted based on guidance provided in the DMRB (Volume 11, Section 3, part 11) and the Model Procedures for the management of land contamination (CLR11)[5]. Significant effects have been determined where a moderate, large or very large effect has been identified.

12.6.1.2 The following potential impacts have been considered in the assessment:

- Construction
  - Changes in ground level resulting in geological or geomorphological change
  - Changes from direct land take on best and most versatile agricultural land and removal of trees for soils in woodland areas
  - Impacts on soil resources affecting social, economic or environmental services.
  - Exposure of contaminated land to construction workers
  - Exposure of contaminated airborne dust to adjacent site users.
- Operational phase
  - Exposure of contaminated land to end-users and maintenance workers.

12.6.1.3 The assessment of potential effects considers the construction phase and the first year of operation only.

12.6.1.4 When determining the significance of an effect, all levels from Moderate to Very Large (beneficial or adverse) are considered to be a significant effect.

12.6.2 Options 1V5, 1V9 and 3V1

12.6.2.1 During construction, Moderate (significant) to Large Adverse effects (significant) are likely on soil resources affecting social, economic or environmental services. Slight Adverse effects (not significant) are likely across these proposed options on potential changes in ground level, direct land take and construction workers. Neutral effects (not significant) are likely on adjacent site users for all three proposed options.

12.6.2.2 Effects during the operational phase are the same for all three proposed options. Neutral effects (not significant) are likely on end users and maintenance workers from the potential effects associated with the exposure of contaminated land.

[5] DEFRA, *Model Procedures for the Management of Land Contamination, CLR11* (2004)

12.6.3 Options 4/5AV1, 4/5AV2 and 5BV1

12.6.3.1 During construction, Moderate Adverse effects (significant) are likely across these three Scheme options as a result of potential direct land take of best and most versatile agricultural land and the impact on soil resources (affecting social, economic or environmental services). Slight Adverse effects (not significant) are likely on potential changes in ground level and construction workers. Neutral effects (not significant) are likely on adjacent site users.

12.6.3.2 Effects during the operational phase are the same for all three proposed options. Neutral effects (not significant) are likely on end users and maintenance workers from the potential effects associated with the exposure of contaminated land.

12.7 Material Assets and Waste

12.7.1.1 The materials assessment has been prepared in accordance with DMRB guidance (IAN 153/11) and additional guidance from Highways England.

12.7.1.2 The following potential impacts were considered in the assessment:

- Construction phase
  - Consumption of natural and non-renewable resources
  - Generation and disposal of waste.

12.7.1.3 The operational phase has been scoped out of the assessment as the consumption of materials and any waste generated by the Scheme during its operational life is not likely to result in significant adverse environmental effects.

12.7.1.4 The assessment of potential effects as a result of the Scheme considers the construction phase and the first year of operation (up to 2027).

12.7.1.5 When determining the significance of an effect there are two slightly different thresholds. For materials (and resources), Large or Very Large effects are considered to be significant. For waste, Moderate to Very Large effects are considered to be a significant effect.

12.7.2 All options

12.7.2.1 During the construction phase, Slight Adverse or negligible (Neutral) effects are likely on the consumption of natural and non-renewable resource, or the generation and disposal of waste for all options. These effects are not considered to be significant.

12.8 Noise and Vibration

12.8.1.1 The noise and vibration assessment has been prepared in accordance with the DMRB (Volume 11, Section 3, Part 7, and IAN 185/15), British Standards and Planning Practice Guidance. All other legislation, policy and guidance applicable to the noise and vibration assessment can be found in Section 11.2 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

12.8.1.2 The following potential impacts were considered in the assessment:

- Construction phase
  - Nearby noise sensitive receptors likely to be affected by noise levels arising from construction activities.
- Operational phase
  - Noise impact due to changes in alignment of existing roads, changes to traffic flows, speeds, or the proportion of heavy vehicles.

12.8.1.3 When determining if an impact is significant, magnitudes classified as moderate and major are likely to be categorised as significant effects. Subsequently, other factors (e.g. the level of noise with reference to the Significant Observed Adverse Effect Level (SOAEL)) have been considered to determine whether the impacts are likely to be significant. Further details can be found in Chapter 11 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

12.8.2 Option 1V5

12.8.2.1 During construction, a total of approximately 427 properties within 100m of Option 1V5 have the potential to experience a significant noise impact arising from the construction activities.

12.8.2.2 The following is a summary of aspects which have potential significant adverse effects over the long-term during the operational phase.

- The number of properties within Noise Important Areas (NIAs) and subject to noise levels exceeding the SOAEL would be reduced by five with the implementation of Option 1V5.
- An estimated 380 properties would experience a noise level increase classified as moderate in the long-term.

12.8.2.3 During the operational phase, significant adverse effects are likely at existing properties east and south of Crossbush, north of Ford Road roundabout and properties on Fitzalan Road and Ford Road.

12.8.3 Option 1V9

12.8.3.1 During construction, a total of approximately 429 properties within 100m of Option 1V9 have the potential to experience a significant noise impact arising from the construction activities.

12.8.3.2 The following is a summary of aspects which have potential significant adverse effects over the long-term during the operational phase.

- The number of properties subject to noise levels exceeding the SOAEL within NIAs would be reduced by two in with the implementation of Option 1V9.
- An estimated 174 properties would experience a noise level increase classified as moderate in the long-term.

12.8.3.3 During the operational phase, significant adverse effects are likely at existing properties east and south of Crossbush, north of Ford Road roundabout and on Fitzalan Road and Ford Road. Significant adverse effects are likely on existing properties south of the A27, west of Ford Road roundabout.

12.8.4 Option 3V1

12.8.4.1 During construction, a total of approximately 24 properties within 100m of Option 3V1 have the potential to experience a significant noise impact arising from the construction activities.

12.8.4.2 The following is a summary of aspects which have potential significant adverse effects over the long-term during the operational phase.

- An estimated 326 properties would experience a noise level increase classified as moderate (317 properties) and major (9 properties) in the long-term.
- The number of properties subject to noise levels exceeding the SOAEL within NIAs would be reduced by nine with the implementation of Option 3V1.

12.8.4.3 During the operational phase, significant adverse effects are likely at existing properties east and south of Crossbush, on Fitzalan Road and on Ford Road. Significant adverse effects are also anticipated at properties in Tortington and to the south of the existing A27, west of Ford Road roundabout.

12.8.5 Option 4/5AV1

12.8.5.1 During construction, a total of approximately 70 properties within 100m of Option 4/5V1 have the potential to experience a significant noise impact arising from the construction activities.

12.8.5.2 The following is a summary of aspects which have potential significant adverse effects over the long-term during the operational phase.

- An estimated 232 properties would experience a noise level increase classified as moderate (141 properties) and major (91 properties) in the long-term.
- The number of properties subject to noise levels exceeding the SOAEL within NIAs would be reduced by seven with the implementation of Option 4/5AV1.

12.8.5.3 During the operational phase, significant adverse effects are likely at existing properties east and south of Crossbush, in Tortington and Binsted. Significant adverse effects are also likely at properties south of A27, west of Ford Road Roundabout and Fitzalan Road.

12.8.6 Option 4/5AV2

12.8.6.1 During construction, a total of approximately 76 properties within 100m of Option 4/5AV2 have the potential to experience a significant noise impact arising from the construction activities.

12.8.6.2 The following is a summary of aspects which have potential significant adverse effects over the long-term during the operational phase.

- An estimated 224 properties would experience a noise level increase classified as moderate (160 properties) or major (64 properties) in the long-term.
- The number of properties subject to noise levels exceeding the SOAEL within NIAs would be reduced by seven with the implementation of Option 4/5AV2.

12.8.6.3 During the operational phase, significant adverse effects are likely at existing properties east and south of Crossbush, on Fitzalan road, in Tortington, Binsted and Slindon. Significant adverse effects are also likely at properties south of A27, west of Ford Road Roundabout.

12.8.7 Option 5BV1

12.8.7.1 During construction, a total of approximately 98 properties within 100m of Option 5BV1 have the potential to experience a significant noise impact arising from the construction activities.

12.8.7.2 The following is a summary of aspects which have potential significant adverse effects over the long-term during the operational phase.

- An estimated 265 properties would experience a noise level increase classified as moderate (176 properties) and major (89 properties) in the long-term.
- The number of properties subject to noise levels exceeding the SOAEL within NIAs would be reduced by seven after the implementation of Option 5BV1.

12.8.7.3 During the operational phase, significant adverse effects are likely at existing properties east and south of Crossbush, on Fitzalan road, in Tortington and south of A27 (west of Ford Road Roundabout). Significant adverse effects are also likely at properties in Binsted and Walberton.

12.9 Population and Health

12.9.1.1 Population and health assessment has been undertaken using the DMRB (Volume 11, Section 3, Parts 6, 8 and 9 and IAN 125/15).

12.9.1.2 The following potential impacts were considered in the assessment:

- Construction

- Permanent requirement for demolitions or land from private assets.
- Temporary changes to journey amenity for Non-Motorised Users (NMU).
- Temporary requirement of development land.
- Temporary impacts on human receptors from construction dust, noise and vibration.
- Permanent requirement of community land or facilities (or accesses to)
- Permanent requirement of agricultural land (or accesses).

- Operational phase

- Permanent road and public right of way diversions or closures which result in changes in journey length or severance
- Permanent changes journey amenity
- Changes to driver views of the landscape.
- Permanent changes to driver stress.
- Permanent air quality and noise impacts on human receptors.
- Permanent impacts on physical activity opportunities.

12.9.1.3 Furthermore, residential properties located within the footprints of the Scheme options which may require permanent acquisition are shown on Figure 12-3 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) (see Appendix A of this report) and include:

- Option 1V5: Three properties accessed from the A27 Chichester Road and two from Ford Road roundabout
- Option 1V9: Two properties accessed from Ford Road roundabout
- Option 3V1: None located within the Option footprint
- Option 4/5AV1: One property accessed from B2132 Shellbridge Road
- Option 4/5AV2: One property accessed from Tortington Lane

Option 5BV1: Two properties accessed from Binsted Lane.

12.9.1.4 When determining the significance of an effect, all levels from Moderate to Very Large (beneficial or adverse) are considered to be a significant effect. Significance criteria is not applied to the assessment of driver stress (receptors are not assigned a sensitivity) or the assessment of health (receptors are not assigned a magnitude).

12.9.2 All Options

Construction

12.9.2.1 During construction, Moderate Adverse effects (significant) are likely on the permanent requirement for demolitions of properties or permanent requirement of land from private assets for all options, and temporary changes in non-motorised user (NMU) journey amenity including disruption of public rights of way routes and footways interact with the road during construction.

12.9.2.2 Neutral effects (not significant) are likely for all options on the temporary requirement for development land and temporary impacts on human receptors from construction dust.

12.9.2.3 Negative effects are likely on human receptors from construction noise. The level of driver stress is not quantifiable during the construction phase.

Operation

12.9.2.4 In the operational phase, all Scheme options are likely to result in Moderate Adverse effects (significant) on users of permanent road and public rights of way (PRoW) from diversions or closures changes in journey amenity, and permanent impacts on physical activity opportunities.

12.9.2.5 No change is expected to the level of driver stress during the operational phase.

12.9.2.6 During operation, positive effects on health due to permanent changes in air quality. There are positive and negative effects on health arising from noise levels across all Scheme options.

12.9.3 Option 1V5

Construction

12.9.3.1 During construction there is likely a Slight Adverse effect (not significant) on Arundel Community Hospital due to the permanent requirement of community land or facilities. A Large Adverse effect (significant) on agricultural land is likely, due to the permanent requirement of agricultural land.

12.9.3.2 Construction works will result in a temporary alteration in driver views of the landscape from the road from open or intermittent view to restricted or no view.

Operation

12.9.3.3 During the operational phase, the option will result in no change in driver views along the existing A27. Along the new alignment, driver views of the landscape will change from 'intermittent' to 'open'.

12.9.4 Option 1V9

Construction

12.9.4.1 There is a likely Moderate Adverse effect (significant) on Arundel Cricket Club due to the permanent requirement of community land or facilities. A large adverse effect (significant) on agricultural land is likely, due to the permanent requirement of agricultural land.

12.9.4.2 Construction works will result in a temporary alteration in driver views of the landscape from the road from open or intermittent view to restricted or no view.

Operation

12.9.4.3 During the operational phase, the option will result in no change in driver views along the existing A27. Along the new alignment, driver views of the landscape will change from 'intermittent' to 'open'.

12.9.5 Option 3V1

Construction

12.9.5.1 There is a likely Moderate Adverse effect (significant) on Binsted Park and woods due to the permanent requirement of community land or facilities. A Large Adverse effect (significant) on agricultural land is likely, due to the permanent requirement of agricultural land.

12.9.5.2 Construction works will result in a temporary alteration of views in the landscape from the road for vehicle travellers from intermittent view to restricted or no view.

Operation

12.9.5.3 During the operational phase, the option will result in a change in driver views of the landscape from 'intermittent' to 'open' views across the floodplain. No change in driver views is likely from the wooded section at the western end of the option.

12.9.6 Option 4/5AV1

Construction

12.9.6.1 There is a likely Slight Adverse effect (not significant) on Strawberry Fair in Binsted due to the permanent requirement of community land or facilities. A Moderate Adverse effect (significant) on agricultural land is likely due to the permanent requirement of agricultural land.

12.9.6.2 Construction works will result in a temporary alteration of views in the landscape from the road for vehicle travellers from intermittent view to restricted or no view.

Operation

12.9.6.3 During the operational phase, the option will result in a change in driver views from intermittent to open views across the floodplain in the eastern section. Driver views will change from 'restricted or no views' to 'no views' in the wooded western section of the option.

12.9.7 Option 4/5AV2

Construction

12.9.7.1 There is a likely Slight Adverse effect (not significant) on Binsted Park and woods due to the permanent requirement of community land or facilities. A Moderate Adverse effect (significant) on agricultural land is likely due to the permanent requirement of agricultural land.

12.9.7.2 Construction works will result in a temporary alteration of views in the landscape from the road for vehicle travellers from intermittent view to restricted or no view.

Operation

12.9.7.3 During the operational phase, the option will result in a change in driver views from 'intermittent views' to 'open views' across the floodplain in the eastern section. Driver views will change from 'restricted or no views' to 'no views' in the wooded western section.

12.9.8 Option 5BV1

Construction

12.9.8.1 There is a likely Neutral effect (not significant) on designated Common Land due to the permanent requirement of community land or facilities. A Moderate Adverse effect (significant) on agricultural land is likely due to the permanent requirement of agricultural land.

12.9.8.2 Construction works will result in a temporary alteration of views in the landscape from the road for vehicle travellers from intermittent view to restricted or no view.

Operation

12.9.8.3 During the operational phase, the proposed option will result in a change in driver views from 'intermittent views' to 'open views' across the floodplain in the eastern section. Driver views will change from 'restricted or no views' to 'no views' in the wooded western section.

12.10 Road Drainage and the Water Environment

12.10.1.1 The Road Drainage and Water Environment assessment has been prepared in accordance with the DMRB (Volume 11, Section 3, Part 10).

12.10.1.2 The following potential impacts were considered in the assessment:

- Construction phase
  - Increased pollution and potential impacts to the hydro-morphological and ecological quality of watercourses
  - Temporary works within a channel and floodplain
  - Cutting and other excavation (e.g. groundwater dewatering)
  - Increased groundwater vulnerability.
- Operational phase:
  - Increased pollution
  - Permanent impacts associated with new structures within or in close proximity to watercourses
  - Increased risk of fluvial, tidal and surface water flooding
  - Impacts to flood flow conveyance of the Binsted Rife, Tortington rife and ordinary watercourses
  - Impacts on groundwater (e.g. groundwater dewatering, groundwater flow and groundwater recharge).

12.10.1.3 When determining the significance of an effect, all levels from Moderate to Very Large (beneficial or adverse) are considered to be a significant effect.

12.10.2 All Options

12.10.2.1 During construction there is a likely Slight Adverse (not significant) risk of increased pollution in the River Arun. The works are unlikely to pose significant impact to the hydro-morphological and ecological quality of watercourses within the Study Area. Construction of the Scheme options is likely to result in Neutral Effects (not significant) on the level of pollution in other ordinary watercourses.

12.10.2.2 During construction temporary works may be required within a river channel or on the floodplain (Flood Zones 2 and 3). This will have a Neutral effect (not significant) on the flood risk associated with the watercourses of the River Arun, Binsted Rife and Tortington Rife.

12.10.2.3 The effect on groundwater vulnerability (i.e. dewatering and aquifer recharges) during construction are likely to be either Neutral or Slight Adverse for all Scheme options (not significant).

12.10.2.4 During the operational phase, Neutral Effects (not significant) are likely on the following aspects: water quality in the River Arun and other watercourses, and flood risk and flood flow assuming that appropriate mitigation is in place.

12.10.2.5 All options are likely to result in Slight Adverse effects (not significant) on the recharge rate of groundwater assets Secondary A aquifers due to pond dewatering during the operational phase.

12.10.3 Option 1V5 and 1V9

12.10.3.1 Option 1V5 and Option 1V9 are considered together as the proposed alignments are largely similar with regard to the water environment. Specific differences in the design of the Scheme are outlined within Chapter 13 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

12.10.3.2 Option 1V5 and Option 1V9 do not cross either Binsted or Tortington Rife. No effects are likely on the potential level of pollution of these main rivers arising from the proposed options. The assessment takes into consideration mitigation that will be included in the embedded and future design of the Scheme.

12.10.4 Option 3V1, 4/5AV1, 4/5AV2 and 5BV1

12.10.4.1 Options 3V1, 4/5AV1, 4/5AV2 and 5BV1 are considered together as they cross the main River Arun floodplain along similar alignments. The proposed offline options cross either Binsted or Tortington Rife. There is a Slight Adverse effect (not significant) on the level of pollution in these main rivers, although any effect associated with construction activities will be temporary. The assessment takes into consideration mitigation that will be included in the embedded and future design of the Scheme.

12.11 Climate: Greenhouse Gases

12.11.1.1 The assessment approach uses best practice methods to consider the likely magnitude of Greenhouse Gas (GHG) emissions (or avoided emissions) in comparison to the baseline scenario without the Scheme. It considers emissions throughout the lifecycle of the Scheme in line with standard practice; legislation and guidance is outlined in Section 14.2 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019).

12.11.1.2 The following potential impacts were considered in the assessment:

- Construction phase
  - Product stage - embodied emissions associated with the production of raw materials
  - Transport of materials or waste
  - Plant and equipment used during construction.
- Operational phase
  - Maintenance and replacement materials
  - End-user traffic GHG emissions.

12.11.1.3 There is currently no specific guidance or carbon emissions threshold, which, if exceeded, is considered significant. Therefore, assessment of significance of emission cannot be judged objectively and can only be based on professional judgement and with reference to guidance from IEMA, the national carbon budgets and local authority emissions. Therefore, the effects below, summarised from Chapter 14 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019), cannot be assessed in terms of significance.

12.11.2 All Options

12.11.2.1 Emissions from the replacement of pavement, and traffic using the road network are the largest emissions sources during operation. Moderate adverse effects are likely during the operational phase for all Scheme options.

12.11.3 Options 1V5 and 1V9

12.11.3.1 Emissions from earthworks are the largest source of emissions during construction. Negligible (i.e. Neutral) effects are likely as the result of constructing either Option 1V5 or 1V9.

12.11.4 Options 3V1, 4/5AV1, 4/5AV2 and 5BV1

12.11.4.1 Emissions from earthworks are the largest source of emissions during construction. Slight Adverse effects are likely as the result of constructing any of the proposed offline options.

12.12 Climate: Vulnerability to Climate Change

12.12.1.1 The climate vulnerability assessment has been prepared in accordance with IEMA EIA Guidance to climate change and resilience.

12.12.1.2 The vulnerability of the Scheme options to climate change has been assessed. The potential construction and operational phase impacts considered in this assessment included:

- Construction
  - Impacts resulting from changes in temperature and rainfall and extreme weather events on site compound, materials, plant and equipment and workforce.
- Operation
  - Impacts resulting from changes in temperature and rainfall and extreme weather events on pavement, embankment, ancillary equipment, drainage, vegetation and end users.

12.12.1.3 The effects are the same for each of the proposed options as all options are:

- Sensitive and Exposed to changes in temperature and rainfall (including flood risk).

12.12.1.4 The significance of a risk to the Scheme from climate change has been qualitatively assessed in terms of their likelihood of occurrence and consequence of occurrence. See Chapter 15 of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019) for further information.

12.12.2 All options

12.12.2.1 Effects on the Scheme from climate change during the construction phase vary from negligible to minor adverse for the majority of potential impacts. The exception is the risk of flooding from climate change, this is likely to be moderate adverse. However, the likelihood of this potential impact occurring is likely to be low with mitigation measures in place. The likelihood of other potential impacts occurring varies from Low to Medium.

12.12.2.2 The effects of climate on the Scheme during the construction phase are not considered significant.

12.12.2.3 During the operational phase, the effects of climate change on the Scheme varied from negligible to moderate adverse. Mitigation measures at the design stage (e.g. ensure that drainage infrastructure can accommodate the potential increase in rainfall) will address these effects. The assessment considered that all the effects in the operational phase were not significant.

12.13 Major Accidents and Disasters

12.13.1.1 There is currently no published guidance on how to assess the effects on the environment arising from a projects vulnerability to major events. The assessment has developed and used a systematic process which takes account of emerging EIA good practice[6,7,8,] which refers to other relevant documentation, including the Cabinet Office's National Risk Register of Civil Emergencies and experience in major accident hazard identification.

12.13.1.2 The following potential events included:

- Natural, such as:
  - Landslides
  - Sinkholes
  - Flooding (i.e. fluvial, surface water and groundwater)
  - Thunderstorms and gales
  - Extreme temperatures (e.g. heatwaves or sub-zero temperatures)
  - Droughts
  - Wildfires (e.g. forest fire or brush fire)
- Manmade and Technological, such as:

[6] Institute of Environmental Management and Assessment (IEMA), EIA Quality Mark Article: Assessing Risks of Major Accidents / Disasters in EIA, March 2016
[7] Institute of Environmental Management and Assessment (IEMA), EIA Quality Mark Article: What is this MADness?, August 2017
[8] Institute of Environmental Management and Assessment (IEMA), EIA Quality Mark Webinar: Major Accidents and Natural Disasters in EIA, 13th July 2017

- Industrial and Urban accidents
- Transport accidents
- Pollution
- Unexploded ordinance
- Infrastructure failure (e.g. bridge failure or flood defence failure).

12.13.2 All Options

12.13.2.1 Major events are those which have potential to rarely occur, despite mitigation, management or regulatory controls put in place to prevent them. Responding to a major event may require the use of resources in addition to those of Highways England or its contractors (e.g. rail incident during construction of the options).

12.13.2.2 Typical methods employed within an EIA to define significance are not applicable to the description of major events. By definition, a major event would be a significant effect on the environment. If a major event were to occur the likely worst case would always be a major adverse effect.

12.13.2.3 Design and mitigation measures appropriate to environmental topics are discussed in detail in the relevant chapters of the PCF Stage 2 A27 Arundel Bypass EAR (August 2019). No additional mitigation measures have been identified as part of the Major Events assessment to further address the risk of potential major events.

12.13.2.4 Overall, for the Major Events outlined above, the assessment concluded that there is no likely requirement for further mitigation measures as based on the information currently available in all the topic chapters in the PCF Stage 2 A27 Arundel Bypass EAR (August 2019). It is therefore considered that the vulnerability of the Scheme to the risk of a Major Event is anticipated to be as low as reasonably practicable.

12.14 Summary

12.14.1.1 In Summary both significant and non-significant effects are likely to during the construction and operational phases for receptors associated with Cultural Heritage, Landscape, Biodiversity, Geology and Soils, Noise and Vibration, and Population and Health topics. Should a Major Event occur, then this is also likely to result in a significant effect.

12.14.1.2 No significant effects are likely to arise during either the construction or operational phase as the result of the Scheme on receptors associated with Air Quality, Materials, Water Environment or Climate Resilience.

Abbreviation

Abbreviation	Explanation
AQMA	Air Quality Management Area
DMRB	Design Manual for Roads and Bridges
EAR	Environmental Assessment Report
GHG	Greenhouse Gas
HPI	Habitat of Principal Importance
IEMA	Institute of Environmental Management and Assessment
LCA	Landscape Character Area
LPG	Liquified Petroleum Gas
LWS	Local Wildlife Site
NIA	Noise Important Area
OS	Ordinance Survey
PCF	Project Control Framework
pSAC	Potential Special Area of Conservation
SAC	Special Area of Conservation
SDNP	South Downs National Park
SOAEL	significant Observed Effect Level
SPA	Special Protected Area
SSSI	Site of Special Scientific Interest

Glossary

Term	Definition
Hazard	Anything with the potential to cause harm, including ill-health and injury, damage to property or the environment; or a combination of these.
Major accident	In the context of the Scheme, an event that threatens immediate or delayed serious damage to one or more of human health, welfare, the environment and requires the use of resources beyond those of the Applicant or its contractors to respond to the event. Serious damage includes one or more of the loss of life, permanent injury, permanent or long-lasting damage to an environmental receptor that cannot be restored through minor clean-up and restoration efforts. The significance of this effect will take into account the extent, severity and duration of harm and the sensitivity of the receptor.

Major event	Term used by Highways England to refer to either or both major accidents and disasters.
Natural disaster	In the context of the Scheme, a naturally occurring phenomenon such as an extreme weather event (e.g. storm, flood, temperature) or ground-related hazard events (e.g. subsidence, landslide, earthquake) with the potential to cause an event or situation that meets the definition of a Major Accident as defined above.
Principal aquifer	Layers of rock or drift deposits that have high intergranular or fracture permeability, meaning they usually provide a high level of water storage and may support water supply or river base flow on a strategic scale.
Reuse	Any operation by which products or components that are not waste are used again for the same purpose for which they were conceived; reuse presumes that significant reprocessing is not required.
Risk	The likelihood of an impact occurring combined with effect or consequence(s) of the impact on a receptor if it does occur.
Secondary A Aquifer	Permeable layers capable of supporting water supplies at a local rather than a strategic scale, and in some cases forming an important source of base flow to rivers.
Vulnerability	In the context of the 2014 EU Directive, the term refers to the 'exposure and resilience' of the Scheme to the risk of either or both a major accident or disaster. Vulnerability is influenced by sensitivity, adaptive capacity and magnitude of impact.
Waste	Any substance or object that is discarded, and that has not been subject to acceptable recovery (including recycling) or disposal.

A27 Arundel Bypass Scheme Assessment Report

Chapter 13 – Safety Assessment

October 2020

CONTENTS

LIST OF TABLES

LIST OF FIGURES

13 Safety Assessment

13.1 Introduction

13.1.1.1 This chapter provides an assessment of the six route options in terms of potential safety impact on road users. Assessment has been undertaken to review design from a road safety perspective, with key considerations for each of the six options including:

- overall alignments
- general highway design features
- junction strategy
- tie-in points
- severance
- implications for the local highway network.

13.1.1.2 The safety benefits of the options are summarised in Chapter 10.

13.1.1.3 Personal Injury Collision (PIC) statistics, obtained from Sussex Safer Roads Partnership for the five-year period from 01/2013-12/2017, have been reviewed to understand the current safety record for the existing route, providing a baseline context from which to consider potential implications for operational safety of each of the six alignment options described in Chapter 8.

13.1.1.4 The extent over which route improvement options has been considered is an 8km length; between the A27 junctions with the A29, to the west, and with Crossbush Lane to the east. This encompasses an approximate 3.6km section of single carriageway through the town, a 3.8km section of existing dual carriageway to the west and 0.6km of dual carriageway to the east.

13.1.1.5 The safety assessment reviews the proposed options with reference to existing local safety issues, overarching route performance and national road safety targets for the Strategic Road Network (SRN)[1], to provide safety related observation and recommendations for consideration in future design development.

[1] Department for Transport "Road Investment Strategy: Performance Specification", December 2014 – *40% reduction in the number of collisions involving fatal or serious injuries on the SRN, against a 2005-2009 average baseline, by the end of 2020*.

13.1.2 Highways England Delivery Plan: 2015-2020 - A safe and serviceable network

13.1.2.1 Highways England Delivery Plan 2015-2020[2] (and, subsequently, the National Incident and Casualty Reduction Plan, 2017[3]) sets out an overarching goal to reduce the number of people killed or injured on the network to as close as possible to zero by the year 2040. More specifically, the target for the first Road Investment Strategy period (as defined in the Department for Transport 'Road Investment Strategy: Performance Specification', December 2014) is a 40% reduction in the number of collisions involving fatal or serious injuries on the SRN, against a 2005–2009 average baseline, by the end of 2020. By this date, Highways England aim to have reached a target of no more than 1,393 KSIs (killed seriously injured) across the SRN in a year.

13.2 Existing Accident Record

13.2.1.1 Personal Injury Collision (PIC) statistics, obtained from Sussex Safer Roads Partnership for the five-year period from 01/2013-12/2017, have been analysed to understand the current safety record on the section of the A27 under review. Rates and trends identified are compared with national statistics for rural A roads, as presented in 'Reported Road Casualties Great Britain: 2017 Annual Report' (RCGB)[4].

13.2.1.2 The extent of the existing A27 considered is an 8km length; between the A27 junctions with the A29, to the west, and with Crossbush Lane to the east. This encompasses an approximate 3.6km section of single carriageway through the town, a 3.8km section of existing dual carriageway to the west and 0.6km of dual carriageway to the east.

[2] Highways England (March 2015) "Highways England Delivery Plan 2015 – 2020" [Available Online] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/424467/DSP2036-184_Highways_England_Delivery_Plan_FINAL_low_res_280415.pdf [Accessed 06/08/2019]

[3] Highways England (May 2017) "Health and Safety Fiver Year Plan" [Available online] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/624552/Health_and_Safety_five_year_plan_May_17.pdf [Accessed 06/08/2019]

[4] Department for Transport, "Reported Road Casualties Great Britain: 2017 Annual Report," September 2018. Available [Online] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/755698/rrcgb-2017.pdf. [Accessed 14/07/19]

13.2.1.3 In the 5-year period (2013-2017), as shown in Table **13-1**, a total of 81 PICs have been recorded on the section of the A27 under review. An average of 16 PICs were recorded in each year, with the number recorded in the latest year (2017) representing a 19% reduction from the 5yr average, to 13 recorded PICs. National RCGB statistics record a 15% reduction in all PICs recorded in 2017, in comparison with the 5 year average[5].

13.2.1.4 Table 13-1 shows that the 81 PICs recorded in the 5-year period has resulted in 121 casualties; no fatalities were reported, with 12% (15) recorded as serious and 88% (106) as slight injury casualties. Although there have been no fatalities reported in the 5-year period, serious injury casualties account for on average 12% of all reported casualties each year and 19% of all casualties in 2017. In comparison with national statistics for all non-built-up A roads the 2017 KSI casualty rate on this section of the A27 is higher; with respective national reported KSIs over the same 5-year period accounting for an average of 13% of all casualties each year and 14% of all casualties in 2017[6].

Table 13-1 **– Personal Injury Collisions and Casualties 2013 to 2017**

	Accidents (PICs)					Casualties			
Year	Fatal	Serious	Slight	Total	KSI* (%)	Serious	Slight	Total	KSI* (%)
2013	-	2	16	18	11	2	21	23	9
2014	-	3	14	17	18	3	21	24	14
2015	-	4	12	16	25	4	17	21	19
2016	-	1	16	17	6	1	26	27	4
2017	-	4	9	13	31	5	21	26	19
Total	0	14	67	81	18	15	106	121	12

*KSI – Killed or Seriously Injured

[5] Department for Transport, "Reported Road Casualties Great Britain: 2017 Annual Report," September 2018. RAS10002 – 'Reported accidents and accident rates by road class and severity'
[6] Department for Transport, "Reported Road Casualties Great Britain: 2017 Annual Report," September 2018. RAS40002 – 'Reported accidents, vehicles and casualties by severity, road class, built-up and non-built-up roads, Great Britain, 2017'

13.2.2 Single and Dual Carriageway Sections

13.2.2.1 Table 13-2 shows that 47 PICs were recorded on the 3.6 km single carriageway section; 8 resulting in serious injury, constituting a KSI ratio of 17%, which is lower than the 21% national KSI ratio reported in RCGB for rural A roads over the same 5 year period.

13.2.2.2 A total of 17 PICs were recorded on the 3.8 km western dual carriageway section; 3 resulting in serious injury, constituting a KSI ratio of 18%, again lower than the national KSI statistic for rural A roads in the same period. All KSIs (3) on this section were recorded in 2017, accounting for 50% of all PICs recorded in this year, compared with a 24% national KSI ratio recorded in 2017 for rural A roads[2].

13.2.2.3 A total of 17 PICs were recorded on the 0.6km eastern dual carriageway section; 3 resulting in serious injury, constituting a KSI ratio of 17%, again lower than the national KSI statistic for rural A roads in the same period. All KSIs on this section were recorded in 2014 or 2015[7].

Table 13-2 – Single and Dual Sections: Personal Injury Collisions 2013 to 2017

	Dual (West)				Single				Dual (East)			
	Ser	Slight	Total	KSI (%)	Ser	Slight	Total	KSI (%)	Ser	Slight	Total	KSI (%)
2013	-	5	5		2	10	12		-	1	1	
2014	-	2	2		1	9	10		2	3	5	
2015	-	-	-		3	5	8		1	7	8	
2016	-	4	4		1	10	11		-	2	2	
2017	3	3	6		1	5	6		-	1	1	
Total	**3**	**14**	**17**	**18**	**8**	**39**	**47**	**17**	**3**	**14**	**17**	**18**

[2] Department for Transport, "Reported Road Casualties Great Britain: 2017 Annual Report," September 2018. RAS10002 – 'Reported accidents and accident rates by road class and severity'

13.2.3 Road Users

13.2.3.1 Table 13-3, as follows, shows that 80% (65) of PIC's involved only motor vehicles, with 12% (10) involving powered two wheelers, 6% (5) involving pedal cyclists and 2% (1) involving a pedestrian. Where pedestrians, pedal cyclists and powered two wheelers were involved, as more vulnerable road users, 44% of these (7) resulted in serious injury. More than 80% (13) of the PICs involving vulnerable road users occurred at junctions or accesses along the route.

Table 13-3 – Personal Injury Collisions by Road User 2013 to 2017

Road User	Accidents (PICs) and (KSI)					
	2013	2014	2015	2016	2017	Total
Pedestrian	0	0	0	1	0	1
Pedal Cyclist	1	(1)	(1)	2	0	5 (2)
Powered 2-Wheeler	(1)	1	2 (1)	2 (1)	4 (2)	10 (5)
Motor Vehicle	16 (1)	15 (2)	13 (2)	12	9 (2)	65 (7)
Total	18 (2)	17 (3)	16 (4)	17 (1)	13 (4)	81 (14)

Note: Figures in brackets are serious PICs and are included in the totals

13.2.4 Location

13.2.4.1 Table 13-4 as follows, provides a summary of PIC locations for the entire A27 length under review. It shows that nearly 80% (63) of PICs were recorded at junctions along the route; 62% (39) at the four roundabouts, 27% (17) at uncontrolled side road priority junctions, 5% (3) at the two uncontrolled staggered junctions and 6% (4) at private accesses. This is higher than national RCGB statistics for all non-built up roads (excluding motorways) in 2017, with accidents at junctions accounting for 38% of all PICs reported[8].

[8] Department for Transport, "Reported Road Casualties Great Britain: 2017 Annual Report," September 2018. RAS10009 – 'Reported accidents by junction type, built-up and non built-up roads and severity, Great Britain, 2017'

Table 13-4 – Personal Injury Collisions by Location 2013 to 2017

	2013	2014	2015	2016	2017	TOTAL (KSI)
Private accesses	1	0	2 (1)	0	1	4 (1)
Uncontrolled priority junctions	4 (1)	3	1	6 (1)	3 (1)	17 (3)
Staggered junctions	1	0	0	1	1 (1)	3 (1)
Roundabouts	7 (1)	9 (2)	12 (3)	6	5 (1)	39 (7)
Total- All junctions / accesses	13 (2)	12 (2)	15 (4)	13 (1)	10 (3)	63 (12)
Total- Not at junction (or within 50m)	5	5 (1)	1	4	3 (1)	18 (2)
Total- All PICs	18	17	16	17	13	81
Percentage at Junctions	72%	71%	94%	76%	77%	78%

Note: Figures in brackets are serious PICs and are included in the totals

13.2.5 Key Contributory Factors

13.2.5.1 Table 13-5 presents the key contributory factors cited for each PIC recorded on the A27 single carriageway section, as provided in the STATs19[9] report obtained from Sussex Safer Roads Partnership; highlighting the types of collisions occurring on the A27. The table shows that for 95% (122) of the PICs road user behaviour was cited as the primary contributory factor, with 3% (4) attributable primarily to the road environment and 2% (2) vehicle related. In comparison with 2017 national statistics for all A roads the percentage of PICs on the A27 primarily attributable to road user behaviour were significantly higher; with national PIC contributory factors presented in RCGB as 87% attributable to road user behaviours, 11% to the environment, 2% to vehicle defects[10].

13.2.5.2 In terms specifically of road user behaviours attributed to PICs on the A27 single carriageway 68% (82) were attributed to driver/rider error or reaction, 14% (17) to behaviour or inexperience, 11% (13) to impairment or distraction and 7% (9) to injudicious actions.

[9] The STATS19 database is a collection of all road traffic accidents that resulted in a personal injury and were reported to the police within 30 days of the accident
[10] Department for Transport, "Reported Road Casualties Great Britain: 2017 Annual Report," September 2018. RAS50003 – 'Contributory factors in reported accidents by road class, Great Britain, 2017'

Table 13-5 – Key Contributory Factors for Personal Injury Collisions 2013 to 2017

Contributory Factor	Personal Injury Collisions		Total	% of all PICs
	Not at Junction (or within 50m)	Junctions/ Accesses		
ROAD ENVIRONMENT	**2**	**2**	**4**	**3%**
Rain, sleet, snow or fog		1	1	
Slippery road (due to weather)	1	1	2	
Animal/object in carriageway	1		1	
VEHICLE DEFECT	**1**	**1**	**2**	**2%**
Defective steering or suspension	1		1	
Visor/windscreen dirty, scratched		1	1	
BEHAVIOUR	**25**	**97**	**122**	**95%**
Injudicious Action	**0**	**9**	**9**	
Following too close		2	2	
Disobeyed Give-way, Stop sign or markings		2	2	
Disobeyed automatic traffic signal		1	1	
Travelling too fast for conditions		3	3	
Illegal turn or direction of travel		1	1	
Driver/Rider Error or Reaction	**20**	**62**	**82**	
Failed to look properly	6	23	29	
Failed to judge other persons path/speed	5	25	30	
Poor turn or manoeuvre	2	6	8	
Sudden braking	2	4	6	
Swerved	1	1	2	
Failed to signal/misleading signal		1	1	
Loss of control	4	2	6	
Impairment or Distraction	**3**	**10**	**13**	
Impaired by alcohol		4	4	
Impaired by drugs		1	1	

Contributory Factor	Personal Injury Collisions		Total	% of all PICs
	Not at Junction (or within 50m)	Junctions/ Accesses		
Fatigue		2	2	
Distraction in vehicle	2	3	5	
Illness/disability (mental/physical)	1		1	
Behaviour or Inexperience	**2**	**16**	**18**	
Careless/Reckless/In a hurry	1	8	9	
Inexperience of driving on the left		1	1	
Aggressive driving	1	2	3	
Driving too slow for conditions, or slow vehicle		1	1	
Nervous, uncertain or panic		2	2	
Learner or inexperienced driver/rider		1	1	
Pedestrian wearing dark clothing at night		1	1	
Total	**28**	**100**	**128**	

13.2.5.3 The two single highest cited contributory factors were failure to look properly (29) and failed to judge other persons path or speed (30); each accounting for 23% of all cited contributory factors.

13.2.5.4 The following list highlights the common type of collision occurring on the A27 in the five-year period under review.

- 14 loss of control collisions - 5 on dual west section, 6 on single carriageway section, 3 on dual east section.
- 13 rear end shunts in traffic - all on single carriageway section.
- 10 collisions involving vehicles turning into/out of side roads and accesses along A27 - 1 on dual west section, 9 on single carriageway section.
- 21 rear shunts at roundabouts - 10 at A27/Crossbush roundabout, 9 at A27/Ford Road roundabout.

13.3 Safety Assessment of Route Options

13.3.1.1 A safety assessment has been carried out for the 6 options described in Chapter 8 and shown in Figure 13-1.

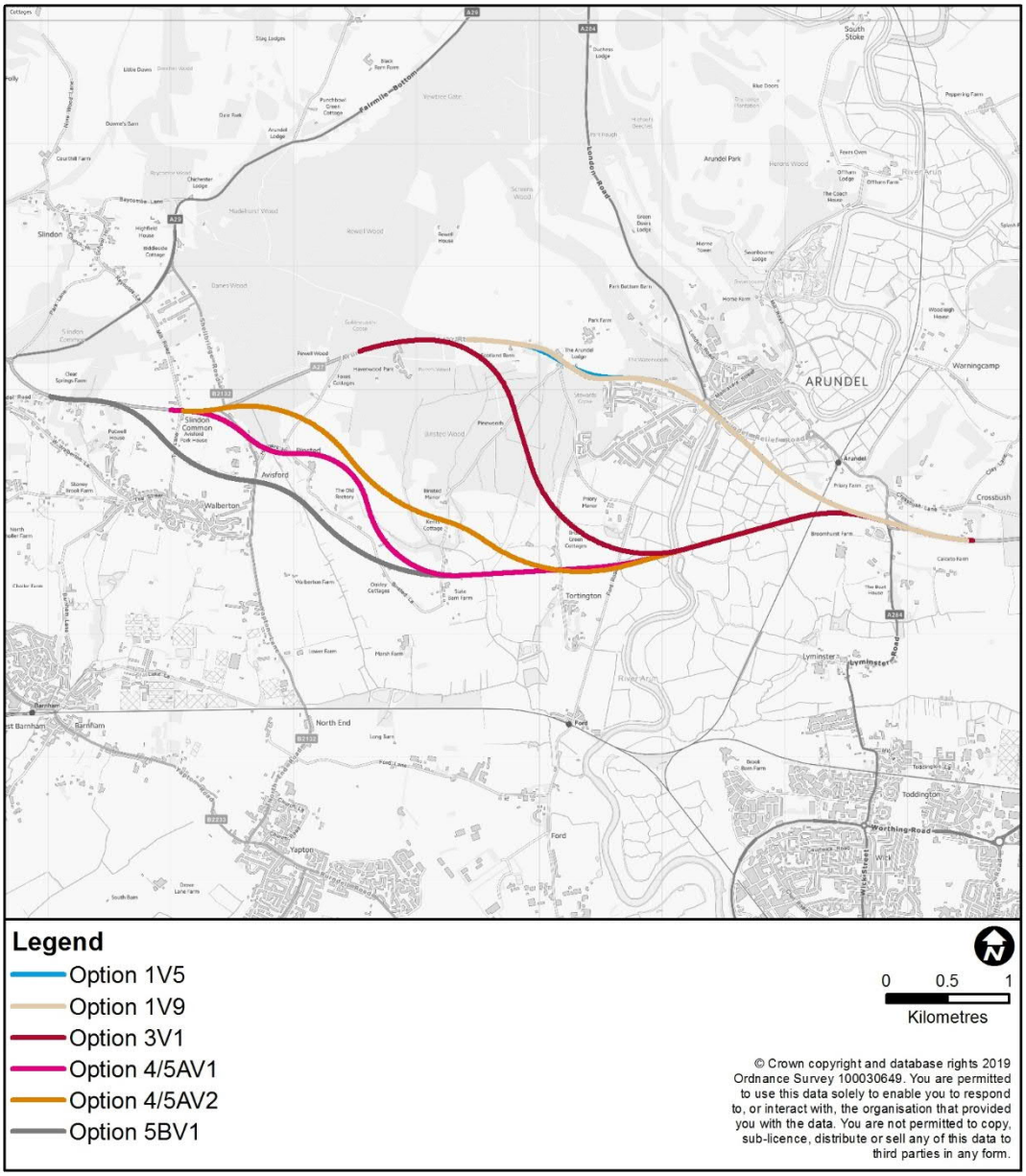


Figure 13-1 - Scheme Options

13.3.2 Implications of Route Options on Existing Route

13.3.2.1 The existing single carriageway section (Figure 13-2) of the A27 transitions from a semi-rural context, to both the east and western extents, into the more built-up area through the town. The A27 Chichester Road section, to the west of the town, passes through the South Downs National Park, with dense woodland set back from the carriageway flanking much of the length, including areas of ancient woodland. Through this approximate 5.5km section the route is unlit and subject to national speed limit. The 2.5km section between Ford Road roundabout and Crossbush roundabout is street lit, with a reduced 40mph speed limit in place.

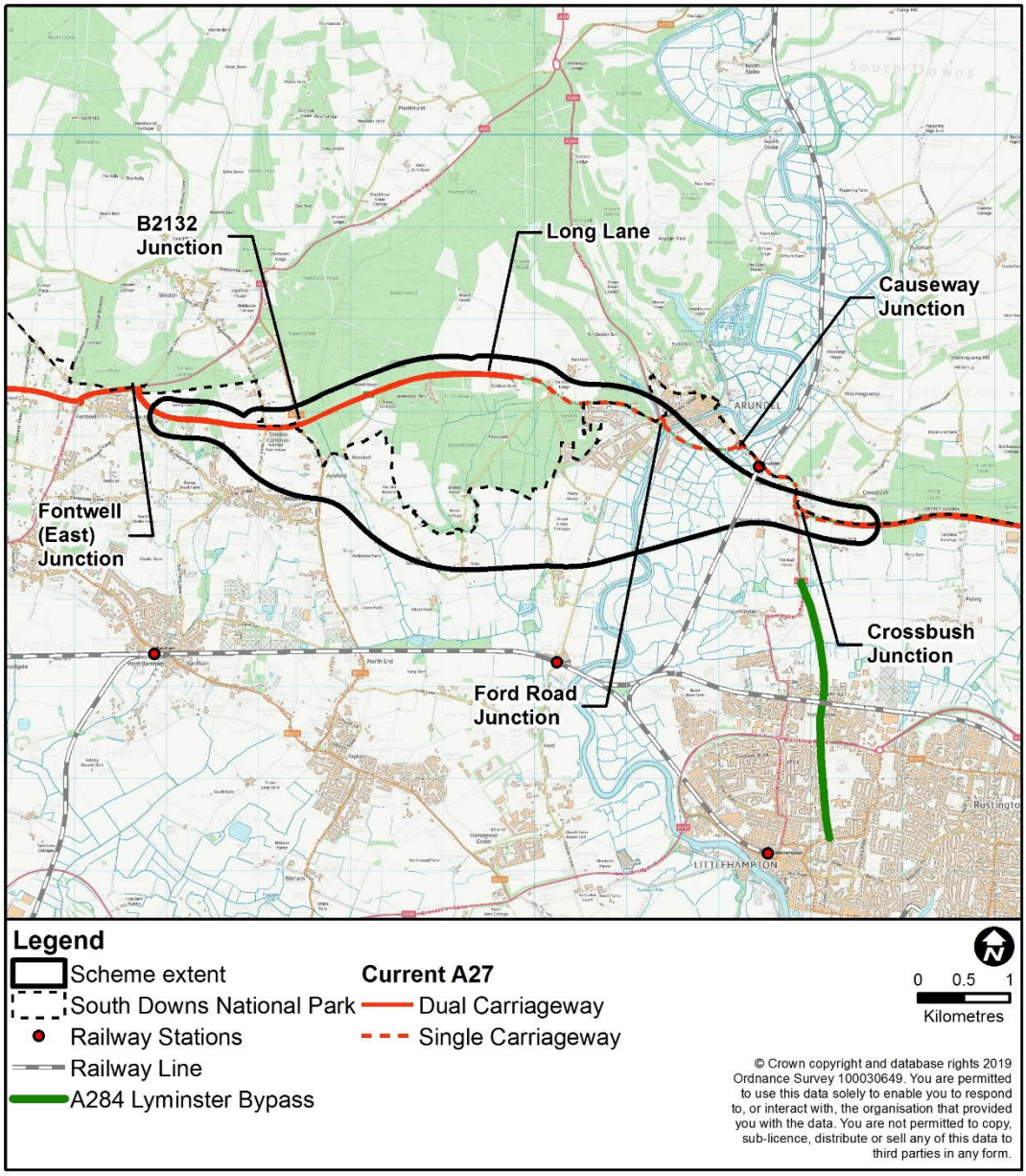


Figure 13-2 - Existing A27

13.3.2.2 The cross-section through this single carriageway section comprises nominal 3.5m width east and westbound lanes, with edge of carriageway markings and some localised widening to facilitate areas of central hatching to accommodate right turning lanes for side road access along the route. There are no notable gradients, although there is some variation in vertical alignment; in particular on the eastbound approach to Ford Road roundabout, on approaches to the river and rail bridge crossings to the south-east of the Causeway roundabout, and on the eastbound approach to the Crossbush roundabout. There is horizontal undulation throughout the existing route; with notable sweeping and sharper bends through the White Swan, Binsted Lane and Crossbush Lane (north) junctions; Park Farm, Arundel & District Community Hospital accesses and longer sections of carriageway between Ford Road and the Causeway roundabouts, and between Crossbush Lane (mid/south) and Crossbush roundabout. Existing highway features are summarised in Table 13-6 as follows.

Table 13-6 – Existing Route Features

Highway Feature		Location
At-grade junnctions	Uncontrolled Priority Junctions	Walberton Lane; Park Farm (W & E); Jarvis Road; Mill Road Fitzalan Road; Station Approach; Crossbush Lane (N, Mid, S)
	Staggered Junctions	Yapton Lane/ Shellbridge Road; White Swan/ Binsted Lane
	Roundabouts	A27/A29; A27/Ford Road; A27/The Causeway; A27/Crossbush
	Private Accesses	Arundel & District Hospital; Arundel Arboretum, Garden Centre & Nursery; Arundel Cricket Club; Weald Shooting School; Batworth Park House; Angmering Park Estate; Havenwood Park; Residential properties, Farm accesses
Lay-by	Parking	Eastern extent - A27 dual section eastbound, parking signs on slip road at 600yds/at start of diverge taper to access layby, no taper for re-entry
	Foot/Cycleway	Discontinuous and varied width footway alongside carriageway, shared use

Highway Feature		Location
WCHR Facilities		northern foot/cycleway - 100m section alongside A27, between The Causeway roundabout western arm and A27 Arundel rail station; deviating to a setback behind grass verge and trees flanking the carriageway. Public Rights of Way - Walberton Bridleway, Binsted Valley, Park Farm (E)
	Crossings	Pedestrian Underpass - link to Fitzalan Road Pelican Crossing - 70m east of The Causeway roundabout. Refuges - Jarvis Road, Arundel & District Community Hospital, Crossbush Lane (S). Dropped kerbs, path through central reserve - Shellbridge Road/Yapton Lane; Havenwood Park access
Public Transport	Bus Services	Limited provision for bus services on route - only posted stops are at east and western extents, sheltered amenity/information only at westbound stop close to Crossbush Lane (S) junction at eastern extent

13.3.3 Safety Review Principles

General Highway Design

13.3.3.1 The cross-section is expected to be formed of 2 standard 3.65m wide lanes in each direction with a central reserve and a 1m hard strip, which is similar to the existing A27 dual-carriageway sections at the tie-in locations. The hard strip would be expected to accommodate drainage features such as gullies for these to be located away from live traffic. In addition, during heavy rainfall events any areas of standing/running water would be accommodated within the hard strip to avoid any impact upon live traffic lanes.

13.3.3.2 The design speed for the scheme has been determined as an 120Bkph (all purpose) and, in accordance with TD9/93 Highway Link Design[11] the number of Design Speed Steps permitted below the Desirable Minimum for a Relaxation are, as follows:

- Stopping Sight Distance – 3 Steps (TD9/93, Para. 2.8)[12]
- Horizontal – 4 Steps (TD9/93, Para. 3.4)[13]
- Vertical – 3 Steps (TD9/93, Para. 4.9)[14]

13.3.3.3 Where horizontal and vertical alignment would be within 1-4 steps of desirable minimum standard it is recommended that further consideration should be given at subsequent stages of scheme development to improve alignment, or reduce safety risk with advanced warning and measures to encourage or enforce reduced speeds. In addition, highway features such as signs and structural elements would be expected to lie outside the visibility splays and not create road safety problems.

13.3.3.4 During the development of landscaping proposals, their impact upon road users would be taken into account at an early stage to incorporate any required mitigation into the design and allow sufficient land-take to be identified.

13.3.3.5 Signs and other roadside features would, where possible, be located away from high risk areas where errant vehicles may be more likely to leave the carriageway. The potential for these features to be struck, and therefore the need to include vehicle restraint systems or passively safe features, would be considered as the design is developed.

13.3.3.6 Vehicle restraint systems would also be required on high embankments or at steep cuttings. Further consideration of these systems will be given as the design is developed.

13.3.3.7 The standard of highway design would be similar to the existing A27 at tie-in points at each end of the scheme.

[11] DMRB, Volume 6, Section 1, Part 1 - TD 9/93 Highway Link Design
[12] DMRB, Volume 6, Section 1, Part 1 - TD 9/93 Highway Link Design – Chapter 2, Paragraph 2.8
[13] DMRB, Volume 6, Section 1, Part 1 - TD 9/93 Highway Link Design – Chapter 3, Paragraph 3.4
[14] DMRB, Volume 6, Section 1, Part 1 - TD 9/93 Highway Link Design – Chapter 4, Paragraph 4.9

Street Lighting

13.3.3.8 As outlined in Chapter 8 of this report, street lighting is not proposed on the mainline A27, other than on Option 1V9 where lighting is assumed on the approaches to Ford Road roundabout and on the roundabout, itself. It has been assumed that lighting would be provided at the Crossbush junction but at no other junction. This is consistent with the existing sections of dual-carriageway to the east and west of the proposed route extents. Street lighting at the junctions may be expected to reduce the likelihood of night-time or poor weather collisions and it is recommended that a safety assessment of the benefits of street lighting at key junctions will form part of further scheme development in Project Control Framework (PCF) Stage 3 (Preliminary Design).

Walking Cycling and Horse Riding (WCHR)

13.3.3.9 The area through which the proposed scheme options would pass contains several PRoWs, with potential for severance. Route options incorporate some provision for pedestrians, cyclists and equestrians. However, the WCHR Assessment will be used to assist the project team in developing the design to accommodate existing routes and enhance WCHR facilities.

Relaxations and Departures from Standards

13.3.3.10 Relaxations and departures from standard have been incorporated into designs primarily where options are restricted by significant environmental constraints, including ancient woodland and the South Downs National Park and where it is considered that safety would not be compromised. Departures and Relaxations of Standards for PCF Stage 2 designs, as presented in the 'Departures from Standard Checklist' Report[15] and summarised in Chapter 8 of this report, have been assessed as part of this safety review of each Route Option, with any aspects of more specific safety concern highlighted in the following sections of this Report.

[15] WSP, 21/6/2019, 'Departures from Standard Checklist: A27 Arundel Bypass – PCF Stage 2 Further Consultation' (Ref. HE551523-WSP-HML-SWI-RP-CH-00001, First Issue)

Existing Route

13.3.3.11 All six options would continue to utilise the existing A27 section of single carriageway as part of the local highway network, providing access to/from Arundel town centre as shown in Figure 13-1. As such the highways features on the single carriageway section between the tie-ins for each option would remain. Fewer incidents are expected with less traffic anticipated on this existing section. However, reduced traffic flows may also mean vehicles travel at higher speeds. Therefore, treatment of the existing A27 will require careful consideration to provide a safer road, taking consideration of the current safety record on the route, new risks and potential for improved pedestrian, cycle and public transport provision.

13.4 Option 1V5 Assessment

13.4.1.1 The overall horizontal alignment of Option 1V5 includes curves and transitions that are generally within the desirable minimum (1,020m radius) for a 120kph design speed given in Table 2 of TD 9/93, other that two curves which are relaxed to 720m.

13.4.1.2 The route includes vertical (crest and sag) curves that are generally within the desirable minimum for a 120kph design speed (K=182), other than two crest curves which are relaxed to K=100.

Structures and Junctions

13.4.1.3 Six new or modified structures are proposed along this option alignment to maintain existing highway, PRoW and rail connections, or passage over waterways. All existing junctions and accesses onto the A27 between Long Lane and Ford Road would be stopped up with this option, with local north-south highway movements served by a new overbridge and access to/from the A27 provided by local link roads and at-grade side roads to the north and south of the carriageway at Long Lane. The existing access for Arundel & District Hospital would also be stopped up, with a new access to be provided on the A284. The existing access at Jarvis Road would also be stopped up. Access would be via the existing road network to Ford Road. Reducing the number of side roads and accesses on the A27 will improve safety and operation on this section.

13.4.1.4 The new dual section would pass over Ford Road roundabout on a viaduct, which is likely to improve safety and operation of the existing roundabout by removing this dominant flow and higher speed traffic.

Tie-in Points

13.4.1.5 Two new junctions would be provided at the east and western extents with this option; a grade separated dumb-bell junction at the existing Crossbush roundabout, to the east, and an overbridge, together with at-grade side roads to the north and south of the carriageway at Park Farm (W), to the west, as discussed.

13.4.1.6 The dumb-bell double roundabout proposal for Crossbush interchange would improve safety and operation of this junction, by reducing the circulating flow past each entry and the higher circulatory speeds associated with the existing layout. Signal control could also improve safety and performance and it is recommended that this is considered where pedestrian and cyclists would cross the A27 slip roads at Crossbush junction.

Departures from Standards

13.4.1.7 Option 1V5 has 13 Departures from Standard and 18 Relaxations from Standard. Those of more specific safety concern, and requiring further consideration in PCF Stage 3 (Preliminary Design), are summarised as follows:

Eastbound:

- D11 – Chainage (Ch). 4370-4610: Below standard weaving length – safety considerations to include potential conflict between road users merging with existing A27 eastbound mainline and those exiting the lay-by

Westbound:

- D06 – Ch. 1390-0740: Sight stopping distance 3 steps below desirable minimum, horizontal curvature 1 step below, vertical crest 1 step below – safety considerations to include impact on westbound bus lay-by, Jarvis Road priority junction if retained.
- R11 – Ch. 1470-1390: Sight stopping distance 1 step below desirable minimum – safety considerations to include impact on gated access to east of Jarvis Road and approach to D06 if retained.

13.5 Option 1V9 Assessment

Overall Alignment

13.5.1.1 The overall horizontal alignment of Option 1V9 includes curves and transitions that are generally within the desirable minimum (1,020m radius) for a 120kph design speed, other than two short curves which are relaxed to 360m. These have been used to fit the proposed alignment to the existing as close as possible and to minimise land take adjacent to ancient woodland.

13.5.1.2 The route includes vertical (crest and sag) curves that are generally within the desirable minimum for a 120kph design speed (K=182), other than a few crest curves which have been relaxed to K=55 and K=100.

Structures and Junctions

13.5.1.3 Seven new or modified structures are proposed along this alignment option to maintain existing highway, PRoW and rail connections, or passage over waterways. The new eastern section of dual carriageway would tie-in with the existing A27 at Ford Road roundabout, with online widening extending from this junction to tie-in with the existing dual section to the west. A new "through-about" layout is proposed for Ford Road roundabout. This will remove the major A27 through-traffic movement from the circulatory carriageway, routing it directly across the centre of the roundabout. Local traffic movements would use the circulatory carriageway. There would be access to the westbound carriageway of the A27 and the existing Fitzalan Arun Bridge would provide a link to the existing A27 Relief Road for local traffic to gain access to the eastbound A27 and to carry on the A284. Proposed signal control and segregated provision for pedestrians and cyclists to negotiate this layout would improve existing safety and operation of the junction, together with a reduced speed limit on approaches to and through the junction.

13.5.1.4 The existing access for Arundel & District Hospital would be stopped up and a new access provided to the eastbound carriageway of the A27 only. The existing access to Tortington Lane would also be stopped up and replaced with a new junction to the westbound carriageway only. Access from/to the other carriageway would be via u-turn at the next adjacent junction.

13.5.1.5 All other existing junctions and accesses onto the A27 between Long Lane and Ford Road would be stopped up, with local north-south highway movements served by a new overbridge and access to/from the A27 provided by local link roads and at-grade side roads to the north and south of the carriageway at Long Lane. The existing access at Jarvis Road would also be stopped up. Access would be via the existing road network to Ford Road. Reducing the number of side roads and accesses on the A27 will improve safety and operation on this section.

Tie-in Points

13.5.1.6 Two new junctions would be provided at the east and western extents with this option; a grade separated dumb-bell junction at the existing Crossbush roundabout, to the east, and an overbridge to the west of The White Swan, together with at-grade side roads to the north and south of the carriageway at Park Farm (W), to the west.

13.5.1.7 To the west of the White Swan, alongside the westbound A27, there are existing at-grade accesses to Arundel Arboretum and residential properties. All accesses would be stopped up and diverted, via a new local road to the south of the A27, with 'left in/left out' mainline access via the new Park Farm (W) junction. Whilst reducing the number of side roads and accesses will improve safety and operation on this section of the A27, the potential for higher approach speeds on the new widened dual section will require further consideration in development of this option in PCF Stage 3 (Preliminary Design) to reduce safety risk at the Park Farm (W) and Binsted Lane junctions. Proposed considerations include provision of advanced warning signing of the side roads, maximising inter-visibility and review of merge/diverge taper lengths to ensure safe accommodation of movements to and from the mainline.

13.5.1.8 The dumb-bell double roundabout proposal for Crossbush interchange would improve safety and operation of this junction, by reducing the circulating flow past each entry and the higher circulatory speeds associated with the existing layout. Signal control could also improve safety and performance and it is recommended that this is considered where pedestrian and cyclists would cross the A27 slip roads at Crossbush junction.

Departures from Standards

13.5.1.9 Option 1V9 has 21 Departures from Standard and 11 Relaxations from Standard. Those of more specific safety concern, and requiring further consideration in PCF Stage 3 (Preliminary Stage 3), are summarised as follows:

Eastbound:

- D03 – Ch. 0500-0590, D04 – Ch. 0590-0680: Sight stopping distance 4-5 steps below desirable minimum and horizontal alignment at D04 3 steps below desirable minimum – safety considerations to include potential impact on the White Swan pub and Arundel Cricket Club if any access to be retained to/from A27 mainline carriageway.
- D06 – Ch. 1180-1570, D18 – Ch. 1720-1900: D06 Sight stopping distance 3 steps and vertical crest 2 steps below desirable minimum and D18 below standard weaving length – safety considerations to include potential conflict between road users entering/exiting the only access for Arundel & District Community Hospital.
- D17 – Ch. 4370-4610: Below standard weaving length – safety considerations to include potential conflict between road users merging with existing A27 eastbound mainline and those exiting the lay-by.

Westbound:

- D14 – Ch. 2540-2090, D13 – Ch. 2090-1450: Sight stopping distance 2 steps and vertical sag 4 steps below desirable minimum – safety considerations to include forward visibility on approach to/through proposed Ford Road hamburger roundabout.
- D12 – Ch. 1430-0720: Sight stopping distance 5 steps, horizontal alignment 3 steps, vertical crest 2 steps below desirable minimum – safety considerations to include inter-visibility between road users exiting/entering the A27 from Binsted Lane/Tortington Lane priority junction and those on the mainline, and access arrangements for properties at the junction mouth.
- D11 – Ch. 0720-0590, D19 – Ch. 0790-0140: Sight stopping distance 2 steps, horizontal alignment 3 steps, vertical sag 2 steps below desirable minimum; with reduced weaving length – safety considerations to include inter-visibility between road users entering the A27 from Binsted Lane and exiting/entering from Park Farm and the mainline.

13.6 Option 3V1 Assessment

Overall Alignment

13.6.1.1 The overall horizontal alignment of Option 3V1 includes curves and transitions that are generally within the desirable minimum (1,020m radius) for a 120kph design speed, other than one curve which is relaxed to 720m.

13.6.1.2 The route includes vertical (crest and sag) curves that are generally within the desirable minimum for a 120kph design speed (K=182), other than one short crest curve which is relaxed to K=100.

Structures and Junctions

13.6.1.3 Nine new or modified structures are proposed along this alignment option to maintain existing highway, PRoW and rail connections, or passage over waterways. The whole of this route alignment is offline, tie-ing in at the existing access for Havenwood Caravan Park, to the west, and with Crossbush Junction to the east. The access for the Caravan Park would be stopped up, with alternative access provided via Binsted Lane.

Tie-in Points

13.6.1.4 A new overbridge will be provided at the western tie-in and a new grade separated double dumb-bell junction at the existing Crossbush roundabout at the eastern extent. The roundabout would improve safety and operation of the Crossbush junction by reducing the circulating flow past each entry and the higher circulatory speeds associated with the existing layout. Signal control could also improve safety and performance and it is recommended that this is considered where pedestrian and cyclists would cross the A27 slip roads at Crossbush junction.

Departures from Standards

13.6.1.5 Option 3V1 has 10 Departures from Standard and 21 Relaxations from Standard. Those of more specific safety concern, and requiring further consideration at subsequent stages of design, are summarised as follows:

Eastbound:

- D10 – Ch. 7830-8070: Below standard weaving length – safety considerations to include potential conflict between road users merging with existing A27 eastbound mainline and those exiting the lay-by.

Westbound:

- D07 – Ch. 3230-2770, D06 – Ch. 2770-2700, D05 – Ch.2700-2610: Sight stopping distance 1-2 steps and horizontal alignment 1 step below desirable minimum – safety considerations to include inter-visibility between road users entering the A27 westbound from the western tie-in overbridge and those on the mainline.

13.7 Option 4/5AV1 Assessment

Overall Alignment

13.7.1.1 The overall horizontal alignment of Option 4/5AV1 includes curves and transitions that are generally within the desirable minimum (1,020m radius) for a 120kph design speed. However, the radii on the section between Binsted Lane (W) overbridge and the PRoW overbridge, is 510m, which is 2 steps below the desirable minimum (1020m radius) for a 120kph design speed. If this design were to be taken forward for further development it is recommended that this is given further consideration to mitigate potential safety risk on this section of the route.

13.7.1.2 The route includes vertical (crest and sag) curves that are generally within the desirable minimum for a 120kph design speed (K=182), other that one short crest curve which is relaxed to K=100.

Structures and Junctions

13.7.1.3 Eleven new or modified structures are proposed along this alignment option to maintain existing highway, PRoW and rail connections, or passage over waterways. The whole of this route alignment is offline, tie-ing in at the junction with Shellbridge Road/Yapton Lane, to the west, and with Crossbush roundabout to the east.

13.7.1.4 At Binsted Lane (W) overbridge there are new and existing side roads and accesses located to the south, within close proximity of the elevated section of carriageway to accommodate the proposed overbridge. There are also properties to the north and south of Tortington Lane overbridge that would be located close to the elevated sections of carriageway required to accommodate this structure. Subsequent scheme development will need to ensure adequate inter-visibility to reduce the risk of collisions between vehicles on approach to/exit from the bridges and vehicles turning into/out of the side roads and properties close to the overbridges. Similarly, the bend in the carriageway on the local road to the north of Binsted Lane (E) overbridge will require further consideration to encourage reduced speeds and enable safe negotiation of this bend on approach to and exit from the overbridge.

Tie-in Points

13.7.1.5 A new grade separated dumb-bell junction at the existing Crossbush roundabout would provide the tie-in with the existing dual carriageway at the eastern extent. This double roundabout layout would improve safety and operation of this junction, by reducing the circulating flow past each entry and the higher circulatory speeds associated with the existing layout. Signal control could also improve safety and performance and it is recommended that this is considered where pedestrian and cyclists would cross the A27 slip roads at Crossbush junction.

13.7.1.6 At the western extent the bypass would tie-in with the existing dual carriageway just to the west of the Shellbridge Road/Yapton Lane junction. At this point an overbridge, together with left in/left out at grade junctions with Shellbridge Road and to access Yapton Lane, provide local connection with the mainline. Both junctions are located on the curve of a bend with a radius of 720m, 1 step below the desirable minimum (1,020m radius) for a 120kph design speed. However, merge and diverge tapers, as proposed, would more safely accommodate vehicles slowing to leave the carriageway or accelerating to join the mainline. The access to Yapton Lane from the A27 westbound diverge is close to the exit which raises some concern where queuing back to the mainline may result in rear end shunts, or reduced inter-visibility between road users exiting the mainline and those accessing or exiting Yapton Lane may result in side swipes. The position of Yapton Lane side road will require further consideration in subsequent stages of design, to maximise visibility and reduce speeds immediately on exit from the A27.

13.7.1.7 It is also proposed with this option to close the existing at-grade junctions with Mill Road and Tye Lane, located to the west of Shellbridge Road and Yapton Lane. Reducing the number of entries and exits to the A27 will improve safety on the mainline, particularly given the proximity of these junctions to the tie-in. However, it will be important in PCF Stage 3 (Preliminary Design) to consider whether the impact of re-routed traffic currently using these junctions to access or exit the A27 will have any adverse impact on safety and operation of other neighbouring local roads, in particular Yapton Lane, requiring wider mitigation measures.

Departures from Standards

13.7.1.8 Option 4/5AV1 has 16 Departures from Standard and 21 Relaxations from Standard. Those of more specific safety concern, and requiring further consideration at subsequent stages of design, are summarised as follows:

Eastbound:

- D01 – Ch. 0820-1260, D02 – Ch. 1260-1420: Sight stopping distance 2 steps, horizontal alignment 1 step and vertical crest 1 step below desirable minimum – safety considerations to include reduced inter-visibility and potential conflict between A27 eastbound road users and those entering/exiting the A27 from the western tie-in junction.
- D05 – Ch. 1820-1850, D06 – Ch. 2050-2530: Sight stopping distance 1-2 steps and horizontal alignment 2 steps below desirable minimum – safety considerations to include potential to improve the radii between Binsted Lane (W) overbridge and the PRoW overbridge.
- D08 – Ch. 6370-7030: Sight stopping distance 2 steps below desirable minimum – safety considerations to include potential impact of reduced forward visibility to diverge for Crossbush junction, particularly in the event of any queuing back from the slip-road onto the A27 mainline.
- D15 – Ch. 7830-8070: Below standard weaving length – safety considerations to include potential conflict between road users merging with existing A27 eastbound mainline and those exiting the lay-by.

Westbound:

- D11 – Ch. 2610-2140: Sight stopping distance and horizontal alignment 2 steps below desirable minimum – safety considerations to include potential to improve the radii between the PRoW overbridge and Binsted Lane (W) overbridge.
- D10 – Ch. 1860-1680, D09 – Ch. 1680-1030: Sight stopping distance 1-2 steps, horizontal alignment 2 steps and vertical crest 1 step below desirable minimum – safety considerations to include reduced inter-visibility and potential conflict between A27 westbound road users and those entering/exiting the A27 from the western tie-in junction and proximity of Yapton Road access, immediately to the south of the tie-in junction.

13.8 Option 4/5AV2 Assessment

Overall Alignment

13.8.1.1 The overall horizontal alignment of Option 4/5AV2 includes curves and transitions that are within the desirable minimum (1,020m radius) for a 120kph design speed.

13.8.1.2 The route includes vertical (crest and sag) curves and these are within the desirable minimum for a 120kph design speed (K=182).

Structures and Junctions

13.8.1.3 Twelve new or modified structures are proposed along this alignment option to maintain existing highway, PROW and rail connections, or passage over waterways. The whole of this route alignment is offline, tie-ing in at the junction with Shellbridge Road/Yapton Lane, to the west, and with Crossbush roundabout to the east.

13.8.1.4 At Tortington Lane overbridge there are a number of properties to the north and south of the bridge that would be located close to the elevated sections of carriageway required to accommodate this structure. Subsequent scheme development will need to ensure adequate inter-visibility to reduce the risk of collisions between vehicles on approach to/exit from the bridge and vehicles turning into/out of the side roads and properties close to the overbridge. Similarly, the bends in the carriageway on the local road both to the north and south of Binsted Lane (E) overbridge will require further consideration to encourage reduced speeds and enable safe negotiation of these bends on approaches to and exits from the overbridge.

13.8.1.5 The length of the merge lane at westbound entry to the mainline from Binsted Lane (W) overbridge raises some concern for the ability of road users to accelerate to meet anticipated traffic speeds on the mainline and safely merge where the taper meets lane 1. Consideration of the potential to increase the length of the merge lane is recommended in subsequent stages of design.

Tie-in Points

13.8.1.6 A new grade separated dumb-bell junction at the existing Crossbush roundabout would provide the tie-in with the existing dual carriageway at the eastern extent. This double roundabout layout would improve safety and operation of this junction, by reducing the circulating flow past each entry and the higher circulatory speeds associated with the existing layout. However, this will require modelling to assess capacity to accommodate existing and future traffic flow without adverse impact upon safety. Signal control could also improve safety and performance and it is recommended that this is considered where pedestrian and cyclists would cross the A27 slip roads at Crossbush junction.

13.8.1.7 At the western extent the bypass would tie-in with the existing dual carriageway at the Shellbridge Road/Yapton Lane junction. Access into and out of these side roads is retained at-grade with this option, with left-in/left-out' only permitted movements. It is also proposed with this option to close the existing at-grade junctions with Mill Road and Tye Lane, located to the west of Shellbridge Road and Yapton Lane. Reducing the number of entries and exits to the A27 will improve safety on the mainline, particularly given the proximity of these junctions to the tie-in. However, it will be important to consider whether restricting any existing movements will have adverse impact on safety and operation of other neighbouring local roads where traffic will re-route and thereby require wider mitigation measures.

Departures from Standards

13.8.1.8 Option 4/5AV2 has 10 Departures from Standard and 8 Relaxations from Standard. Those of more specific safety concern, and requiring further consideration at subsequent stages of design are summarised as follows:

Eastbound:

- D08 – Ch. 0515-1070: Below standard weaving length – safety considerations to include potential late lane-changing and conflicts between A27 road users and those exiting/entering the mainline from Shellbridge Road or exiting at Binsted Lane diverge.
- D06 – Ch. 5290-5950: Sight stopping distance 2 steps below desirable minimum – safety considerations to include potential impact of reduced forward visibility to diverge for Crossbush junction, particularly in the event of any queuing back from the slip-road onto the A27 mainline.
- D07 – Ch. 6750-6990: Below standard weaving length – safety considerations to include potential conflict between road users merging with existing A27 eastbound mainline and those exiting the lay-by.

Westbound:

- D09 – Ch. 0910-0380: Below standard weaving length – safety considerations to include potential late lane-changing and conflicts between A27 road users and those entering the mainline from the Binsted Lane merge and exiting/entering the mainline at Yapton Lane.

13.9 Option 5BV1 Assessment

Overall Alignment

13.9.1.1 The overall horizontal alignment of Option 5BV1 includes curves and transitions that are generally within the desirable minimum (1,020m radius) for a 120kph design speed, other than two curves which are relaxed to 720m.

13.9.1.2 The route includes vertical (crest and sag) curves that are generally within the desirable minimum for a 120kph design speed (K=182), other than two short crest curves which are relaxed to K=100 and K=140.

Structures and Junctions

13.9.1.3 Thirteen new structures are proposed along this alignment option to maintain existing highway, PROW and rail connections, or passage over waterways. At Yapton Lane, Binsted Lane West and East, and Tortington Lane overbridges there are both new and existing side roads and accesses located within close proximity of the elevated sections of carriageway to accommodate the proposed overbridges. Subsequent scheme development will need to ensure adequate inter-visibility to reduce the risk of collisions between vehicles on approach to/exit from the bridge and vehicles turning into/out of side roads and properties close to the overbridge.

Tie-in Points

13.9.1.4 Three new junctions would be provided at the east and western extents with this option; a grade separated dumb-bell junction at the existing Crossbush roundabout, to the east, a loop junction on the westbound carriageway of the proposed A27 located at Mill Road and an at-grade four arm roundabout on the existing A27 at Mill Road/Tye Lane, to the west.

13.9.1.5 At the Mill Road/Tye Lane junction there is concern that the existing national speed limit and a relatively straight horizontal alignment through this section will enable high approach speeds, with the risk of over-shoots, side swipes and shunts at the roundabout and high severity injury. Further design development would need to consider measures to reduce speeds on approach, including a reduced speed limit, advanced warning signing and transverse carriageway markings on approaches, together with reduced entry width and increased deflection at the roundabout itself.

13.9.1.6 The dumb-bell double roundabout proposal for Crossbush interchange would improve safety and operation of this junction, by reducing the circulating flow past each entry and the higher circulatory speeds associated with the existing layout. The Mill Road/Tye lane roundabout layouts will require further junction modelling to assess capacity to accommodate existing and future traffic flow without adverse impact upon safety in PCF Stage 3 (Preliminary Design) if this option is taken forward. Signal control could also improve safety and performance and it is recommended that this is considered where pedestrian and cyclists would cross the A27 slip roads at Crossbush junction.

Departures from Standards

13.9.1.7 Option 5BV1 has 9 Departures from Standard and 18 Relaxations from Standard. Those of more specific safety concern, and requiring further consideration at subsequent stages of design, are summarised as follows:

Eastbound:

- D04 – Ch. 6365-7035: Sight stopping distance 2 steps below desirable minimum – safety considerations to include potential impact of reduced forward visibility to diverge for Crossbush junction, particularly in the event of any queuing back from the slip-road onto the A27 mainline.
- D09 – Ch. 7830-8070: Below standard weaving length – safety considerations to include potential conflict between road users merging with existing A27 eastbound mainline and those exiting the lay-by.

Westbound:

- D06 – Ch. 1045-0745, D05 – Ch. 0745-0535: Sight stopping distance 2 steps, horizontal alignment 1 steps and vertical crest 1 step below desirable minimum – safety considerations to include reduced inter-visibility and potential conflict between A27 road users and those entering the mainline at the western tie-in junction.

13.10 Conclusion

13.10.1.1 There have been 81 personal injury collisions recorded in the latest 5-year period (2013-2017) on the existing 8km section of the A27 under review; resulting in 121 casualties. Over the full length a broadly similar number of PICs and resulting casualties have been recorded each year; on average 16 PICs and 24 casualties. Although there have been no fatalities in the latest 5-year period 12% (15) of all casualties are recorded as serious, increasing to 19% of all casualties in 2017. Whilst the 5-year KSI rate is comparable with national statistics for all rural A roads, the 2017 rate is significantly higher. National rates, as presented in RCGB (2017), report KSIs as accounting for 13% of all casualties in the same 5-year period and 14% of all casualties in 2017.

13.10.1.2 More than half (47) of the PICs were recorded on the 3.6km existing single carriageway section of the A27, with 21% (17) recorded on both the dual sections to the west (3.8km) and east (0.6km) of the town. In turn, more than half (8) of all PICs resulting in serious injury were recorded on the single carriageway section, with again 21% (3) recorded on both the dual sections to the west and east.

13.10.1.3 The distribution of PICs recorded on the A27 and factors contributing to their occurrence are common to a heavily trafficked, high speed, strategic rural A road of this nature; with key collision types identified as following.

- Loss of control - 14 collisions: 6 on single carriageway, 5 on dual west, 3 on dual east.
- Rear-end shunts in traffic - 13 collisions: all on single carriageway section.
- Side roads/accesses - 10 collisions: 9 on single carriageway, 1 on dual west.
- Rear-end shunts at roundabouts - 21 collisions: 10 at Crossbush roundabout, 9 at Ford Road Roundabout.

13.10.1.4 The objectives of the A27 Arundel upgrade/bypass include to improve safety and operation, to ease congestion and improve journey-time reliability on both the strategic route and local roads in and around the town. It is anticipated that key aspects of PCF Stage 2 design options, including dualling, improved horizontal and vertical route geometrics, reduced points of access to the route, and provision of new/modified layouts for key junctions will significantly improve capacity and flow, as well as having a positive impact on the general safety performance, and specific types of collision reported on this section of the A27.

13.10.1.5 With the existing route running through South Downs National Park and flanked with pockets of ancient woodland, environmental sensitivities present a significant engineering challenge for all route options. As such, all options incorporate a number of Relaxations/Departures from Standard to minimise landtake and adverse environmental impact (see Chapter 8 for more details). Assessment of the designs for each of the route improvement options, and associated relaxations and departures from standard, has not identified any significant safety issues at this stage that cannot, without further consideration, be addressed through subsequent stages of preferred route design development.

13.10.1.6 The safety performance of rural roads relies heavily on road user behaviour. On this section of the A27, for 95% (122) of the PICs, road user behaviour was cited as the primary contributory factor, with 3% (4) attributable primarily to the road environment and 2% (2) vehicle related. In comparison with 2017 national statistics for all A roads the percentage of PICs on the A27 primarily attributable to road user behaviour were significantly higher; with national PIC contributory factors presented in RCGB as 87% attributable to road user behaviours. Route upgrade and increased capacity will, by necessity for a strategic route, improve flow and enable higher vehicle speeds on this section of the A27. However, it is important that subsequent preferred route design development encompasses consideration of measures to advise of, encourage, enforce/self-enforce appropriate or reduced vehicle speeds where there are localised changes in the highway environment, or where a build-up of traffic during peak periods may introduce increased risk of any section of the route or on approach to/at junctions along the route.

13.10.1.7 Given the predominantly rural nature of the existing route only 8% (6) of the PICs involved non-motorised road users; 6% (5) involving pedal cyclists and 2% (1) involving a pedestrian. However, PICs involving powered two wheelers, as a more vulnerable road user, accounted for 12% (10) of all personal injury accidents recorded in the 5-year period under review.

13.10.1.8 More than 80% (13) of the PICs involving powered two wheelers, pedal cyclists and pedestrians, as collective vulnerable road users, occurred at junctions or accesses along the route. Safer accommodation of powered two wheelers at roundabout controlled junctions should be an important design consideration at subsequent stages of preferred route design development. Regarding accommodation of pedestrians, cyclists and equestrians, the area through which the proposed scheme options would pass also contains several Public Rights of Way (PROW), with further potential for safety risk/severance at existing desire lines. Route options incorporate some provision for pedestrians, cyclists and equestrians. However, the ‘Walking, Cycling and Horse-Riding Assessment’ should be used to assist the project team in developing the preferred route option design to safely accommodate existing movements and enhance non-motorised user facilities.

Abbreviations

Acronym	Explanation
KSI	Killed Seriously Injured
PCF	Project Control Framework
PIC	Personal Injury Collision
PRoW	Public Right of Way
RCGB	Reported Road Casualties Great Britain
SRN	Strategic Road Network
WCHR	Walking Cycling and Horse Riding

Glossary

Term	Explanation
Accident/ Collision[16]	Involves personal injury occurring on the public highway (including footways) in which at least one road vehicle or a vehicle in collision with a pedestrian is involved and which becomes known to the police within 30 days of its occurrence. One accident may give rise to several casualties.
Casualty[17]	A person killed or injured in an accident. Casualties are sub-divided into killed, seriously injured and slightly injured
Chainage	Used to measure the horizontal distance along an imaginary line made up of straights and curves. For the A27 Arundel Bypass, the chainage used to describe the distance along the proposed road, measured from the scheme extents in a west to east direction.
Departures and Relaxations from Standard	Relaxations are written into design standards to introduce limited flexibility in certain circumstances allowing designers to design to less stringent requirements than those specified in a standard. These need to be agreed with but not approved by the Project Sponsor. A departure from standard is any other variation or waiving

[16] DfT "Reported Road Casualties in Great Britain: notes, definitions, symbols and conventions – 2017" [Available online] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/743853/reported-road-casualties-gb-notes-definitions.pdf [accessed 07/8/19].
[17] Ibid

Term	Explanation
	from a requirement contained within the design standards and requires formal approval from the Project Sponsor.
Fatal accident	An accident in which at least one person is killed.
Injury accident	An accident involving human injury or death
Serious accident	One in which at least one person is seriously injured but no person (other than a confirmed suicide) is killed
Serious injury	An injury for which a person is detained in hospital as an "in-patient", or any of the following injuries whether or not they are detained in hospital: fractures, concussion, internal injuries, crushings, burns (excluding friction burns), severe cuts, severe general shock requiring medical treatment and injuries causing death 30 or more days after the accident. An injured casualty is recorded as seriously or slightly injured by the police on the basis of information available within a short time of the accident. This generally will not reflect the results of a medical examination, but may be influenced according to whether the casualty is hospitalised or not. Hospitalisation procedures will vary regionally
Severity	Of an accident; the severity of the most severely injured casualty (either fatal, serious or slight). Of a casualty; killed, seriously injured or slightly injured
Slight accident	One in which at least one person is slightly injured but no person is killed or seriously injured
Slight injury	An injury of a minor character such as a sprain (including neck whiplash injury), bruise or cut which are not judged to be severe, or slight shock requiring roadside attention. This definition includes injuries not requiring medical treatment

A27 Arundel Bypass Scheme Assessment Report

Chapter 14 – Operational, Technology and Maintenance Assessments

October 2020

CONTENTS

14 Operational, Technology and Maintenance Assessments

14.1 Introduction

14.1.1.1 This chapter provides a brief statement as to whether the 6 options described in Chapter 8 would have any significant implications for the following.

- For the safe and economic operation and maintenance of the completed Scheme.
- On the requirement for additional road side technology and the ability to provide maintenance in a safe manner on the completed Scheme.

14.1.1.2 The options are broadly classified as either online or offline. Option 1V5 and Option 1V9 are described as online because both use the existing A27 corridor west of Ford Road Junction. The four offline routes - Option 3V1, Option 4/5AV1, Option 4/5AV2 and Option 5BV1 all take a route to the south of the existing A27.

14.2 Operational Assessment

14.2.1.1 All options would operate as a dual two-lane carriageway and improve the operational performance of the A27 by reducing accidents, minimising delays and maintaining traffic flows.

14.2.1.2 The existing operational issues caused by the capacity of the existing single carriageway section of the A27 and capacity of the existing Crossbush, Causeway and Ford Road junctions would be removed as traffic diverts from the existing A27 to the Scheme.

14.2.1.3 Option 3V1, Option 4/5AV1, Option 4/5AV2, Option 5BV1 and Option 1V5 would have an operating regime of a modern all-purpose dual carriageway. These include:

- all-purpose dual 2 lane carriageway at national speed limit;
- clearway (no stopping order);
- 1m hard strips;
- grade separated junctions;
- no junctions with minor local roads; and
- no right turning movements.

14.2.1.4 This operating regime would be applied for the full length of the route as follows:

- Option 1V5 – 4.5km
- Option 3V1 – 6km
- Option 4/5AV1 – 7.2km
- Option 4/5AV2 – 6.9km
- Option 5BV1 – 8km

14.2.1.5 Option 1V9 has been designed with the same operating regime as the other options for 2.4km from the proposed Crossbush junction to where the route crosses Fitzalan Road. Then with a reduced standard operating regime for 2.1km west of Ford Road Junction. This would be due to the design features used on this section of the route (see Chapter 8 of this report). These features include:

- reduced cross section with no hard strips west of Ford Road junction;
- lower speed limits;
- left in left out at local accesses;
- traffic signal controlled junction at Ford Road roundabout with at grade pedestrian crossing facilities; and
- reduced alignment standard.

14.2.1.6 A strategy would need to be developed in Project Control Framework (PCF) Stage 3 (Preliminary Design) to ensure acceptable levels of compliance with any proposed speed limits adopted for Option 1V9. This could include speed enforcement technology.

14.2.1.7 Other operational factors relevant to the Scheme design have been noted.

- No laybys are proposed along the route (see Chapter 8).
- The Traffic Officer Service does not operate on the A27.

14.3 Technology Assessment

14.3.1.1 The Scheme is not expected to adopt technology to support operational regimes which manage traffic, for example variable mandatory speed limits and provide current information to drivers, for example variable message signs. Therefore, the technology provision for all options would be expected to be limited to the following.

- Traffic counter loops on the approaches to and departures from all new junctions.
- Sensors for the monitoring of water levels and water quality at highway drainage assets together with associated telemetry outstations.

14.3.1.2 In-addition Option 1V9 would require the provision of the following technology.

- The traffic signal control with either MOVA or SCOOT, associated traffic detector loops and pan-tilt-zoom closed circuit television cameras located at the proposed traffic signal controlled Ford Road Junction.
- Speed enforcement technology (see paragraph 14.2.1.6) west of the Ford Road Junction.

14.4 Maintenance Assessment

14.4.1.1 As the Scheme is in the early stages of development, it is usual that the design of various assets has not commenced. Assets would also vary depending on the route option identified as the preferred route. An initial Maintenance and Repair Strategy Statement Report[1] has been produced which identifies likely new assets and their possible locations regardless of route option.

14.4.1.2 The geometric departures from standard associated with the design of each option (see Chapter 8) would affect future traffic management arrangements for maintenance operations.

14.4.1.3 In particular traffic management arrangement for Option 1V9 would be affected by the following.

- Reduced forward visibility associated with an increased number of geometric departures and the reduced cross section.
- The presence of at grade junctions and accesses.

14.4.1.4 The increased number of geometric departures with Option 4/5AV1 at the approach to the western tie in junction (see Chapter 8) would also need to be considered when planning future traffic management arrangements for maintenance activities.

14.4.1.5 The four offline options retain access to the existing A27 west of Ford Road offering the opportunity to allow traffic to be temporarily diverted to the existing A27 in the event of a closure for a planned or unplanned event to avoid the existing lengthy diversion route via the A284, A259 and A29 or alternative via the existing A27, A284 and A29. This would be subject to agreement with West Sussex County Council on the future status of the bypassed section of the existing A27.

[1] WSP (September 2019) “Maintenance Repair Strategy Statement – A27 Arundel Bypass – PCF Stage 2 Further Consultation”

14.4.1.6 In contrast Option 1V5 would provide an opportunity to use the existing A27 between only the Crossbush and Ford Road junctions as a temporary diversion route. For Option 1V9 this would only be possible eastbound, as traffic movements would be restricted to this direction only at the existing River Arun / Fitzalan Road Bridge.

14.4.1.7 For which ever option is taken forward as the preferred route an assessment would be made in PCF Stage 3 of the benefits/dis-benefits of different central reserve road restraint systems. A similar assessment of the benefits/dis-benefits of soft or paved central reserve would be carried out considering both landscape and maintenance issues

14.4.1.8 All route options would need to be designed appropriately to avoid ongoing maintenance problems caused by settlement across the River Arun floodplain were the ground is known to be underlain by deep, soft alluvial soils. Earthworks would require ongoing inspection and monitoring of settlement and to assess for flood damage.

14.4.1.9 All route options included for a significant number of new structures including major bridge structures which would require on going inspection and repair.

14.4.1.10 The Scheme does not include for the required maintenance renewal works at the existing Arundel Station Bridge. This structure would be located on the de-trunked section of the existing A27 for all options and there would be a need to coordinate the required maintenance renewal works with the delivery of the Scheme.

Abbreviations

Abbreviation	Explanation
PCF	Project Control Framework
SCOOT	Split Cycle Offset Optimisation Technique
MOVA	Microprocessor Optimised Vehicle Actuation

Glossary

Term	Explanation
All-purpose road	A road for use by all classes of traffic.
Clearway	A clearway (also known as a No Stopping Order) is a special type of Traffic Regulation Order placed on numerous lengths of road in Great Britain and Northern Ireland to prohibit stopping, loading, parking, and waiting. Their use is granted by the powers given in Section 9 of the Road Traffic Regulation Act 1984
Departures and Relaxations from Standard	Relaxations are written into design standards to introduce limited flexibility in certain circumstances allowing designers to design to less stringent requirements than those specified in a standard. These need to be agreed with but not approved by the Project Sponsor. A departure from standard is any other variation or waiving from a requirement contained within the design standards and requires formal approval from the Project Sponsor.
Dual Carriageway	A road that has two separated carriageways for travel in opposite directions.
Dual 2 lane Carriageway	A road that has two separated carriageways for travel in opposite directions with 2 lanes in each direction
Grade Separated Junction	A Grade Separated Junction (GSJ) is a junction where the intersecting roads are separated at different heights, usually by a bridge, so that traffic flows do not intersect one another. For the A27 Arundel Bypass only traffic on the proposed A27 would be free flowing.
Hard Strip	A surfaced strip that abuts a carriageway. Usually not more than 1 m in width
Traffic Officer Service	Highways England Traffic Officer service patrols England's motorways, helping to keep traffic flowing smoothly.

A27 Arundel Bypass Scheme Assessment Report

Chapter 15 – Appraisal Summary

October 2020

CONTENTS

15 Appraisal summary

15.1 Appraisal summary tables (ASTs)

15.1.1.1 Appraisal summary tables with corresponding worksheets have been produced in accordance with the Department for Transport's Transport Analysis Guidance[1] (WebTAG). The summary tables are reproduced in Appendix F of this report.

15.2 Additional Assessments

15.2.1.1 The assessment and appraisal reported in Chapters 8 to 12 represents the work undertaken in line with the DfT transport appraisal guidance (WebTAG). This work is summarised into the Appraisal Summary Tables in Appendix F.

15.2.1.2 The following sections discusses supplementary assessment work of potential environmental and social impacts of the Scheme which have informed the identification of the preferred route in Chapter 16 of this report.

15.3 South Downs National Park Assessment

15.3.1.1 Highways England prepared an assessment of the effects of the Scheme options on the SDNP special qualities.

15.3.1.2 The SDNP special qualities assessment was prepared to allow the South Downs National Park Authority (SDNPA), Highways England, Department for Transport and other stakeholders, to consider the SDNP special qualities in assessment, option selection processes, and decision making.

15.3.1.3 The SDNP special qualities assessment is provided in a Technical Note attached to Environmental Assessment Report[2].

[1] https://www.gov.uk/guidance/transport-analysis-guidance-webtag
[2] WSP on behalf of Highways England (August 2019) "A27 Arundel Bypass Environmental Assessment Report, Appendix 1-1"

15.3.2 Background to the SDNP Special Qualities Assessment

15.3.2.1 The SDNPA developed a list of special qualities with input from the public including residents and visitors, landowners and farmers, businesses, school pupils and parish councils. One of the purposes of the special qualities is to act as a baseline for measuring changes over time and to hold the National Park Authority and its partners to account for their contributions to its future. The special qualities are:

- Diverse, inspirational landscapes and breathtaking views
- A rich variety of wildlife and habitats including rare and internationally important species
- Tranquil and unspoilt places
- An environment shaped by centuries of farming and embracing new enterprise
- Great opportunities for recreational activities and learning experiences
- Well-conserved historical features and a rich cultural heritage
- Distinctive towns and villages and communities with real pride in their area.

15.3.2.2 The key piece of legislation and policy which resulted in the production of this report are the National Parks and Access to the Countryside Act 1949 which places a duty on certain bodies and persons, including public bodies such as Highways England, to have regard to the purposes for which National Parks are designated.

15.3.2.3 The statutory provisions outlined above were reflected in the Scheme objective: to 'Respect the SDNP and its special qualities in our decision-making'.

15.3.2.4 The SDNPA Position Statement on the A27 Route Corridor (attached as Appendix A of the SDNP assessment[3]) sets out the expectation that Highways England will use the framework of the seven special qualities to assess the specific impacts of the Scheme options.

15.3.3 Purpose

15.3.3.1 The purpose of the SDNP special qualities assessment was to provide an assessment of the impacts of the Scheme on the 'special qualities' of the SDNP.

[3] Ibid

15.3.3.2 This report addresses the request for a specific assessment against the special qualities, and informs the consideration of the Scheme options against the relevant Scheme objective.

15.3.3.3 The SDNP special qualities assessment aims to provide information to enable the special qualities to be considered in the option selection process and subsequent decision-making processes.

15.3.4 Methodology

15.3.4.1 The environmental assessments undertaken for the Scheme generally follow the assessment process outlined in the Design Manual for Roads and Bridges (DMRB).

15.3.4.2 The assessment of the majority of the special qualities are covered by environmental assessments covered within the Environmental Assessment Report prepared under DMRB guidance. However, the existing assessments do not align directly with the special qualities and were re-focussed and supplemented to specifically address the special qualities.

15.3.4.3 Certain impacts, or elements of impacts, are not assessed through DMRB processes and where this is the case, professional judgement has been applied.

15.3.5 Outcomes of the SDNP special qualities assessment

15.3.5.1 The outcomes of the SDNP special qualities assessment have been provided to the SDNP Authority for its consideration.

15.3.5.2 The SDNP special qualities assessment will also be considered, as part of a wider suite of engineering, traffic, cost, environmental and other assessments, in the overall comparison of Scheme options, to arrive at a Preferred Route.

15.4 Social Impact Assessment (SIA)

15.4.1.1 A Social Impact Assessment[4] (SIA) was prepared for PCF Stage 2 as a supplementary Technical Note.

15.4.1.2 The intent of the SIA was to collate the relevant SIA-specific sections of a range of PCF Stage 2 documents into a single document that sets out the assessments for each Scheme option.

[4] Interim SIA

15.4.1.3 Work done to date via current PCF Stage 2 assessments and associated reports assesses social impacts across a variety of topics. However, it has been identified that issues such as residential amenity, and way of life (which are a combination of many of the topics covered within DMRB and WebTAG) are not fully summarised for each Scheme option within the existing reports such as the EAR and SAR.

15.4.2 Purpose of the Interim Social Impact Assessment

15.4.2.1 The purpose of the SIA report[5] was to consolidate the social impact assessment (SIA) information provided in the existing PCF Stage 2 products for the A27 Arundel Bypass scheme in order to improve interpretation of the potential social impacts.

15.4.2.2 Specifically, the objectives of this report were to:

- Collate SIA related assessment and appraisals into a single, cohesive report.
- Assist with the assessment of the Scheme options against the Scheme objective 'Throughout the design and delivery stages, the scheme should ensure that customers and communities are fully considered.'

15.4.3 Overview of Social Impact Assessment

15.4.3.1 In general, social impact assessment includes the process of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment.

15.4.3.2 SIA is best understood as an umbrella or overarching framework that embodies the evaluation of all impacts on humans and on all the ways in which people and communities interact with their socio-cultural, economic and biophysical surroundings.

[5] Ibid

15.4.3.3 Social impacts may occur where there are changes to one or more of the following[6]:

- people's way of life
- their culture
- their community
- their political systems
- their environment
- their health and wellbeing
- their personal and property rights
- their fears and aspirations.

15.4.4 Social Impact Assessment source documents

15.4.4.1 The SIA draws on information from the following reports, prepared as part of PCF Stage 2 for the Scheme:

- Project Control Framework (PCF) Stage 2 (2019) Environmental Assessment Report (EAR).
- PCF Stage 2 (2019) WebTAG A3 Environmental Impacts Worksheet.
- PCF Stage 2 (2019) Equality Impact Assessment (EqIA).
- PCF Stage 2 (2019) Wider Economic Impacts Study Report.
- PCF Stage 2 (2019) Combined Modelling and Appraisal Report.
- PCF Stage 2 - Report on Public Consultation (May 2020).

15.4.5 Overview of Social Impact Assessment scope and methods

15.4.5.1 The scope of the SIA comprised the review and consolidation of the reports listed above. The assessment methodology utilised the existing DMRB and WebTAG methodology for the assessment and appraisal of environmental and social impacts. Existing information and data from the Equalities Impact Assessment (EqIA) was also utilised.

[6] International Association for Impact Assessment. Social Impact Assessment Definition. https://www.iaia.org/wiki-details.php?ID=23 [Accessed June 2019]

15.4.5.2 The political systems and culture SIA sub-topics were 'scoped out' as these topics were considered to be unaffected by the Scheme. The environment sub-topic was largely scoped out, as impacts upon the environment are fully reported in the EAR. However, relevant environmental topics (for example, air quality, noise and population and health) were also considered in the Interim SIA. Further information on the Scope and Methodology used is presented in the Interim SIA[7].

15.4.5.3 The data and assessments gathered from the above data sources provide predominantly objective data following prescribed methods. It is proposed to supplement the objective assessments with 'subjective' information collected from responses to the consultation questionnaire. Certain questions in the questionnaire seek the opinions of respondents, so that these may be collated and included in the SIA.

15.4.6 Outcomes of the Interim and Final SIA and use in the Options Selection process

15.4.6.1 The SIA Source Documents (listed above) (with the exception of the EqIA) are developed as standard reports following DMRB and WebTAG guidance. These reports will be considered, as part of a wider suite of engineering, traffic, cost, environmental and other assessments, in the overall comparison of Scheme options, to arrive at a Preferred Route. This is the standard practice as part of the PCF process. As such, much of the objective data provided in the Interim SIA will be captured in the Option Selection process in PCF Stage 2.

15.4.6.2 The responses to SIA related questions in the consultation questionnaire will be reported in the Report on Consultation and considered in the option selection process.

15.4.6.3 The outcomes of assessments contained in the SIA report will form a compilation of reports and data sets that can be considered in the context of the Scheme objective 'Throughout the design and delivery stages, the scheme should ensure that customers and communities are fully considered.'

Abbreviations

Abbreviation	Explanation

[7] Interim SIA

DMRB	Design Manual for Roads and Bridges
EAR	Environmental Assessment Report
EqIA	Equality Impact Assessment
NN NPS	National Networks National Policy Statement
SDNP	South Downs National Park
SDNPA	South Downs National Park Authority
WebTAG	Web-based Transport Appraisal Guidance

Glossary

Term	Explanation
WebTAG	WebTAG (Web-based Transport Analysis Guidance) is the Department for Transport's transport appraisal guidance and toolkit. It consists of software tools and guidance on transport modelling and appraisal methods that are applicable for highways and public transport interventions (The word 'interventions' is used to cover the entire range of measures from demand management measures through to major engineering projects).

A27 Arundel Bypass Scheme Assessment Report

Chapter 16 – Summary of Further Consultation

October 2020

CONTENTS

16 Summary of further consultation

16.1.1.1 The further public consultation, which took place between 30 August and 24 October 2019, presented the latest available information on the revised options for the scheme.

16.2 Further consultation arrangements

16.2.1.1 A variety of methods were used to raise awareness of the further consultation, including:

- Letters delivered to more than 78,000 properties in the region
- Local newspaper advertising
- Social media posts
- Email bulletins to people who had registered for updates about the scheme
- Deposit points, containing posters, reference copies of the technical reports and copies of the brochure and consultation response form

16.2.1.2 Ten staffed public exhibitions were held at different venues around the area, to give people the opportunity to ask specific questions of the project team. In addition, there were four unstaffed exhibitions, where people could view further consultation material.

16.2.1.3 The main mechanism for responding was via the Highways England project webpage (www.highwaysengland.co.uk/a27arundel). Paper copies of the consultation response form could also be submitted via Freepost or returned at a further consultation event, while people were also able to submit their feedback by letter or email.

16.2.1.4 During the further consultation period, some corrections were necessary to the technical documents that underpinned the principal further consultation materials. The primary further consultation materials were also corrected accordingly. These corrections were published from the 13 September (the second week of the eight-week further consultation period) and widely publicised via:

- Letters to those that were written to previously
- Email bulletins to those who registered for email updates
- Online updates

16.2.1.5 Anyone who had already submitted a response and wanted to alter their comments as a result of the corrections was given the opportunity to do so.

16.2.1.6 As part of our work to collate and review the responses to the further consultation, we identified some issues around the way certain pieces of information were presented. Following this, we undertook further reviews of the published documents and identified additional errors within the technical information that underpinned the principal further consultation materials.

16.2.1.7 While the corrections required to be made to the technical information did not alter our overall assessments of each of the options, people who took part in the further consultation were invited to consider the corrections and let us know if their opinions had changed as a result. This further review period took place between 3 February and 1 March 2020. The corrections were publicised online, via stakeholder emails, social media and a letter drop to the same distribution area that was originally notified of the further consultation. Printed copies of the corrected information were also available via local deposit points.

16.2.1.8 For more details on the consultation arrangements, please refer to the Report on Further Consultation.

16.3 Effectiveness of further consultation

16.3.1.1 A total of 4,945 consultation response forms were completed during the further consultation period, comprising 4,245 online and 700 paper copies. Of these, 163 were submitted on behalf of an organisation. In addition, 113 other written responses were received via letter or email; 59 of which were submitted by individuals and 54 by organisations.

16.3.1.2 Two email response campaigns opposing the proposals were also launched during the further consultation: one in support of the ‘Arundel Alternative’ (a wide single carriageway option that was promoted locally) prompted 575 emails. The other, led by the Woodland Trust, objected to all of the proposed options put forward as part of the further consultation due to environmental impacts and prompted 1,449 emails.

16.3.1.3 The majority of respondents (91%) who completed the consultation response form found the further consultation materials useful to some extent in answering their questions about the A27 around Arundel. Thirty-eight per cent of respondents felt that the materials were useful, while a further 53% found them useful to a certain extent. Conversely, 9% of respondents did not find the materials useful.

16.3.1.4 More than 1,600 people attended the staffed exhibitions. Around two-thirds of those who visited an exhibition and completed the response form indicated that they found it to be very useful (22%) or useful (42%). In contrast, one fifth of respondents had not found the event to be useful in addressing their questions about the options (12% described it as 'not useful' and 8% as 'not at all useful').

16.4 Consultation response form analysis

16.4.1.1 The consultation response form included a series of closed ('tick box') and open (free-text) questions. Responses to free-text questions were grouped thematically for analysis and reporting.

16.4.1.2 Analysis of the consultation responses revealed a distinct polarisation of views between different sections of the community.

16.4.1.3 When asked to identify their preferred option if all are brought into an affordable range (Question B1), Beige (Option 1V9) and 'Do nothing' attracted the most support with 27% and 25% respectively. A further 22% of respondents stated a preference for Magenta (Option 4/5AV1), followed by 12% for Cyan (Option 1V5), 7% for Grey (Option 5BV1), 3% for Crimson (Option 3V1) and 2% for Amber (Option 4/5AV2). Finally, 1% of respondents stated 'Don't know' (percentages have been rounded to the nearest whole percentage point). A small number of respondents selected multiple options.

16.4.1.4 When these results were analysed alongside respondents' free text comments (Question B10), an underlying preference for the wide single carriageway 'Arundel Alternative' became apparent in a high proportion of responses: 56% of those who selected Beige and added additional comments indicated a preference for the 'Arundel Alternative'. The same was true for around two-thirds of those who selected 'Do nothing'.

16.4.1.5 A local campaign that promoted the 'Arundel Alternative' encouraged supporters to choose either Beige (Option 1V9) or 'Do nothing' from the options presented and then explain their preference for a wide single carriageway with supplementary comments. The campaign also asked respondents to object to the four 'offline' options that would avoid Arundel town centre: Crimson (Option 3V1), Magenta (Option 4/5AV1), Amber (Option 4/5AV2) and Grey (Option 5BV1), with an emphasis on Magenta being the worst option of the four. The results seem to suggest that this campaign was effective in influencing responses of this nature.

16.4.1.6 Respondents were again asked to consider their preferred options later in the consultation response form, and rank them in a preference of first, second, and third choice (Question B8). The results were broadly consistent with Question B1.

16.4.1.7 Respondents were asked to consider their least preferred (last choice) option, should all options be brought into an affordable range (Question B9). The results again demonstrated that respondent opinions were polarised, although Magenta (Option 4/5AV1) accounted for a significantly higher proportion of responses than the next least preferred options:

- 37% selected Magenta (Option 4/5AV1)
- 15% selected Cyan (Option 1V5)
- 12% selected Beige (Option 1V9)
- 11% selected 'Do nothing'
- 9% selected Crimson (3V1)
- 9% selected Grey (5BV1)
- 2% selected Amber (4/5AV2)

16.5 Key stakeholders and organisations

16.5.1.1 As with individual responses, the views of organisations were polarised to some extent. West Sussex County Council, Arun District Council and Arundel Town Council all favoured Magenta (Option 4/5AV1), as did the sitting constituency MP at the time of the further consultation. In contrast, Slindon Parish Council strongly opposed Magenta in favour of Crimson (Option 3V1) and Walberton Parish Council favoured either Option 1 variant (Cyan, Option 1V5, or Beige, Option 1V9), or Crimson.

16.5.1.2 The South Downs National Park Authority issued a holding objection to all six options on the basis that more information was needed about mitigation to inform an overall judgment. Other statutory environmental bodies, including the Environment Agency, Forestry Commission, Historic England and Natural England, expressed significant concerns about the potential impacts of each option, though suggested that the 'online' Option 1 variants (Cyan, Option 1V5, or Beige, Option 1V9) would be least damaging from an environmental perspective.

16.5.1.3 A series of organisation-specific questions were also included in the consultation response form (section D), to help us better understand the possible impacts of the options on the local economy and communities. In total, 163 respondents submitted a response form on behalf of an organisation. Key findings from these, which again highlighted the polarisation of views on the six options, were:

- The highest proportion of respondents (22%) felt that Magenta (Option 4/5AV1) would have the most significant impact on their organisation during construction, followed by Beige (Option 1V9) with 20%.

- 38% of respondents felt that Magenta (Option 4/5AV1) would deliver most benefit for organisations, followed by Beige (Option 1V9) with 21%.
- Conversely, 28% of respondents felt that Magenta (Option 4/5AV1) would least benefit their organisation, followed by Beige (Option 1V9) at 21%.

16.6 Further review period responses

16.6.1.1 The further review period prompted 472 responses in total, comprised of 132 responses via the online questionnaire and 340 letters or emails. This compared to 4,945 completed consultation response forms and 2,137 other written responses received during the further consultation period.

16.6.1.2 The majority of online respondents (55%) had not changed their views of the options as a result of the corrections. When concentrating on a preferred option after reviewing the corrections, Magenta (Option 4/5AV1) and 'Do nothing' were most preferred with 30% and 29% of responses, respectively. Magenta was, however, also the least preferred option of 31% of respondents.

16.6.1.3 The main themes to emerge from analysis of the letters and emails were concerns about the process itself, including suggestions that some misleading information had not been corrected, support for the 'Arundel Alternative' and concerns about the impact of the scheme on climate change.

A27 Arundel Bypass Scheme Assessment Report

Chapter 17 Identification of the Preferred Route

October 2020

CONTENTS

LIST OF FIGURES

17 Identification of the Preferred Route

17.1 Introduction

17.1.1.1 This Chapter presents the methodology and results obtained in identifying the preferred route for the Scheme. The Chapter provides an overview of the performance of the six options and enables a discussion of the preferred route.

17.2 Route Selection Process and Methodology

17.2.1.1 The methodology used to appraise the route options follows on from that used for the initial sifting of options described in Section 7.9. It is based around the Transport Business Case Five Case Model[1] criteria and uses the structure of the Option Assessment Framework contained within the Web-based Transport Analysis Guidance (WebTAG) Transport Appraisal Process[2]. The five headline assessment criteria are as follows:

- Strategic Case.
- Value for Money.
- Financial Case.
- Delivery Case.
- Commercial Case.

17.2.1.2 The assessments carried out in Stage 2 summarised in this report and presented at the Further Public Consultation have been used to inform the route selection process.

17.2.2 Strategic Case

17.2.2.1 The strategic case comprises a review of the performance of each of the six options (Option 1V5, Option 1V9, Option 3V1, Option 4/5AV1, Option 4/5AV2 and Option 5BV1) with the Scheme objectives given in Chapter 2.

[1] Department for Transport (January 2013) "The Transport Business Cases" available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/85930/dft-transport-business-case.pdf (accessed April 2020)
[2] https://www.gov.uk/guidance/transport-analysis-guidance-webtag (accessed April 2020)

17.2.2.2 This was informed by:

- The WebTAG appraisals and the assessments undertaken using Design Manual for Roads and Bridges (DMRB) guidance (summarised in Chapters 10, 11 and 12);
- The appraisal/assessment of South Downs National Park (SDNP) special qualities[3];
- The PCF Stage 2 A27 Arundel Bypass Environmental Assessment Report (EAR) (August 2019)[4];
- The findings of the Social Impact Assessment[5] [6] (SIA); and
- The results of the public consultation (summarised in Chapter 16).

17.2.2.3 The criteria used to measure performance are detailed in the Option Assessment Framework provided in Appendix G. They were developed to provide a broad differentiation of the route options in terms of their performance against the Scheme objectives. The criteria provide a means for qualitative or quantitative grading of the performance of options.

17.2.2.4 The National Networks National Policy Statement (NN NPS) sets out the need for, and government's policies to deliver the development of Nationally Significant Infrastructure Projects (NSIPs) on the national road network in England. It sets out the primary basis for making decisions of development consent for NSIPs in England. The options were assessed for compliance with key policies within the Statement using the evidence from the NN NPS Accordance Table for the Scheme.

17.2.2.5 The options were also assessed against relevant local planning policy requirements and objectives set out in the following documents (see Chapter 2):

- Arun District Council (Arun DC), Adopted Arun Local Plan 2011 - 2031 (July 2018)
- Adopted South Downs Local Plan 2014 – 2033.

[3] WSP on behalf of Highways England, (August 2019) "A27 Arundel Bypass Environmental Assessment Report Appendix 1-1: South Downs National Park Special Quality Assessment" and Errata
[4] WSP on behalf of Highways England (August 2019) "A27 Arundel Bypass Environmental Assessment Report" and Errata.
[5] WSP on behalf of Highways England (April 2020) "Social Impact Assessment A27 Arundel Bypass – PCF Stage 2 Further Consultation"
[6] The SIA is a compilation of SIA related inputs from other PCF products; not a new set of information.

17.2.3 Economic Case (Value for Money)

17.2.3.1 The economic case considers the economic, social and environmental impacts and significance of effect (summarised in Chapters 10, 11 and 12) of the six scheme options and relates these impacts to the costs of investment to provide an indication of the value for money of alternative options.

17.2.3.2 The environmental aspects considered in the Economic Case use the Department for Transport WebTAG methodology to calculate the monetised value of the impacts. This methodology is different to the assessment method used in the EAR[7]. The EAR results (which were used to inform the Strategic Case) used the assessment method defined in the Design Manual for Roads and Bridges (see paragraph 17.2.2.2). The DMRB assessment method evaluates the potential environmental impacts and significance of effect of the scheme but does not apply an economic aspect to the assessment. Due to the differences in assessment methodology, the assessment results for some topics, and the preferred option for a particular topic within a pairwise comparison, may vary between the economic case and the strategic case.

17.2.4 Financial Case

17.2.4.1 The financial case is concerned with the estimated scheme cost of the six alternative options. The funding sources will be the same for all route options and therefore the source of funding was not a differentiator between options and has not been assessed as part of the route comparison process. The financial case considered the central estimate costs (in 2010 base price) given in Chapter 8.

17.2.5 Delivery Case

17.2.5.1 The delivery case covers the complexity of scheme options' deliverability and stakeholder and public acceptability. The results of the Further Public Consultation have been used to inform the delivery case[8]. The complexity of the scheme delivery has considered construction issues and any required departures from the standards given in the Design Manual for Roads and Bridges (see Chapter 8).

[7] WSP on behalf of Highways England (August 2019) "A27 Arundel Bypass Environmental Assessment Report" and Errata.
[8] This included consideration of the findings of the further review period held in February 2020

17.2.6 Commercial Case

17.2.6.1 The commercial case requires consideration of possible procurement options, level of risk and likely level of market interest for each option. At the current stage of the project development, these have been assumed to be the same for all route options. Scheme procurement and market interest are expected to be similar for all options and as a result this was scoped out of this assessment.

17.2.7 Option Assessment Framework

17.2.7.1 As with the initial sifting a pairwise comparison process has been followed to identify the best performing options. The comparison process considered the strategic case, economic case and delivery case assessments in the Assessment Framework. The financial case assessment will be reviewed as part of Highways England's governance process considering the findings of the pairwise comparisons.

17.2.7.2 The pairwise process uses the completed Assessment Framework to compare the performance of competing options two at a time and against each other, one being eliminated after each comparison. The option remaining after the comparison process is the best performing option and is taken forward in the assessment. The process has been repeated until only one option remained.

17.2.7.3 The process therefore started by comparing the four offline options (Option 4/5AV1, Option 4/5AV2, Option 3V1 and Option 5BV1) to identify the best performing offline route. The offline routes were compared against each other first because they all share a common route east of the River Arun and therefore would be expected to be more closely matched. The two online options (Option 1V5 and Option 1V9) were then compared to identify the best performing online route.

17.2.7.4 The order in which comparisons have been made start with the next most similar option (Figure 17-1).

- Comparison 1 - compares Option 4/5AV1 which was developed from the 2018 Preferred Route (see Chapter 7 of this report) and Option 4/5AV2 which is the route most similar to Option 4/5AV1.

- Comparison 2 - compares the preference from Comparison 1 with Option 3V1, which like Option 4/5AV1 and Option 4/5AV2 would require development within the SDNP and loss of ancient woodland[9].
- Comparison 3 - compares the preference from Comparison 2 with Option 5BV1 as the remaining offline route option.
- The outcome of Comparison 3 was deemed to be the best performing offline route option of the routes taken to Public Consultation and therefore advances to the next stage of the comparisons against the online options.

17.2.7.5 The process then continued with:

- Comparison 4 - to compare the two online options, Option 1V5 and Option 1V9 to identify the best performing online option.
- Comparison 5 - The final planned comparison was between the preference from Comparison 3 (the best performing offline option) with the preference from Comparison 4 (the best performing online option) to give the best performing overall option.

17.2.7.6 Additional pairwise comparisons can be carried out if during the process there is little to choose between front-running options to help confirm the better performing options in accordance with TA 30/84[10]. Subsequently an additional comparison was carried out:

- Comparison 6 – to compare the runner up of Comparison 5 and the runner up of Comparison 3 or 4 (depending on the outcome of Comparison 5).

17.2.7.7 The findings of the pairwise comparison will be considered as part of Highways England's decision-making processes for the selection of the preferred route.

[9] Ancient woodland loss refers to areas defined and mapped by Natural England's Ancient Woodland Inventory. The term ancient woodland used throughout this chapter refers to this inventory.
[10] TA 30/82 Choice Between Options for Trunk Road Schemes, DMRB, Issued Jul 1982, withdrawn Sep 2019.

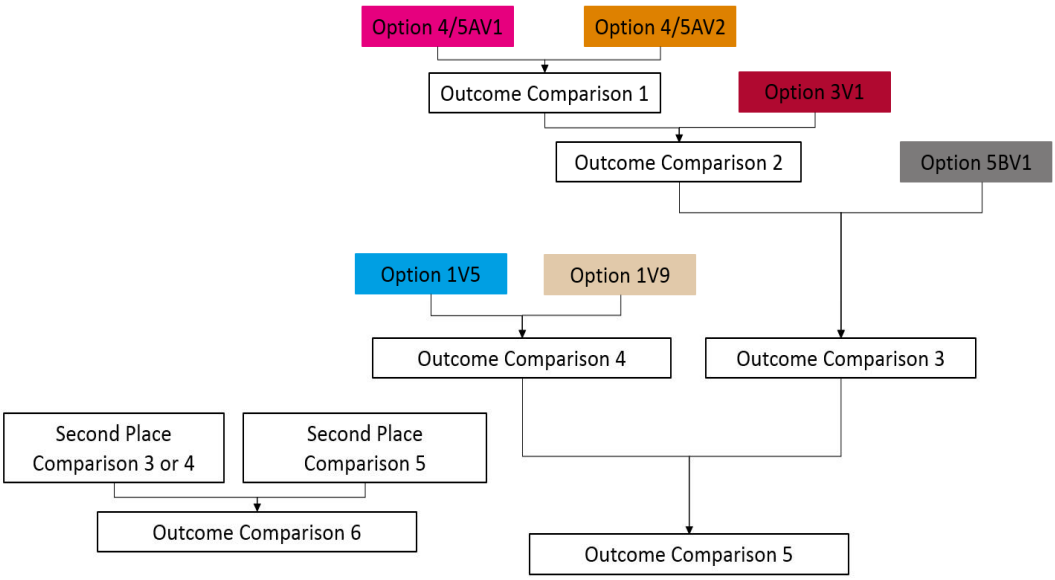


Figure 17-1 - Pairwise Comparison Structure

17.2.7.8 The following sections summarises the findings of each comparison.

17.3 Comparison 1 - Option 4/5AV1 and Option 4/5AV2

17.3.1 Strategic Case – Scheme Objectives

Scheme Objective	Assessment Summary	
	Option 4/5AV1	Option 4/5AV2
Improve Safety	Both options reduce the number of accidents on the A27 and wider road network and make a contribution to meeting this objective. The assessment shows no significant differentiation in performance between these two options. Therefore, neither option is preferred with respect to this Scheme objective	
Customers and Communities	Both options were assessed to have challenges in meeting this objective. Though both options follow a rural route away from the main population centre of Arundel they impact the communities of Tortington, Binsted and Walberton. Both Options perform at a similar level on journey amenity, community severance, townscape, accidents, noise, personal and property rights, and vulnerable user groups. Option 4/5AV1 performs better in terms of: • Visual amenity. Option 4/5AV2 performs better in terms of: • Cultural heritage • Fears and aspirations. Overall Option 4/5AV2 is the preferred of these two options for this objective as it has the greater number of better performing criteria.	
Improve Capacity	Both options would make a significant contribution to meeting the objective by: • Increasing the capacity of the A27 • Operating with a volume to capacity below 0.8 in 2041 • Reducing significantly traffic levels on the existing A27 between Crossbush and Arundel and • Generating significant wider economic benefits. The assessment shows no material differentiation in performance between these two options. Therefore,	

Scheme Objective	Assessment Summary	
	Option 4/5AV1	Option 4/5AV2
	neither option is preferred over the other in respect of this Scheme objective.	
Reduce Congestion	Both options would positively address this objective. There was no performance differentiation between options for four of the criteria: improving journey times on the A27; reduction in journey times and delay across the network; improving journey time reliability, and; junction operating capacity. Option 4/5AV2 performs better than Option 4/5AV1 for reducing traffic volumes on key local roads. This is mainly due to the different design and location of the western tie in junction. In response to issues raised at the public consultation on potential negative impacts on the local road network from the options it would be possible to consider additional mitigation measures, such as traffic calming, to improve performance. However, this hasn't been considered in the assessment. Overall it was therefore concluded that Option 4/5AV2 is marginally preferred for this objective.	
Improve Accessibility	Both options would reduce severance effects overall with beneficial effects along the existing A27. Both options would result in a new route introducing new severance along a similar rural corridor. Neither Option is preferred over the other in respect of this Scheme objective.	
Minimises environmental impact	Both options have significant environmental effects and therefore would have challenges in meeting this objective. Option 4/5AV1 performs better in terms of: • Landscape • Biodiversity • Greenhouse gases. Option 4/5AV2 performs better in terms of: • Cultural heritage Both options perform similarly for: • Noise	

Scheme Objective	Assessment Summary	
	Option 4/5AV1	**Option 4/5AV2**
	• Air quality • Water environment. Option 4/5AV1 generally performs better than or similar to Option 4/5AV2 for all the criteria for this objective other than cultural heritage and is therefore preferred of these two options in this regard.	
Respect the SDNP	Both options would have major impacts on the SDNP and would therefore have challenges in meeting this objective. Option 4/5AV1 performs slightly better for three of SDNP special qualities: • Diverse, inspirational landscapes and breath-taking views (Special Quality 1) • A rich variety of wildlife and habitats including rare and internationally important species (Special Quality 2) • Tranquil and unspoilt places (Special Quality 3). Option 4/5AV2 performs slightly better for three of SDNP special qualities: • An environment shaped by centuries of farming and embracing new enterprise (Special Quality 4) • Well-conserved historical features and a rich cultural heritage (Special Quality 6) • Distinctive towns and villages and communities with real pride in their area (Special Quality 7). There is no preference between Option 4/5AV1 and Option 4/5AV2 for the remaining special quality of, “Great opportunities for recreational activities and learning experiences” (Special Quality 5). Overall Option 4/5AV1 is preferred of these two options in respect of this objective.	
Summary	Option 4/5AV1 performs better for: • Minimise environmental impact • Respect the SDNP. Option 4/5AV2 performs better for: • Customers and communities • Reduce congestion. For the three remaining objectives: • Improve safety	

Scheme Objective	Assessment Summary	
	Option 4/5AV1	Option 4/5AV2
	• Improve capacity • Improve accessibility. Neither option is preferred. The assessment concluded that for Option 4/5AV2 the lower customer and community impacts and marginally better performance for reducing congestion do not outweigh the greater environmental effects and impact on the SDNP for this option. Therefore Option 4/5AV1 is preferred in respect of meeting the Scheme objectives.	

17.3.2 Strategic Case – Policy

Policy Area	Assessment Summary	
	Option 4/5AV1	Option 4/5AV2
NN NPS	The policy differences are driven by the outcomes from the PCF Stage 2 environmental assessments, which have been used to inform the professional judgements made in respect of compliance with policy. Hence a key source of differentiation is the environmental performance of each option. However, with regard to policy compliance, both options were considered against the requirements for the 14 parameters in the NN NPS Policy. Both options were considered compliant against eight NN NPS Policy parameters: • Safety • Air Quality • Sites of Special Scientific Interest (includes National Nature Reserves) • Civil and military aviation and defence interests • Coastal Change • Flood risk • Land use: Green Belt • Water quality and resources. Both options were considered to be non-compliant with the following NN NPS policy parameters (but national need or benefits of the scheme could outweigh the loss): • Protection of other habitats and species	

Policy Area	Assessment Summary	
	Option 4/5AV1	Option 4/5AV2
	• Land use: open space / sports and recreational buildings and land • Noise and vibration. Both options were considered to be non-compliant for three NN NPS Policy parameters: • Irreplaceable habitats including ancient woodland and veteran trees • The historic environment (designated heritage assets) • Nationally designated areas: National Parks, the Broads and Areas of Outstanding Natural Beauty. Overall neither option was preferred over the other in this regard as both are assessed to have a similar level of risk.	
Local Policy	Overall there is no preference between these two options as both options are likely to have similar impacts when assessed against local planning policy objectives.	

17.3.3 Value for Money

Value for Money	Assessment Summary	
	Option 4/5AV1	Option 4/5AV2
Value for Money	The comparison of the value for money afforded for each option is given below: • Both options provide significant monetary benefits in terms of journey time, wider economic benefits and accidents. • Both options return negative monetised impacts for noise, air quality and greenhouse gases. • Option 4/5AV1 has a slightly lower estimated Scheme capital cost compared to Option 4/5AV2. • Option 4/5AV2 provides a slightly higher rate of return for monetised impacts with a Benefit Cost Ratio (BCR) of 2.06 compared to 2.02 for Option 4/5AV1. • Both options have significant non-monetised environmental impacts including large adverse impacts for landscape. Option 4/5AV1 has a large adverse impact for biodiversity and Option 4/5AV2 a very large adverse impact for biodiversity.	
Summary	Considering both monetised and non-monetised impacts both options are expected to deliver medium value for money. Therefore, there is no preference between these options in terms of value for money. Sensitivity testing shows that there is a risk of the Scheme dropping a value for money category with these two options[11].	

[11] See Chapter 10 for details of the sensitivity testing referenced in Value for Money.

17.3.4 Financial Case

Financial Case	Summary	
	Option 4/5AV1	Option 4/5AV2
Central Estimate	At a cost of £340m (central estimate), Option 4/5AV1 currently has a lower estimated capital cost than Option 4/5AV2 (£358m central estimate).	
Scheme Budget	Estimated capital costs for both options at the time of these assessments are above the Scheme budget.	

17.3.5 Delivery Case

Delivery Case	Assessment Summary	
	Option 4/5AV1	Option 4/5AV2
Buildability	Option 4/5AV2 has been assessed to have the greater construction risks. This is primarily due to more complex environmental mitigation associated with the greater risk on ancient woodland.	
Standards	Option 4/5AV1 requires both increased numbers of and more extensive Departures from Standard when compared to Option 4/5AV2. However, at this stage of scheme development, departures required for both Options are considered acceptable with only marginal risk to deliverability.	
Stakeholder Acceptability	Key observations: • West Sussex County Council (WSCC), Arun DC and the sitting constituency MP at the time of the Further Consultation have identified Option 4/5AV1 as their preferred option. • Arun DC stated they did not support Option 4/5AV2. • The statutory environmental bodies expressed significant concerns about all six options. Though suggested that either Option 1V5 or Option 1V9 would be least damaging from an environmental perspective. • The response to the public consultation from Natural England shows that it is questionable whether the necessary licenses and agreements required for a successful Development Consent	

Delivery Case	Assessment Summary	
	Option 4/5AV1	Option 4/5AV2
	Order (DCO) application would be obtained. For the pairwise comparison the level of uncertainty regarding protected species licences[12] was considered to be slightly lower for Option 4/5AV1 than Option 4/5AV2. • The SDNP Authority have issued a holding objection to all six options. However, they have stated that either of the two online options are likely to be the least damaging to the SDNP. • There is a polarisation of views between stakeholders on the preference of offline or online solutions. Overall both options have a high delivery risk due to the polarised views of stakeholders. It is questionable whether either option would obtain the necessary licenses and agreements required for a successful DCO application. However, the support of WSCC and Arun DC for Option 4/5AV1 as their preferred option means Option 4/5AV1 was assessed to have marginally the lower risk of the two options in respect of stakeholder acceptability.	
Public Acceptability	Key observations: • 22% of respondents identified Option 4/5AV1 as their preferred option if all options are brought into the affordable range compared to 2% for Option 4/5V2. • However, Option 4/5AV1 received the highest percentage response as least preferred option (37%) compared to Option 4/5AV2(2%). • Option 4/5AV1 appeared to be well supported by respondents from Arundel itself, although it was generally unpopular with outlying communities. • The results of the public consultation demonstrated a distinct polarisation of views between different sections of the community. This results in a high delivery risk due to lack of public support for both of these options.	

[12] This may include (for example) bats, hazel dormouse, water vole and badger.

Delivery Case	Assessment Summary	
	Option 4/5AV1	Option 4/5AV2
	• Neither option was identified as preferred over the other in respect of the Delivery Case comparison.	
Summary	Overall it was concluded that both options have a high delivery risk due to the polarised views of stakeholders and the public but that Option 4/5AV1 would have marginally the better Delivery Case as it is identified as preferred choice by WSCC and Arun DC and has some support from sections of the community.	

17.3.6 Conclusion

17.3.6.1 Key observations from the assessment are:

- The options perform similarly for three of the Scheme objectives, with 4/5AV1 and 4/5AV2 each performing better for two of the remaining four.
- Both options perform similarly well in respect of the Scheme objectives for safety, capacity and accessibility. Option 4/5AV2 performs marginally better for the Scheme objective to reduce congestion.
- Neither option performs well for the Scheme objectives relating to customers and communities, minimises environmental impact and respect the SDNP. Option 4/5AV1 performs better than Option 4/5AV2 for minimises environmental impact and respect the SDNP while Option 4/5AV2 performs better for customers and communities.
- The assessment concluded that the lower customer and community impacts and marginally better performance for reducing congestion of Option 4/5AV2 do not outweigh the greater environmental effects and impact on the SDNP for this option and therefore Option 4/5AV1 is preferred in respect of meeting the Scheme objectives.
- Both options would require development within the SDNP and take areas of ancient woodland within the Binsted Wood Complex Local Wildlife Site (LWS). There are strong national policy presumptions against such development. Overall neither option was preferred in respect of compliance with the NN NPS as both are assessed to have a similar level of risk.
- Both Options are expected to deliver medium value for money.

- Overall it was concluded that both options have a high delivery risk due to the polarised views of stakeholders and the public but that Option 4/5AV1 would have marginally the better Delivery Case as it is the preferred choice of WSCC and Arun DC and has some support from sections of the community.

17.3.6.2 Based on the above assessment Option 4/5AV1 is preferred overall when compared to Option 4/5AV2 and is therefore taken forward for further consideration against other options.

17.4 Comparison 2 - Option 4/5AV1 and Option 3V1

17.4.1 Strategic Case – Scheme Objectives

Scheme Objective	Assessment Summary	
	Option 4/5AV1	Option 3V1
Improve Safety	Both options reduce the number of accidents on the A27 and wider road network and make a contribution to meeting this objective. The assessment shows a marginal differentiation in performance between these two options. Therefore, neither of these two options are considered to have a higher preference in respect of this Scheme objective.	
Customers and Communities	Both Options perform at a similar level on journey amenity, community severance, visual amenity, townscape, accidents and vulnerable users. Option 3V1 performs better in terms of: • Cultural heritage • Personal and property rights • Fears and Aspirations. Option 4/5AV1 performs better in terms of: • Noise. Option 3V1 is preferred over Option 4/5AV1 in respect of this objective due to its better performance for cultural heritage and personal and property rights.	
Improve Capacity	Both options would make a significant contribution to meeting this objective by: • Increasing the capacity of the A27 • Operating with a volume to capacity of well below 0.8 in 2041 • Reducing significantly traffic levels on the existing A27 between Crossbush and Arundel and • Generating significant wider economic benefits. The assessment shows no differentiation in performance between these two options. Therefore, neither option is preferred over the other in respect of this Scheme objective.	

Scheme Objective	Assessment Summary	
	Option 4/5AV1	Option 3V1
Reduce Congestion	Both options would positively address this objective. There is no performance differentiation between these two options for four of the required assessment criteria: improving journey times on the A27; reduction in journey times and delay across the network; improving journey time reliability; and junction operating capacity. Option 3V1 performs better than Option 4/5AV1 for reducing traffic volumes on key local roads. This is mainly due to the different design and location of the western tie in junction. In response to issues raised at the public consultation on potential negative impacts on the local road network from the options it would be possible to consider additional mitigation measures, such as traffic calming, to improve performance. However, this hasn't been considered in the assessment and therefore Option 3V1 is preferred for this criteria. Overall it was therefore concluded that Option 3V1 is marginally preferred of these two options for this objective.	
Improve Accessibility	Both options would reduce severance effects overall with beneficial effects along the existing A27. Both options would result in a new route introducing new severance along a similar rural corridor. Neither option is considered to be preferred over the other in respect of this objective.	
Minimises environmental impact	Both options have significant environmental effects and would have a challenge in meeting the Scheme objective. Both options perform similarly for • Air quality • Water environment. Option 3V1 performs better in terms of: • Cultural heritage. Option 4/5AV1 performs better in terms of: • Noise • Landscape • Biodiversity	

Scheme Objective	Assessment Summary	
	Option 4/5AV1	Option 3V1
	• Greenhouse gases. Option 4/5AV1 is preferred of these two options in respect of this objective as it presents fewer effects on the environment across noise, landscape, biodiversity and greenhouse gases.	
Respect the SDNP	Both options have major impacts on the SDNP and would have a challenge in meeting the Scheme objective. Option 3V1 performs better for three of the SDNP special qualities: • An environment shaped by centuries of farming and embracing new enterprise (Special Quality 4) • Great opportunities for recreational activities and learning experiences (Special Quality 5) • Well-conserved historical features and a rich cultural heritage (Special Quality 6). Option 4/5AV1 performs better for three of the SDNP special qualities: • Diverse, inspirational landscapes and breath-taking views (Special Quality 1) • A rich variety of wildlife and habitats including rare and internationally important species (Special Quality 2) • Tranquil and unspoilt places (Special Quality 3). Both options perform similarly for: • Distinctive towns and villages and communities with real pride in their area (Special Quality 7). Option 4/5AV1 was assessed to perform slightly better across the SDNP special qualities than Option 3V1. This is due to the alignment's reduced physical impact on the SDNP and less ancient woodland loss.	
Summary	Option 4/5AV1 performs better for: • Minimises environmental impact • Respect the SDNP. Option 3V1 performs better for: • Customers and communities	

Scheme Objective	Assessment Summary	
	Option 4/5AV1	Option 3V1
	• Reduce congestion. For the three remaining objectives: • Improve safety • Improve capacity • Improve accessibility. Neither option is preferred. The assessment concluded that the lower customer and community impacts and marginally better performance for reducing congestion of Option 3V1 do not outweigh the greater environmental effects and impacts on the SDNP for this option. Therefore Option 4/5AV1 is preferred in respect of meeting the Scheme objectives.	

17.4.2 Strategic Case – Policy

Policy Area	Assessment Summary	
	Option 4/5AV1	Option 3V1
NN NPS	The policy differences are driven by the outcomes from the PCF Stage 2 environmental assessments, which have been used to inform the professional judgements made in respect of compliance with policy. Hence a key source of differentiation is the environmental performance of each option. However, with regard to policy compliance, both options were considered against the requirements for the 14 parameters in the NN NPS Policy. Both options were considered compliant against the following NN NPS Policy parameters: • Safety • Air Quality • Sites of Special Scientific Interest (includes National Nature Reserves) • Civil and military aviation and defence interests • Coastal change • Flood risk • Land use: Green Belt • Water quality and resources.	

Policy Area	Assessment Summary	
	Option 4/5AV1	Option 3V1
	Both options were considered to be non-compliant with the following NN NPS policy parameters (but national need or benefits of the scheme could outweigh the loss): • Protection of other habitats and species • Land use: open space / sports and recreational buildings and land • Noise and vibration. Both options were considered to be non-compliant for three NN NPS Policy parameters: • Irreplaceable habitats including ancient woodland and veteran trees • The historic environment (designated heritage assets) • Nationally designated areas: National Parks, the Broads and Areas of Outstanding Natural Beauty. Based on professional judgement overall neither of these two options is considered to be preferred over the other in respect of compliance with NN NPS as both are assessed to have a similar level of risk.	
Local Policy	There is no preference between these two options as both options are likely to have similar impacts when assessed against local planning policy objectives.	

17.4.3 Value for Money

Value for Money	Assessment Summary	
	Option 4/5AV1	Option 3V1
Value for Money	The comparison of the value for money afforded for each option is given below: • Both options provide significant benefits in terms of journey time, wider economic benefits and accidents. • Both options return negative monetised impacts for noise, air quality and greenhouse gases. • Option 3V1 has a slightly lower estimated Scheme capital cost compared to Option 4/5AV1.	

Value for Money	Assessment Summary	
	Option 4/5AV1	Option 3V1
	• Option 3V1 provides a higher rate of return for monetised impacts with a BCR of 2.17 compared to 2.02 for Option 4/5AV1. Both options have significant non-monetised environmental impacts including large adverse impacts for landscape. Option 4/5AV1 has a large adverse impact for biodiversity and Option 3V1 a very large adverse impact for biodiversity.	
Summary	Considering both monetised and non-monetised impacts both options are expected to deliver medium value for money. Therefore, there is no preference between these options in terms of value for money. Sensitivity testing shows that there is a risk of the Scheme dropping a value for money category with these two options.	

17.4.4 Financial Case

Financial Case	Summary	
	Option 4/5AV1	Option 3V1
Central Estimate	At a cost of £320m (central estimate), Option 3V1 currently has a lower estimated capital cost than Option 4/5AV1 (£340m central estimate).	
Budget	Estimated capital costs for both options at the time of these assessments are above the Scheme budget.	

17.4.5 Delivery Case

Delivery Case	Assessment Summary	
	Option 4/5AV1	Option 3V1
Buildability	Option 3V1 has been assessed to have the greater construction risks of these two options. This is primarily due to more complex environmental mitigation associated with the greater impact on ancient woodland.	

Delivery Case	Assessment Summary	
	Option 4/5AV1	Option 3V1
Standards	Option 4/5AV1 requires both an increased number and more extensive departures from standard when compared to Option 3V1. However, at this stage of scheme development, departures from standard for both options are considered acceptable with only a marginal risk to deliverability.	
Stakeholder Acceptability	Key observations: • WSCC, Arun DC and the sitting constituency MP at the time of the Further Consultation have identified Option 4/5AV1 as their preferred option. • Arun DC did express limited support for Option 3V1. • The SDNP Authority have issued a holding objection to all six options. However, they have stated that either of the two online options are likely to be the least damaging to the SDNP. • The statutory environmental bodies expressed significant concerns about all six options. Though suggested that either Option 1V5 or Option 1V9 would be least damaging from an environmental perspective. • The response to the public consultation from Natural England shows that it is questionable whether the necessary licenses and agreements required for a successful DCO application would be obtained. For the pairwise comparison the level of uncertainty regarding protected species licences were considered to be slightly lower for Option 4/5AV1 than Option 3V1. • Slindon and Walberton Parish Councils indicated support for Option 3V1. Overall both options have a high delivery risk due to the polarised views of stakeholders. It is questionable whether either option would obtain the necessary licenses and agreements required for a successful DCO application. Whilst it is recognised that Option 3V1 has some local support at a local parish level it was felt that the wider support of WSCC and Arun DC for Option 4/5AV1 as their preferred option means Option 4/5AV1 was assessed to have marginally the lower risk of the two options in respect of stakeholder acceptability.	

Delivery Case	Assessment Summary	
	Option 4/5AV1	Option 3V1
Public Acceptability	Key observations: • 22% of respondents identified Option 4/5AV1 as their preferred option if all options are brought into the affordable range compared to 3% for Option 3V1. • However, Option 4/5AV1 received the highest percentage response as least preferred option (37%) compared to Option 3V1 (9%). • Option 4/5AV1 appeared to be well supported by respondents from Arundel itself, although it was generally unpopular with outlying communities. The results of the public consultation demonstrated a distinct polarisation of views between different sections of the community resulting in a high delivery risk due to lack of public support for both of these options. Therefore, neither option is preferred in respect of public acceptability.	
Summary	Overall it was concluded that both options have a high delivery risk due to the polarised views of stakeholders and the public but that Option 4/5AV1 would have marginally the better delivery case as it is the preferred choice of WSCC and Arun DC and has some support from sections of the community.	

17.4.6 Conclusion

17.4.6.1 Key observations from the assessment are:

- The options perform similarly for three of the Scheme objectives, with Option 4/5AV1 and Option 3V1 each performing better for two of the remaining four.
- Both options perform similarly well in respect of the Scheme objectives for safety, capacity and accessibility. Option 3V1 is considered better performing than Option 4/5AV1 for customer and communities and reducing congestion. Option 4/5AV1 is considered the least environmental damaging of the two options and is better aligned with the Scheme objective on respecting the SDNP. The assessment concluded that the lower customer and community impacts and marginally better performance for reducing congestion of Option 3V1 do not outweigh the greater environmental adverse effects and impact

on the SDNP for this option. Therefore Option 4/5AV1 is preferred in respect of meeting the Scheme objectives.

- Both options would require development within the SDNP and take areas of ancient woodland. There is a strong policy presumption against building of new roads in a National Park and the NN NPS policy is that the Secretary of State should not grant development consent for any development that would result in the loss or deterioration of ancient woodland unless the national need for and benefits of the development in that location clearly outweigh the loss. Overall both options were considered to have the same risk of non-compliance with the NN NPS.
- Both Options are expected to deliver medium value for money.
- Overall it was concluded that both options have a high delivery risk due to the polarised views of stakeholders and the public but that Option 4/5AV1 would have marginally the better delivery case as it is the preferred choice of WSCC and Arun DC and some support from sections of the community.

17.4.6.2 Based on the above assessment Option 4/5AV1 is preferred over Option 3V1 and is therefore taken forward for further consideration against other options.

17.5 Comparison 3 - Option 4/5AV1 and Option 5BV1

17.5.1 Strategic Case – Scheme Objectives

Scheme Objective	Assessment Summary	
	Option 4/5AV1	Option 5BV1
Improve Safety	Both options reduce the number of accidents on the A27 and wider road network and make a contribution to meeting this objective. Option 5BV1 performs marginally better of the two options for both safety criteria but the difference in performance was assessed not to be significant. Therefore, neither of these two options are considered to have a higher preference in respect of this Scheme objective.	
Customers and Communities	Both options would have challenges in meeting the Scheme objective. Key observations: • Both options would have similar levels of construction impacts. • Both options would perform at a similar level for journey amenity, community severance, visual amenity, townscape, accidents and vulnerable users. Option 4/5AV1 performs better in terms of: • Noise • Personal and property rights. Option 5BV1 performs better in terms of: • Cultural heritage • Fears and aspirations. Overall, it was concluded that on the balance of performance there was no preference between these two options in respect of this Scheme objective. The difference in performance for noise, personal and property rights, cultural heritage and fear and aspirations, were considered to be insufficient to lead to an overall conclusion that one option performed significantly better than the other.	

Scheme Objective	Assessment Summary	
	Option 4/5AV1	Option 5BV1
Improve Capacity	Both options would make a significant contribution to meeting the objective by: • Increasing the capacity of the A27 • Operating with a volume to capacity of well below 0.8 in 2041 • Reducing significantly traffic levels on the existing A27 between Crossbush and Arundel and • Generating significant wider economic benefits. The assessment shows no differentiation in performance between these two options. Therefore, neither option is preferred over the other in respect of this Scheme objective.	
Reduce Congestion	Both options would positively address the Scheme objective. Both route options would significantly reduce journey times on the existing A27 and across the wider network and improve journey time reliability. Option 5BV1 performs better than Option 4/5AV1 for reducing traffic volumes on key local roads. This is mainly due to the different design and location of the western tie in junction. In response to issues raised at the public consultation on potential negative impacts on the local road network from the options it would be possible to consider additional mitigation measures, such as traffic calming, to improve the performance of Option 4/5AV1. However, this hasn't been considered in the assessment and therefore Option 5BV1 is preferred for this criteria. Therefore, overall Option 5BV1 was considered marginally better than Option 4/5AV1 in respect of this Scheme objective.	
Improve Accessibility	Both options would positively address the Scheme objective. Both options would reduce severance impacts overall with beneficial effects along the existing A27. Both options would create a new route introducing new	

Scheme Objective	Assessment Summary	
	Option 4/5AV1	Option 5BV1
	severance along a similar rural corridor. Neither option is preferred over the other in respect of this objective.	
Minimises environmental impact	Both options have significant environmental effects and would have challenges in meeting the Scheme objective. Option 4/5AV1 performs better in terms of: • Noise. Option 5BV1 performs better in terms of: • Landscape • Biodiversity • Greenhouse gases • Cultural heritage. Both options perform similarly for: • Air quality • Water environment. Overall Option 5BV1 was assessed as being preferred over Option 4/5AV1 in respect of this objective. Though Option 5BV1 has large adverse effects on landscape and biodiversity it has fewer adverse effects than Option 4/5AV1. In particular it avoids ancient woodland and has a likely lower impact on Annex II bat species.	
Respect the SDNP	Although there is a clear difference between the two options, in that Option 5BV1 lies wholly outside the SDNP, and Option 4/5AV1 passes through part of the SDNP, both of these options would have a significant impacts on the special qualities of the SDNP and would have a challenge in meeting the Scheme objective. Option 4/5AV1 performs better for: • An environment shaped by centuries of farming and embracing new enterprise (Special Quality 4) • Distinctive towns and villages and communities with real pride in their area (Special Quality 7). Option 5BV1 performs better for: • Diverse, inspirational landscapes and breath-taking views (Special Quality 1) • A rich variety of wildlife and habitats including rare and internationally important species (Special Quality 2)	

Scheme Objective	Assessment Summary	
	Option 4/5AV1	**Option 5BV1**
	• Tranquil and unspoilt places (Special Quality 3) • Well conserved historical features and a rich cultural heritage (special Quality 6). Both options perform similarly for: • Great opportunities for recreational activities and learning experiences (special Quality 5). Option 5BV1 is preferred as it performs better than Option 4/5AV1 against more of the SDNP Special Qualities.	
Summary	Option 5BV1 performs better for: • Reduce congestion • Minimise environmental impact • Respect the SDNP. For the four remaining objectives: • Improve safety • Improve capacity • Customers and communities • Improve accessibility. Neither option is preferred. Both options would positively address the Scheme objectives to, improve safety; improve capacity; reduce congestion, and; improve accessibility, with similar levels of performance, except for congestion for which Option 5BV1 performs marginally better. Both options would have challenges in meeting the Scheme objectives of minimising environmental impacts and respecting the SDNP, though Option 5BV1 performs better for both. Both options would have similar challenges in meeting the Scheme objective for the customer and communities Scheme objective. Overall Option 5BV1 performed better or similar to Option 4/5AV1 for all the Scheme objectives and therefore was preferred in respect of meeting the Scheme objectives.	

17.5.2 Strategic Case – Policy

Policy Area	Assessment Summary	
	Option 4/5AV1	Option 5BV1
NN NPS	The policy differences are driven by the outcomes from the PCF Stage 2 environmental assessments, which have been used to inform the professional judgements made in respect of compliance with policy. Hence a key source of differentiation is the environmental performance of each option. However, with regard to policy compliance, both options were considered against the requirements for the 14 parameters in the NN NPS Policy. Both options were considered compliant against eight NN NPS Policy parameters: • Safety • Air Quality • Sites of Special Scientific Interest (includes National Nature Reserves) • Civil and military aviation and defence interests • Coastal Change • Flood risk • Land use: Green Belt • Water quality and resources. Both options were considered to be non-compliant with the following NN NPS Policy parameters (but national need or benefits of the scheme could outweigh the loss): • Protection of other habitats and species • Land use: open space / sports and recreational buildings and land • Noise and vibration. Option 4/5AV1 was rated as having a greater risk of non-compliance with the NN NPS in relation to: • Irreplaceable habitats including ancient woodland and veteran trees • The historic environment (designated heritage assets) • Nationally designated areas: National Parks, the Broads and Areas of Outstanding Natural Beauty.	

Policy Area	Assessment Summary	
	Option 4/5AV1	Option 5BV1
	Option 5BV1 was also rated as high risk in regard to impacts on: • The historic environment (designated heritage assets). Due to its location outside of the SDNP and as a result of there being no loss of ancient woodland meant that Option 5BV1 outperforms Option 4/5AV1 against these parameters. Therefore, in terms of overall NN NPS compliance, Option 5BV1 was assessed to be the preferred of these two options.	
Local Policy	Option 5BV1 involves development outside the National Park and avoids loss of ancient woodland and is therefore considered to better align with local plan objectives relating to protecting and enhancing landscape and the setting of the SDNP.	

17.5.3 Value for Money

Value for Money	Assessment Summary	
	Option 4/5AV1	Option 5BV1
Value for Money	The comparison of the value for money afforded for each option is given below: • Both options provide significant benefits in terms of journey time, wider economic benefits and accidents. • Both options return similar negative monetised impacts for noise, air quality and greenhouse gases. • Option 4/5AV1 has a slightly lower estimated capital cost compared to Option 5BV1. • Option 4/5AV1 provides the higher rate of return for monetised impacts with a BCR of 2.02 compared to 1.95 for Option 5BV1. Both options have significant environmental impacts including large adverse impacts for landscape and	

Value for Money	Assessment Summary	
	Option 4/5AV1	Option 5BV1
	biodiversity. However, it is considered that Option 5BV1 performs slightly better than Option 4/5AV1 for biodiversity and landscape because it avoids ancient woodland and does not enter the SDNP.	
Summary	Considering both monetised and non-monetised impacts both options are expected to deliver medium value for money. Therefore, there is no preference between these options in terms of value for money. Sensitivity testing shows that there is a risk of the Scheme dropping a value for money category with these two options.	

17.5.4 Financial Case

Financial Case	Summary	
	Option 4/5AV1	Option 5BV1
Central Estimate	At a cost of £340m (central estimate), Option 4/5AV1 has a lower estimated cost than Option 5BV1 (£384m central estimate).	
Budget	Estimated capital costs for both options at the time of these assessments are above the Scheme budget.	

17.5.5 Delivery Case

Delivery Case	Assessment Summary	
	Option 4/5AV1	Option 5BV1
Buildability	Both options are predominantly offline with similar construction requirements and level of construction risks.	
Standards	Option 4/5AV1 requires both an increased number and more extensive departures from standards when compared to Option 5BV1. However, at this stage of scheme development, departures required for both Options are considered acceptable with only marginal risk to deliverability.	

Delivery Case	Assessment Summary	
	Option 4/5AV1	Option 5BV1
Stakeholder Acceptability	Key observations: • WSCC, Arun DC and the sitting constituency MP at the time of the Further Consultation have identified Option 4/5AV1 as their preferred option. • The statutory environmental bodies expressed significant concerns about all six options. Though suggested that either Option 1V5 or Option 1V9 would be least damaging from an environmental perspective. • The response to the public consultation from Natural England shows that it is questionable whether the necessary licenses and agreements required for a successful DCO application would be obtained. For the pairwise comparison the level of uncertainty regarding protected species licences was considered to be similar for both of these options. • SDNP Authority have issued a holding objection to all six options However, they have stated that either of the two online options are likely to be the least damaging to the SDNP. • There is a polarisation of views between stakeholders on the preference of offline or online solutions. Overall both options have a high delivery risk due to the polarised views of stakeholders. It is questionable whether the necessary licenses and agreements required for a successful DCO application would be obtained for either option. However, the support of WSCC and Arun DC for Option 4/5AV1 as their preferred option means Option 4/5AV1 was assessed to have marginally the lower risk of the two options in respect of stakeholder acceptability.	
Public Acceptability	Key observations: • 22% of respondents identified Option 4/5AV1 as their preferred option if all options are brought into the affordable range compared to 7% for Option 5BV1. • However, Option 4/5AV1 received the highest percentage response as least preferred option (37%) compared to Option 5BV1 (9%).	

Delivery Case	Assessment Summary	
	Option 4/5AV1	Option 5BV1
	• Option 4/5AV1 appeared to be well supported by respondents from Arundel itself, although it was generally less popular with outlying communities. The results of the public consultation demonstrated a distinct polarisation of views between different sections of the community resulting in a high delivery risk due to lack of public support for both these options. Therefore, neither option is preferred in respect of public acceptability.	
Summary	Overall it was concluded that both options have a high delivery risk due to the polarised views of stakeholders and the public but that Option 4/5AV1 would have marginally the better delivery case as it is the preferred choice of WSCC and Arun DC and has some support from sections of the community.	

17.5.6 Conclusion

17.5.6.1 Key observations from the assessment are:

- The options perform similarly for four of the Scheme objectives, with Option 5BV1 performing better for the remaining three, and therefore Option 5BV1 is preferred.
- Both options perform similarly in respect of the Scheme objectives for safety, customers and communities, capacity, and accessibility. Option 5BV1 performs marginally better for congestion. Option 5BV1 also performs better for minimising the environmental impacts and respecting the SDNP. It avoids the loss of ancient woodland, has a likely lower impact on Annex II bat species and avoids development within the SDNP. Considering all the Scheme objectives and in particular the balance between environmental impacts and effects together with community impacts it is concluded that Option 5BV1 would best meet the Scheme objectives.
- Considering the NN NPS policy tests which would need to be met in terms of development within the SDNP and the loss of ancient woodland Option 5BV1 is considered to better align with the NN NPS than Option 4/5AV1.

- Both options are expected to deliver medium value for money considering monetised and non-monetised impacts.
- Overall it was concluded that both options have a high delivery risk due to the polarised views of stakeholders and the public but that Option 4/5AV1 would have marginally the better delivery case as it is the preferred choice of WSCC and Arun DC and has some support from sections of the community

17.5.6.2 Based on the above assessment Option 5BV1 is preferred to Option 4/5AV1 and is therefore taken forward for further consideration against other options.

17.6 Comparison 4 - Option 1V5 and Option 1V9

17.6.1 Strategic Case – Scheme Objectives

Scheme Objective	Assessment Summary	
	Option 1V5	Option 1V9
Improve Safety	Both options reduce the number of accidents on the A27 and wider road network and make a contribution to meeting this objective. Option 1V5 performed similarly or better than Option 1V9 for both safety criteria and is therefore preferred.	
Customers and Communities	Both options were assessed as having challenges in meeting this Scheme objective. By following the existing A27 both options would increase traffic levels on the A27 through Arundel, further segregating the town. Both options performed similarly for: • Delays to journeys during construction • Journey amenity • Community severance • Cultural heritage • Vulnerable users. Option 1V9 performed better for: • Visual amenity • Townscape (marginal) • Noise • Personal and property rights • Stakeholder fears and aspirations. Option 1V5 performs better than Option 1V9 for • Accidents Overall it was observed that Option 1V9 would be expected to perform marginally better than Option 1V5 for more criteria and was therefore preferred for this objective.	
Improve Capacity	Option 1V5 would positively address the objective while Option 1V9 faces some challenges.	

Scheme Objective	Assessment Summary	
	Option 1V5	Option 1V9
	Option 1V9 would be forecast to operate with a route capacity of between 0.8 and 0.9 by 2041 leading to an increased risk of congestion returning on the A27 compared to Option 1V5. Option 1V5 is preferred for this objective. It either performed similarly or better than Option 1V9 for all but the one criteria of, reducing the volume of traffic on local roads. For this criteria, Option 1V9 performs better due to the provision of a junction with the A284 at Ford Road.	
Reduce Congestion	Option 1V5 would positively address the objective, while Option 1V9 would have some challenges. Both of these options performed similarly for three of the criteria: improving journey times on the A27; reduction in journey times and delay across the network and improving journey time reliability. For the remaining criteria, junction operating capacity, Option 1V5 performs significantly better than Option 1V9. This is because the Ford Road roundabout included in the design for Option 1V9 would be operating with a maximum Degree of Saturation of 90%. There would be a high risk of junctions exceeding or operating close to operational capacity with limited scope to resolve through further design development.	
Improve Accessibility	Both options were assessed as having challenges in meeting the Scheme objective. Both options would significantly increase traffic levels and widen the highway corridor through Arundel resulting in greater levels of severance than at present due to increased traffic levels.	
Minimises environmental impact	Both options would have significant environmental effects and therefore would have a challenge in meeting the Scheme objective. Option 1V9 performs marginally better in terms of: • Landscape • Biodiversity • Cultural heritage • Greenhouse gases.	

Scheme Objective	Assessment Summary	
	Option 1V5	Option 1V9
	Both options perform similarly for: • Air quality • Water environment. Option 1V5 performs marginally better in terms of: • Noise. Overall Option 1V9 was assessed as marginally preferred for this objective. This was mainly related to the lower vertical alignment through Arundel due to the provision of an at grade junction at Ford Road and less woodland take (including ancient woodland).	
Respect the SDNP	Both options would have major impacts on the SDNP and therefore would face a challenge in meeting the Scheme objective. Option 1V9 performs marginally better for the following 4 special qualities: • Diverse, inspirational landscapes and breath-taking views (Special Quality 1) • A rich variety of wildlife and habitats including rare and internationally important species (Special Quality 2) • Tranquil and unspoilt places (Special Quality 3) • Well-conserved historical features and a rich cultural heritage (Special Quality 6). Option 1V5 performs marginally better for the following special quality: • Distinctive towns and villages and communities with real pride in their area (Special Quality 7). For the remaining 2 special qualities there was no differentiation in preference: • An environment shaped by centuries of farming and embracing new enterprise (Special Quality 4). • Great opportunities for recreational activities and learning experiences (Special Quality 5).	

Scheme Objective	Assessment Summary	
	Option 1V5	Option 1V9
	Overall Option 1V9 was assessed as marginally preferred for this objective.	
Summary	Option 1V5 performs better for: • Improve safety • Improve capacity • Reduce congestion. Option 1V9 performs marginally better for: • Customers and communities • Minimises environmental impact • Respect the SDNP. For the remaining objective: • Improve accessibility. Neither option is preferred. It was concluded that these marginal differences for Option 1V9 do not outweigh the improved operational performance of Option 1V5 for improving capacity, reducing congestion and improving safety. Therefore, overall Option 1V5 is preferred in respect of meeting the Scheme objectives.	

17.6.2 Strategic Case – Policy

Policy Area	Assessment Summary	
	Option 1V5	Option 1V9
NN NPS	The policy differences are driven by the outcomes from the PCF Stage 2 environmental assessments, which have been used to inform the professional judgements made in respect of compliance with policy. Hence a key source of differentiation is the environmental performance of each option. However, with regard to policy compliance, both options were considered against the requirements for the 14 parameters in the NN NPS Policy. Both options were considered compliant against eight NN NPS Policy parameters: • Safety • Air Quality	

Policy Area	Assessment Summary	
	Option 1V5	Option 1V9
	• Sites of Special Scientific Interest (includes National Nature Reserves) • Civil and military aviation and defence interests • Coastal Change • Flood Risk • Land use: Green Belt • Water Quality and Resources. Both options were considered to be non-compliant with the following NN NPS Policy parameters (but national need or benefits of the scheme could outweigh the loss): • Protection of other habitats and species • Land use: open space / sports and recreational buildings and land • Noise and vibration. Both options were considered to be non-compliant for three NN NPS Policy parameters: • Irreplaceable habitats including ancient woodland and veteran trees • The historic environment (designated heritage assets) • Nationally designated areas: National Parks, the Broads & Areas of Outstanding Natural Beauty. As a result, both options are considered to be at risk of non-compliance with the NN NPS and therefore neither of these options is considered more preferable than the other in this respect.	
Local Policy	There is no preference between these two options as both options are likely to have similar impacts when assessed against local plan objectives.	

17.6.3 Value for Money

Value for Money	Assessment Summary	
	Option 1V5	Option 1V9
Value for Money	The comparison of the value for money afforded for each option is given below:	

Value for Money	Assessment Summary	
	Option 1V5	Option 1V9
	• Both options provide significant benefits in terms of journey time, wider economic benefits and accidents. • Both options return negative monetised impacts for noise, air quality and greenhouse gases. • Option 1V9 has a slightly lower estimated Scheme capital cost compared to Option 1V5. • Option 1V5 provides the higher rate of return for monetised impacts with a BCR of 2.16 compared to 2.06 for Option 1V9 due to its increased operational performance benefits. Both options have significant non-monetised environmental impacts including large adverse impacts for biodiversity and moderate adverse impacts for landscape and townscape. It is considered that Option 1V9 performs slightly better than Option 1V5 for biodiversity, landscape, townscape and cultural heritage.	
Summary	Considering both monetised and non-monetised impacts both options are expected to deliver medium value for money. Therefore, there is no preference between these options in terms of value for money. Sensitivity testing shows that there is a risk of the Scheme dropping a value for money category with these two options.	

17.6.4 Financial Case

Financial Case	Summary	
	Option 1V5	Option 1V9
Central Estimate	At a cost of £249m (central estimate), Option 1V9 has a marginally lower estimated capital cost than Option 1V5 (£255m central estimate).	
Budget	Estimated capital costs for both options at the time of these assessments are broadly within the Scheme budget.	

17.6.5 Delivery Case

Delivery Case	Assessment Summary	
	Option 1V5	Option 1V9
Buildability	Both options would require complex traffic management arrangements to maintain traffic flows on the existing A27 west of Arundel and therefore have similar level of construction risks.	
Standards	Option 1V9 has both a greater number of departures from standards as well as a greater scale and extent of departures from standard compared to Option 1V5. At the current stage of development, the departures from standards identified for both Option 1V5 and Option 1V9 are considered likely to be acceptable. However, the departures for Option 1V9 may require increased levels of mitigation to achieve acceptance. As such Option 1V5 is marginally preferred at this stage.	
Stakeholder Acceptability	Key observations: • WSCC have indicated a preference for do nothing rather than either Option 1V5 or Option 1V9. • Arun DC has stated that they do not support either option. • The statutory environmental bodies expressed significant concerns about all six options. Though suggested that either Option 1V5 or Option 1V9 would be least damaging from an environmental perspective. • The response to the further consultation from Natural England shows that it is questionable whether the necessary licenses and agreements required for a successful DCO application would be obtained. For the pairwise comparison the level of uncertainty regarding protected species licences were considered to be similar for both of these options. • The SDNP Authority have issued a holding objection to all six options However, they have stated that either of the two online options are likely to be the least damaging to the SDNP. Overall both options have a high delivery risk due to the polarised views of stakeholders. Neither option was identified as a preferred choice of WSCC or Arun DC	

Delivery Case	Assessment Summary	
	Option 1V5	Option 1V9
	and it is questionable whether either option would obtain the necessary licenses and agreements required for a successful DCO application. Therefore, it was concluded that neither option is preferred over the other in respect of stakeholder acceptability.	
Public Acceptability	Key observations: • 27% of respondents identified Option 1V9 as their preferred option if all options are brought into the affordable range compared to 12% for Option 1V5. • Both options received similar percentage response as least preferred option (12% for Option 1V9 and 15% for Option 1V5). • Neither option is well supported by respondents from Arundel itself, although both are more popular within outlying communities, reflecting the polarisation of views on the different options. Option 1V9 is considered marginally preferred over 1V5 with respect to public acceptability.	
Summary	Overall it was concluded that both options have a high delivery risk due to the polarised views of stakeholders and high construction risk. Though Option 1V9 is marginally preferred by the public neither option is preferred in this respect.	

17.6.6 Conclusion

17.6.6.1 Key observations from the assessment are:

- The options perform similarly for one of the Scheme objectives with 1V5 and 1V9 each performing better for three each of the remaining.
- Option 1V5 is considered better performing than Option 1V9 for three Scheme objectives, safety, capacity and congestion.
- Option 1V9 is considered better performing than Option 1V5 for the three Scheme objectives: customer and communities, environmental impact and respecting the SDNP.
- On balance Option 1V5 is better aligned with the Scheme objectives. The better environmental performance of Option 1V9 is marginal and

does not outweigh the enhanced operational performance of Option 1V5 for improving capacity, reducing congestion and improving safety.

- Both options would require development within the SDNP and take areas of ancient woodland. There is a strong policy presumption against building of new roads in a National Park and the NN NPS policy is that the Secretary of State should not grant development consent for any development that would result in the loss or deterioration of ancient woodland unless the national need for and benefits of the development in that location clearly outweigh the loss. Overall neither option was preferred in respect of compliance with the NN NPS as both are assessed to have a similar level of risk.
- Both options are expected to deliver medium value for money considering monetised and non-monetised impacts.
- Overall it was concluded that both options have a high delivery risk due to the polarised views of stakeholders and high construction risk and that neither option is preferred in this respect.

17.6.6.2 Based on the above assessment Option 1V5 is preferred and is taken forward in the assessment. Overall, Option 1V9 has lower environmental effects and slightly reduced impacts on the SDNP than Option 1V5. However, this difference is marginal and does not outweigh the improved operational performance of Option 1V5 versus 1V9 for improving capacity, reducing congestion and improving safety.

17.7 Comparison 5 - Option 5BV1 and Option 1V5

17.7.1 Strategic Case – Scheme Objectives

Scheme Objective	Assessment Summary	
	Option 1V5	Option 5BV1
Improve Safety	Both options reduce the number of accidents on the A27 and wider road network and make a contribution to meeting this objective. Both options perform better than the other for one safety criteria but in both cases the difference in performance was considered not to be significant. Therefore, neither of these two options are considered to have a higher preference in respect of this Scheme objective.	
Customers and Communities	Both options would have challenges in meeting the Scheme objective. Option 1V5 makes use of the existing A27 corridor through and west of Arundel. This minimises some environmental impacts but increases the impact on the community of Arundel and for the users of the A27. The mostly rural Option 5BV1 still has major community impacts passing close to the villages of Tortington and Walberton and through the village of Binsted. Both options perform at a similar level for journey amenity and accidents though affect different communities within the environs of the improvement. Option 1V5 performs better in terms of: • Visual amenity • Cultural heritage. Option 5BV1 performs better in terms of: • Construction impact • Townscape • Noise impacts • Personal and property rights • Fears and aspirations • Effects on vulnerable users.	

Scheme Objective	Assessment Summary	
	Option 1V5	Option 5BV1
	Overall, Option 5BV1 is preferred over Option 1V5. Key differences include better performance on the travelling public during construction, noise, townscape and fewer potential demolitions.	
Improve Capacity	Both options would make a significant contribution to meeting the objective by: • Increasing the capacity of the A27 • Operating with a volume to capacity below 0.8 in 2041 • Reducing significantly traffic levels on the existing A27 between Crossbush and Arundel and • Generating significant wider economic benefits. The assessment shows that both options have a similar level of performance. Therefore, neither option is preferred over the other in respect of this Scheme objective.	
Reduce Congestion	Both options would positively address the Scheme objective. Key observations: • Both options would significantly improve journey times on the A27. • Option 5BV1 would provide greater network resilience compared to Option 1V5 as the existing A27 is retained as an alternative parallel route. Overall it has been concluded that Option 5BV1 is marginally preferred between the two options for this objective due to the greater network resilience provided.	
Improve Accessibility	Option 5BV1 would reduce severance overall with beneficial effects along the existing A27 but with some new severance along a new largely rural corridor. In comparison Option 1V5 significantly increases traffic levels and the highway infrastructure through Arundel resulting in greater severance. Therefore, Option 5BV1 is preferred in respect of this objective.	

Scheme Objective	Assessment Summary	
	Option 1V5	Option 5BV1
Minimises environmental impact	Both options have significant environmental effects, therefore would face a challenge in meeting the Scheme objective. Option 1V5 performs better in terms of: • Landscape • Biodiversity • Cultural heritage. Option 5BV1 performs better in terms of: • Noise • Greenhouse gases • Water environment. Both Options have a large adverse effect on biodiversity. Option 1V5 performs better because of a lower overall habitat severance effect of online options as compared to offline options. This is despite Option 1V5 impacting ancient woodland. Option 1V5 performs better than Option 5BV1 for landscape despite it requiring development within the SDNP. The better performance of Option 1V5 for cultural heritage, biodiversity and landscape comes at a significant increase in noise effects. Overall the assessment concluded that the better performance of Option 1V5 for biodiversity, landscape and cultural heritage outweighed the areas where Option 5BV1 performed better and therefore Option 1V5 is preferred in respect of this objective.	
Respect the SDNP	Although there is a clear difference between the two options, in that Option 5BV1 lies wholly outside the SDNP, and Option 1V5 requires road widening in the SDNP, both options would have challenges in meeting the scheme objective. Option 1V5 performs better for: • Diverse, inspirational landscapes and breath-taking views (Special Quality 1)	

Scheme Objective	Assessment Summary	
	Option 1V5	Option 5BV1
	• A rich variety of wildlife and habitats including rare and internationally important species (Special Quality 2) • Tranquil and unspoilt places (Special Quality 3) • An environment shaped by centuries of farming and embracing new enterprise (Special Quality 4). • Great opportunities for recreational activities and learning experiences (Special Quality 5) • Well-conserved historical features and a rich cultural heritage (Special Quality 6). Option 5BV1 performs better for: • Distinctive towns and villages and communities with real pride in their area (Special Quality 7). When considering impact on the special qualities of the SDNP, overall Option 1V5 is preferred to Option 5BV1 as widening the existing corridor of the A27 within the SDNP is considered to have less impact on the SDNP Special Qualities than creating a new route outside of the Park but within the setting of the Park.	
Summary	Option 5BV1 performs better for: • Customers and communities • Reduce congestion • Improve accessibility. Option 1V5 performs better for: • Minimises environmental impact • Respect the SDNP. For the remaining objectives: • Improve safety • Improve capacity Neither option is preferred. Both options positively address, with only marginal differences in performance, the Scheme objectives to improve safety and improve capacity. Both options positively address the Scheme objective to reduce congestion but Option 5BV1 performs marginally better by providing more network resilience.	

Scheme Objective	Assessment Summary	
	Option 1V5	Option 5BV1
	Both options would face a challenge in meeting the Scheme objectives to minimise environmental impact, respect the SDNP and for customer and communities. Though Option 5BV1 has major community impacts on communities it passes near, overall it performs better than Option 1V5 for community impacts. It has lower noise impacts, no impact on townscape, would reduce severance within Arundel and would result in less disruption during construction. Option 1V5 has lower adverse effects for cultural heritage, biodiversity and landscape. Comparison of the greater community impacts of severance, greenhouse gases and noise of Option 1V5 compared with greater landscape, biodiversity and cultural heritage effects of Option 5BV1 cannot be easily compared. The balance of performance does not favour either option and as such neither of these options is considered to be preferred over the other in respect of the Scheme objectives.	

17.7.2 Strategic Case – Policy

Policy Area	Assessment Summary	
	Option 1V5	Option 5BV1
NN NPS	The policy differences are driven by the outcomes from the PCF Stage 2 environmental assessments, which have been used to inform the professional judgements made in respect of compliance with policy. Hence a key source of differentiation is the environmental performance of each option. However, with regard to policy compliance, both options were considered against the requirements for the 14 parameters in the NN NPS Policy. Both options were considered compliant against eight NN NPS Policy parameters: • Safety • Air Quality	

Policy Area	Assessment Summary	
	Option 1V5	Option 5BV1
	• Sites of Special Scientific Interest (includes National Nature Reserves) • Civil and military aviation and defence interests • Coastal Change • Flood risk • Land use: Green Belt • Water quality and resources. Both options were considered to be non-compliant with the following NN NPS Policy parameters (but national need or benefits of the scheme could outweigh the loss): • Protection of other habitats and species • Land use: open space / sports and recreational buildings and land • Noise and vibration. Both options were considered to be non-compliant with the following NN NPS Policy parameters • Historic environment (designated heritage assets) Option 1V5 was rated as having a greater risk of non-compliance with the NN NPS requirements for: • Irreplaceable habitats including ancient woodland and veteran trees • Nationally designated areas: National Parks, the Broads and Areas of Outstanding Natural Beauty. Option 5BV1 is located outside of the SDNP and there is no loss of ancient woodland. Option 1V5 is in part located in the SDNP and also results in the loss of ancient woodland and therefore Option 5BV1 was considered to perform better in respect of compliance with NN NPS. Whilst the strategic case assessment identifies that Option 1V5 marginally outperformed Option 5BV1 against several of the biodiversity and landscape considerations, these were not considered to be differentiators in terms of policy compliance. The protection afforded to ancient woodland and the SDNP by the NN NPS resulted in Option 5BV1 being	

Policy Area	Assessment Summary	
	Option 1V5	Option 5BV1
	considered the best performing option in respect of compliance with NN NPS.	
Local Policy	Option 5BV1 involves development outside the National Park and avoids loss of ancient woodland whereas Option 1V5 requires development within the National Park and takes ancient woodland. As such Option 5BV1 is therefore considered to better align with local plan objectives relating to protecting and enhancing landscape and the setting of the SDNP.	

17.7.3 Value for Money

Value for Money	Assessment Summary	
	Option 1V5	Option 5BV1
Value for Money	The comparison of the value for money afforded for each option is given below: • Both options provide significant benefits in terms of journey time, wider economic benefits and accidents. • Both options return negative impacts monetised for noise, air quality and greenhouse gases. • Option 1V5 has a significantly lower estimated capital cost compared to Option 5BV1. • Option 1V5 provides the higher rate of return for monetised impacts with a BCR of 2.16 compared to 1.95 for Option 5BV1. • Both options have significant non-monetised environmental impacts including large adverse impacts for biodiversity. In addition, Option 5BV1 has a large adverse impact for landscape and Option 1V5 a large adverse impact for townscape.	
Summary	Considering both monetised and non-monetised impacts both options are expected to deliver medium value for money. Therefore, there is no preference between these options in terms of value for money.	

Value for Money	Assessment Summary	
	Option 1V5	Option 5BV1
	Sensitivity testing shows that there is a risk of the scheme dropping a value for money category with these two options.	

17.7.4 Financial Case

Financial Case	Summary	
	Option 1V5	Option 5BV1
Central Estimate	At a cost of £255m (central estimate), Option 1V5 has a lower estimated capital cost than Option 5BV1 (£384m central estimate).	
Budget	Estimated capital costs at the time of these assessments for Option 1V5 is broadly within the Scheme budget and for Option 5BV1 is above the Scheme budget.	

17.7.5 Delivery Case

Delivery Case	Assessment Summary	
	Option 1V5	Option 5BV1
Buildability	Construction of Option 1V5 would require complex traffic management arrangements to maintain traffic flows on the existing A27 west of Arundel. Option 5BV1 is therefore preferred to Option 1V5 as it has a lower construction risk.	
Standards	Option 1V5 has both a greater number of departures from standards as well as scale and extent of departures than Option 5BV1. At the current stage of development, the departures from standards identified for both Option 1V5 and Option 5BV1 are considered likely to be acceptable.	
Stakeholder Acceptability	Key observations: • WSCC and Arun DC has not identified either option as their preferred choice. WSCC have indicated a preference for do nothing rather than either Option 1V5 or Option 1V9.	

Delivery Case	Assessment Summary	
	Option 1V5	Option 5BV1
	• The statutory environmental bodies expressed significant concerns about all six options. Though suggested that either Option 1V5 or Option 1V9 would be least damaging from an environmental perspective. • The response to the public consultation from Natural England shows that it is questionable whether the necessary licenses and agreements required for a successful DCO application would be obtained. For the pairwise comparison the level of uncertainty regarding protected species licences was considered to be slightly lower for Option 1V5 than Option 5BV1. • The SDNP Authority have issued a holding objection to all six options However, they have stated that either of the two online options are likely to be the least damaging to the SDNP. • Overall both options have a high delivery risk due to the polarised views of stakeholders. Neither option was identified as a preferred choice of WSCC or Arun DC. It is also questionable whether either option would obtain the necessary licenses and agreements required for a successful DCO application (though the risk is slightly lower for Option 1V5 than Option 5BV1). Therefore, it was concluded that neither option is preferred over the other in respect of stakeholder acceptability.	
Public Acceptability	Key observations: • 12% of respondents identified Option 1V5 as their preferred option if all options are brought into the affordable range compared to 7% for Option 5BV1. • However, Option 1V5 received a higher percentage response as least preferred option (15%) compared to Option 5BV1 (9%). The results of the public consultation demonstrated a distinct polarisation of views between different sections of the community resulting in a high degree of delivery risk due to lack of public support for both options.	

Delivery Case	Assessment Summary	
	Option 1V5	Option 5BV1
	Neither option has been identified as a clear preference over the other in respect of public acceptability.	
Summary	Overall it was concluded that both options have a high delivery risk due to the polarised views of stakeholders and the public but that Option 5BV1 would have slightly the better delivery case due to lower construction risks.	

17.7.6 Conclusion

17.7.6.1 Key observations:

- The options perform similarly for two of the Scheme objectives, with 5BV1 performing better for three and 1V5 performing better for two of the remaining five objectives.
- These two options impact the Scheme objectives in different ways reflecting the comparison between offline and online routes. Both options would make a significant contribution in meeting the Scheme objectives for improving capacity and improving safety. The rural route of Option 5BV1 has greater impacts and adverse effects on biodiversity, landscape and cultural heritage but overall lower community impacts as it is further away from the main population centre of Arundel. It would also result in less disruption during construction.
- Both options positively address the Scheme objective to reduce congestion but Option 5BV1 performs marginally better by providing more network resilience.
- In terms of overall performance against the Scheme objectives neither option is preferred over the other. There is considered to be a balance of performance between the greater community impacts of Option 1V5 compared with the greater landscape, biodiversity and cultural heritage effects of Option 5BV1.
- Option 1V5 requires development within the SDNP and loss of ancient woodland. Considering the NN NPS policy tests which would need to be met in terms of development within the SDNP and the loss of ancient woodland Option 5BV1 is considered to be the most NN NPS compliant and the best compromise between environmental and community impacts.

- Both options are expected to deliver medium value for money considering monetised and non-monetised impacts.
- Overall it was concluded that both options have a high delivery risk due to the polarised views of stakeholders and the public but that Option 5BV1 would have slightly the better delivery case due to lower construction risks.

17.7.6.2 Based on the above assessment Option 5BV1 is preferred to Option 1V5. In terms of overall performance against the Scheme objectives neither option is preferred over the other. Considering the NN NPS policy tests which would need to be met in terms of development within the SDNP and the loss of ancient woodland Option 5BV1 is considered to be the most NN NPS compliant and the best compromise between environmental and community impacts.

17.8 Comparison 6 - Option 4/5AV1 and Option 1V5

17.8.1 Strategic Case – Scheme Objectives

Scheme Objective	Assessment Summary	
	Option 1V5	Option 4/5AV1
Improve Safety	Both options reduce the number of accidents on the A27 and wider road network and make a contribution to meeting this objective. The assessment shows no significant differentiation in performance between these two options. Therefore, neither of these two options are considered to have a higher preference in respect of this Scheme objective.	
Customers and Communities	Both options would have challenges in meeting the Scheme objective. Option 1V5 makes use of the existing A27 corridor through and west of Arundel. This minimises some environmental impacts and adverse effects but increases the impact on the community of Arundel and for the users of the A27. The mostly rural Option 4/5AV1 still has major community impacts passing close to the villages of Tortington and Walberton and through the village of Binsted. Both options perform at a similar level for journey amenity, community severance and accidents. Option 1V5 performs better in terms of: • Visual amenity • Cultural heritage • Fears and aspirations. Option 4/5AV1 performs better in terms of: • Disruption to the travelling public during construction • Townscape • Noise • Personal and property rights • Effects on vulnerable users (community cohesion).	

Scheme Objective	Assessment Summary	
	Option 1V5	Option 4/5AV1
	Overall Option 4/5AV1 is preferred due to better performance on the travelling public during construction, noise impacts, townscape and fewer potential demolitions.	
Improve Capacity	Both options would make a significant contribution to meeting the objective by: • Increasing the capacity of the A27 • Operating with a volume to capacity below 0.8 in 2041 • Reducing significantly traffic levels on the existing A27 between Crossbush and Arundel and • Generating significant wider economic benefits. The assessment shows that both options have a similar level of performance. Therefore, neither option is preferred over the other in respect of this Scheme objective.	
Reduce Congestion	Both options would significantly improve journey times on the A27 with no differentiation in performance. Option 4/5AV1 would provide greater network resilience compared to Option 1V5 as the existing A27 is retained as an alternative parallel route. Option 1V5 performs better than Option 4/5AV1 for reducing traffic volumes on key local roads. This is mainly due to the different design and location of the western tie in junction. In response to issues raised at the public consultation on potential negative impacts on the local road network from the option it would be possible to consider additional mitigation measures, such as traffic calming, to improve performance. However, this hasn't been considered in the assessment and therefore Option 1V5 is preferred for this criteria. Both options would positively address the Scheme objective. Overall it has been concluded that the assessment shows that there is no significant difference in performance between the two options for this objective.	

Scheme Objective	Assessment Summary	
	Option 1V5	Option 4/5AV1
Improve Accessibility	Option 4/5AV1 would reduce severance overall with beneficial effects along the existing A27 but with some new severance along a new largely rural corridor. In comparison Option 1V5 significantly increases traffic levels and the highway infrastructure through Arundel resulting in greater severance. Therefore, Option 4/5AV1 is preferred in respect of this objective.	
Minimises environmental impact	Both options have significant environmental effects and therefore would face a challenge in meeting the Scheme objective. Option 1V5 performs better in terms of: • Landscape • Biodiversity • Cultural heritage. Option 4/5AV1 performs better in terms of: • Noise • Greenhouse gases • Water environment. Both options have a large adverse effect on biodiversity. Option 1V5 performs better because of the lower overall habitat severance of online options as compared to offline options. This is despite Option 1V5 causing greater ancient woodland loss than Option 4/5AV1. Option 1V5 performs better than Option 4/5AV1 for landscape despite it requiring more development within the SDNP. This is because it is widening part of existing A27 corridor rather than creating a completely new route. The better performance of Option 1V5 for cultural heritage, biodiversity and landscape comes at a significant increase in adverse noise effects. Overall the assessment concluded that the better performance of Option 1V5 for biodiversity, landscape and cultural heritage outweighed the areas where Option 4/5AV1 performed better. Therefore, Option 1V5 is preferred in respect of this objective.	

Scheme Objective	Assessment Summary	
	Option 1V5	Option 4/5AV1
Respect the SDNP	Both options would have challenges in meeting the scheme objective. Both options perform similarly for: • An environment shaped by centuries of farming and embracing new enterprise (Special Quality 4) Option 1V5 performs better for: • Diverse, inspirational landscapes and breath-taking views (Special Quality 1) • A rich variety of wildlife and habitats including rare and internationally important species (Special Quality 2) • Tranquil and unspoilt places (Special Quality 3) • Great opportunities for recreational activities and learning experiences (Special Quality 5) • Well conserved historical features and a rich cultural heritage (Special Quality 6) Option 4/5V1 performs better for: • Distinctive towns and villages and communities with real pride in their area (Special Quality 7). Overall Option 1V5 is preferred to Option 4/5AV1. Though it is the longer route within the SDNP, widening the existing corridor of the A27 within the SDNP is considered to have less impact on the SDNP Special Qualities than creating a new route on the boundary of the Park and within the setting of the Park.	
Summary	Option 4/5AV1 performs better for: • Customers and communities • Improve accessibility. Option 1V5 performs better for: • Minimises environmental impact • Respect the SDNP. For the remaining objectives: • Improve safety • Improve capacity • Reduce congestion. Neither option is preferred. Both options positively address with only marginal differences in performance the scheme objectives to,	

Scheme Objective	Assessment Summary	
	Option 1V5	Option 4/5AV1
	improve safety, improve capacity, and reduce congestion. Both options would face a challenge in meeting the Scheme objectives to minimise environmental impact, respect the SDNP and for customer and communities. Option 1V5 was considered to perform better than Option 4/5AV1 for minimising environmental impact and respect the special qualities of the SDNP as it involves, in part, widening the existing corridor of the A27. Though Option 4/5AV1 has major community impacts on communities it passes near, overall it performs better than Option 1V5 for community impacts. It has lower noise impacts, no impact on townscape, would reduce severance within Arundel and would result in less disruption during construction. Option 1V5 has lower adverse effects for cultural heritage, biodiversity and landscape. Comparison of the greater community impacts of severance, greenhouse gases and noise of Option 1V5 compared with greater landscape, biodiversity and cultural heritage adverse effects of Option 4/5AV1 cannot be easily compared. The balance of performance does not favour either option as such neither of these options is considered to be preferred over the other in respect of the Scheme objectives.	

17.8.2 Strategic Case – Policy

Policy Area	Assessment Summary	
	Option 1V5	Option 4/5AV1
NN NPS	The policy differences are driven by the outcomes from the PCF Stage 2 environmental assessments, which have been used to inform the professional judgements made in respect of compliance with policy. Hence a key source of differentiation is the environmental performance of each option. However, with regard to policy compliance, both options were considered against	

Policy Area	Assessment Summary	
	Option 1V5	Option 4/5AV1
	the requirements for the 14 parameters in the NN NPS Policy. Both options were considered compliant against eight NN NPS Policy parameters: • Safety • Air Quality • Sites of Special Scientific Interest (includes National Nature Reserves) • Civil and military aviation and defence interests • Coastal Change • Flood Risk • Land use: Green Belt • Water Quality and Resources. Both options were considered to be non-compliant with the following NN NPS Policy parameters (but national need or benefits of the scheme could outweigh the loss): • Protection of other habitats and species • Land use: open space / sports and recreational buildings and land • Noise and vibration. Both options were considered to be non-compliant for three NN NPS Policy parameters: • Irreplaceable habitats including ancient woodland and veteran trees • The historic environment (designated heritage assets) • Nationally designated areas: National Parks, the Broads & Areas of Outstanding Natural Beauty. Overall neither option was preferred as both were assessed to have a similar level of risk.	
Local Policy	There is no preference between the options as both options are likely to have similar impacts when assessed against local plan objectives.	

17.8.3 Value for Money

Value for Money	Assessment Summary	
	Option 1V5	Option 4/5AV1
Value for Money	The comparison of the value for money afforded for each option is given below: • Both options provide significant benefits in terms of journey time, wider economic benefits and accidents. • Both options return negative monetised impacts for noise, air quality and greenhouse gases. • Option 1V5 has a lower estimated Scheme capital cost compared to Option 4/5AV1. • Option 1V5 provides the higher rate of return for monetised impacts with a BCR of 2.16 compared to 2.02 for Option 4/5AV1. • Both options have significant non-monetised environmental impacts including large adverse impacts for biodiversity. In addition, Option 4/5AV1 has a large adverse impact for landscape and Option 1V5 a large adverse impact for townscape.	
Summary	Considering both monetised and non-monetised impacts both options are expected to deliver medium value for money. Therefore, there is no preference between these options in terms of value for money. Sensitivity testing shows that there is a risk of the Scheme dropping a value for money category with these two options.	

17.8.4 Financial Case

Financial Case	Summary	
	Option 1V5	Option 4/5AV1
Central Estimate	At a cost of £255m (central estimate), Option 1V5 is estimated to have a lower capital cost than Option 4/5AV1 at a cost £340m (central estimate).	
Budget	Estimated capital costs at the time of these assessments for Option 1V5 is broadly within the Scheme budget and for Option 4/5AV1 is above the Scheme budget.	

17.8.5 Delivery Case

Delivery Case	Assessment Summary	
	Option 1V5	Option 4/5AV1
Buildability	Construction of Option 1V5 would require complex traffic management arrangements to maintain existing traffic flows on the existing A27 west of Arundel. Option 4/5AV1 is therefore preferred to Option 1V5 as it has a lower construction risk.	
Standards	Both options can be constructed to acceptable geometric standards with both options requiring similar numbers and scale of Departures.	
Stakeholder Acceptability	Key observations: • WSCC, Arun DC and the sitting constituency MP at the time of the Further Consultation have identified Option 4/5AV1 as their preferred option • The statutory environmental bodies expressed significant concerns about all six options. Though suggested that either Option 1V5 or Option 1V9 would be least damaging from an environmental perspective. • The response to the public consultation from Natural England shows that it is questionable whether the necessary licenses and agreements required for a successful DCO application would be obtained. For the pairwise comparison the level of uncertainty regarding protected species licences was considered to be slightly lower for Option 1V5 than Option 4/5AV1. • The SDNP Authority have issued a holding objection to all six options However, they have stated that either of the two online options are likely to be the least damaging to the SDNP. • There is a polarisation of views between stakeholders on the preference of offline or online solutions. Overall both options have a high delivery risk due to the polarised views of stakeholders. It is questionable whether either option would obtain the necessary licenses and agreements required for a successful DCO application (though the risk is slightly lower for Option 1V5 than Option 4/5AV1). However, the support of WSCC and Arun DC for Option 4/5AV1 as their	

Delivery Case	Assessment Summary	
	Option 1V5	Option 4/5AV1
	preferred option means Option 4/5AV1 was assessed to have marginally the lower risk of the two options in respect of stakeholder acceptability.	
Public Acceptability	Key observations: • 22% of respondents identified Option 4/5AV1 as their preferred option if all options are brought into the affordable range compared to 12% for Option 1V5. • However, Option 4/5AV1 received the highest percentage response as least preferred option (37%) compared to Option 1V5 (15%). • Option 4/5AV1 appeared to be well supported by respondents from Arundel itself, although it was generally less popular with outlying communities. The results of the public consultation demonstrated a distinct polarisation of views between different sections of the community resulting in a high degree of delivery risk due to lack of public support for both options. Neither option has been identified as a clear preference over the other in respect of public acceptability.	
Summary	Overall it was concluded that both options have a high delivery risk due to the polarised views of stakeholders and the public but that Option 4/5AV1 would have slightly the better delivery case as it is the preferred choice of WSCC and Arun DC and has lower construction risks	

17.8.6 Conclusion

17.8.6.1 Key observations:

- The options perform similarly for three of the Scheme objectives, with Option 4/5AV1 and Option 1V5 both performing better for two of the remaining four objectives.
- These two options impact the Scheme objectives in different ways reflecting the comparison between offline and online routes. Both options would make a significant contribution in meeting the Scheme objectives for improving capacity and improving safety. The rural route of Option 4/5AV1 has greater adverse effects for biodiversity, landscape and cultural heritage but overall lower community impacts

as it is further away from the main population centre of Arundel. It would also result in less disruption during construction.

- Both options positively address the Scheme objective to reduce congestion. Option 4/5AV1 performs better by providing more network resilience while Option 1V5 has less impact on key parts of the local road network.
- In terms of overall performance against the Scheme objectives neither option is preferred over the other. There is considered to be a balance of the better community performance of Option 1V5 compared with the greater landscape, biodiversity and cultural heritage adverse effects of Option 4/5AV1.
- Both options require development within the SDNP and loss of ancient woodland. Considering the NN NPS policy tests which would need to be met in terms of development within the SDNP and the loss of ancient woodland neither option was preferred as both are assessed to have a similar level of risk of non-compliance.
- Both options are expected to deliver medium value for money.
- Overall it was concluded that both options have a high delivery risk due to the polarised views of stakeholders and the public but that Option 4/5AV1 would have slightly the better delivery case as it is the preferred choice of WSCC and Arun DC and lower construction risks.

17.8.6.2 Based on the above assessment there is considered to be a balance of performance between Option 1V5 and Option 4/5AV1 and neither option is preferred. In terms of overall performance against the Scheme objectives neither option is preferred over the other. Both options require development within the SDNP and loss of ancient woodland. Option 4/5AV1 is considered to have a lower risk to deliverability as it is the preferred option for WSCC and Arun DC.

17.9 Conclusion of the Pairwise Process

17.9.1.1 A detailed comparison of the performance of the six options presented at the Further Public Consultation has been undertaken.

17.9.1.2 The methodology used to compare options has followed relevant standards and guidance. It is based around the Transport Business Case Five Case Model criteria and uses the Option Assessment Framework contained within the Web-based Transport Analysis Guidance (WebTAG) Transport Appraisal Process.

17.9.1.3 A summary of the comparison process is shown in Figure 17.2. The top performing option considering performance against scheme objective, planning policy, value for money and deliverability was Option 5BV1. The next best two performing options were Option 4/5AV1 and Option 1V5. The findings of the pairwise process together with the financial case were reviewed as part of the Highways England's governance process for deciding on the preferred route.

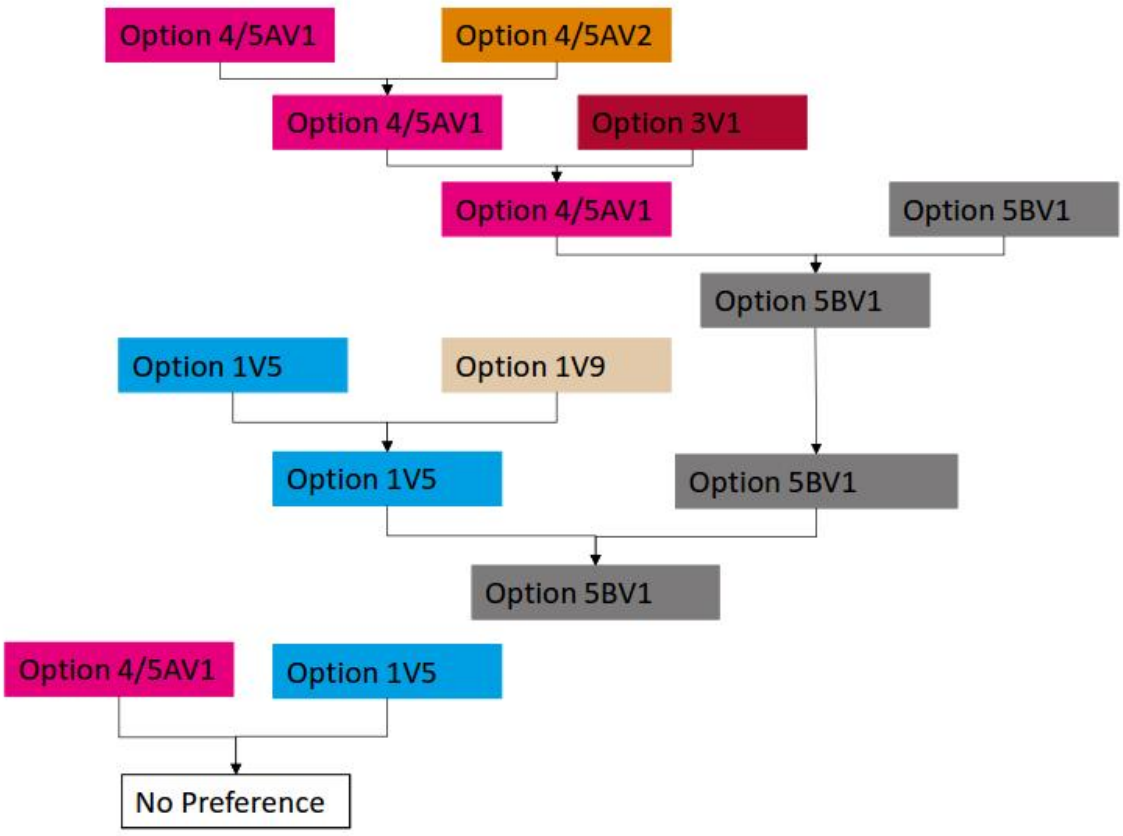


Figure 17-2 - Summary of the Pairwise Process

17.10 Greenhouse Gas Impacts

17.10.1.1 Initial and likely conservative assessments which have been undertaken to date demonstrate that the scheme's greenhouse gas impacts (for any of the options) as a proportion of total UK carbon emissions is negligible, with the effect of Scheme options representing less than 0.004% of any of the current UK carbon budgets. The carbon assessment was undertaken using the set of carbon budgets available at the time of the assessment, which were calculated to meet the previous (80% reduction) target.

17.10.1.2 Whilst it is acknowledged that the Climate Change Act 2008 has been amended to introduce a new 100% reduction target by 2050, the sixth carbon budget to meet this net zero carbon target is yet to be released. Once the revised carbon budgets are released we will update the assessment of the CO_2 impact of the Scheme against the new net zero carbon target for the preferred route.

17.10.1.3 Having regard to this, together with the policies contained in the NN NPS, the 2050 Target Amendment and the Paris Agreement, there is no reason that on climate change grounds a preferred route announcement cannot be made at this time. Particularly given that based on the current information available, it is predicted that the Scheme would not have a material impact on the ability of Government to meet its carbon reduction targets. Further assessments will be undertaken as part of the Scheme development at Stage 3 and the Scheme will be tested against prevailing carbon policies prior to obtaining consent.

17.10.1.4 In view of the marginal difference in Greenhouse Gas (GHG) emissions between options and the conservative assessment completed to date, the GHG emissions of each option was not a strong differentiator for option selection.

17.11 Preferred Route Decision

17.11.1 Introduction

17.11.1.1 There is a compelling case for the Scheme and the Road Investment Strategies for 2015-2020 and 2020-2025 (RIS 1 and 2) both made a commitment to replace “the existing single carriageway road with a dual carriageway bypass, linking together the two existing dual carriageway sections of the road”. In addition, 67% of respondents to the Further Public Consultation (2019) agreed that there is a need to improve the A27 around Arundel.

17.11.1.2 From the analysis undertaken, it is clear that the factors to be taken into account in determining options selection and the weight to be given to different factors raises complex and inter-related issues. The policy constraints are considerable and the feedback from the Further Public Consultation shows that stakeholders are polarised with no single option which generates a majority of support. As such, Highways England has had to consider each of the relevant factors, and undertake a balancing exercise of those factors to determine a preferred route.

17.11.1.3 The option analysis considered all factors but, on consideration, Highways England found that the nine key factors which directly influenced the option choice were (in no particular order):

- Policy compliance including compliance with the NN NPS;
- Impact on the SDNP;
- Impact on local communities during construction and operation;
- Future capacity and journey time;
- Protected Species licencing;
- Cultural heritage considerations;
- Noise and other environmental impacts;
- The views of stakeholders; and
- Cost.

17.11.1.4 The options analysis was carried out using a pairwise comparison methodology to help inform Highways England's preferred route decision and was carried out by suitably qualified technical experts from the appointed consultants, using professional judgement where appropriate.

17.11.1.5 The outcome of the technical pairwise analysis indicated that Option 5BV1 was the best performing option as it considered as a key factor that Option 5BV1 is located entirely outside of the SDNP. As a result the NN NPS strong presumption against any significant road widening or the building of new roads within nationally designated areas is not engaged. In addition, Option 5BV1 would not result in the loss of ancient woodland. Overall it was considered to be the best performing in terms of compliance with national policy. It also performed better than the other three offline options for biodiversity and landscape and performed better than the online options for noise, other community impacts including townscape and disruption during construction.

17.11.1.6 However, the options analysis also highlighted some significant negative factors in relation to Option 5BV1. This included a lack of public and stakeholder support (only 7% of respondents to the Further Public Consultation supported Option 5BV1 as their first-choice option[13]). Another significant negative factor included noise and construction impacts on local communities due to its proximity to residential properties in the Walberton Parish.

17.11.1.7 In addition, whilst Option 5BV1 is not the only option being considered that falls outside of the Scheme's current allocated budget of c.£100-250 million, it is the most expensive based on 2019 estimates. Using the central figure from the estimated cost ranges, it is £134m over the planned budget at consultation.

17.11.1.8 At the Further Public Consultation, it was recognised that “only two of the six options were broadly deliverable within the current budget” and the cost ranges were “early estimates”. Furthermore, that Highways England would develop the design in such a way that seeks to deliver the best possible value for money in line with the needs of the Scheme.

17.11.1.9 Should the cost of a particular option fall outside of the Scheme's budget, this in and of itself is not a reason to discount that particular option, provided that other positive factors out-weigh the higher cost. Should it be apparent that the best option for the Scheme, taking into account all relevant factors, is outside of the Scheme's allocated budget, it will be up to Highways England to explore other funding mechanisms to deliver that option. However, the relative cost of an option compared to others is a material consideration for Highways England to consider in reaching its decision on the preferred route.

17.11.1.10 The full cost estimates from the Further Public Consultation are shown in Table 17-1.

[13] In response to Question B1 (preferred option overall if all are brought into an affordable range) of the Further Public Consultation.

Table 17-1 – Cost Ranges of Options at Consultation

Project Phase	Estimate	Narrower Range Lower Cost (£m)	Central Estimate (£m)	Narrower Range Upper Cost (£m)
Options (Stage 2 for further consultation)	Option 1V5 (Online, grade separated)	200	255	295
	Option 1V9 (Online, at grade)	195	249	290
	Option 3V1 (Offline)	255	320	380
	Option 4/5AV1 (Offline)	280	340	405
	Option 4/5AV2 (Offline)	290	358	420
	Option 5BV1 (Offline)	320	384	455

17.11.1.11 In accordance with the methodology described in the SAR, further analysis was carried out to establish the comparative performance of the two next best performing options: Option 4/5AV1 and Option 1V5. This was to enable Highways England to have a fuller understanding of the relative performance of the options.

17.11.1.12 The result of that additional comparison indicated that Options 4/5AV1 and Option 1V5 performed similarly overall albeit across different factors, and a preferred option between these two could not be selected from the results of the pairwise analysis alone. Option 4/5AV1 was more expensive (and outside of the Scheme's allocated budget) and had greater adverse effects on cultural heritage and biodiversity. However, Option 1V5 had negative impacts on the townscape of Arundel during construction and operation, the difficulty of construction and a lack of stakeholder and public support (12% of respondents to the Further Public Consultation selected Option 1V5 as preferred compared to 22% for Option 4/5AV1).

17.11.2 Planning Policy – NN NPS

17.11.2.1 For context, it is worth noting that in accordance with section 104 of the Planning Act 2008, the Secretary of State (SoS) must decide applications for DCOs in accordance with the NN NPS as the relevant national policy statement. That approach applies unless deciding the application in accordance with the NN NPS would lead the UK to breach international obligations, lead the SoS to breach any legal duties, or be otherwise unlawful.

17.11.2.2 In addition, Highways England is under a number of legal duties, for example to have regard to the purposes of National Parks[14] when exercising or performing functions, as well as a duty to comply with the conditions attached to its Licence from the Secretary of State. This includes, but is not limited to, minimising the environmental impacts of operating, maintaining and improving its network and to protect and enhance the quality of the surrounding environment.

17.11.2.3 When determining a DCO application in relation to, or which affects land within, a National Park, the SoS must have regard to the statutory purposes which apply to National Parks. If it appears that there is a conflict between those purposes, the SoS shall attach greater weight to the purpose of conserving and enhancing the natural beauty, wildlife and cultural heritage of the area comprised in the National Park (see section 11 of the National Parks and Access to the Countryside Act 1949).

17.11.2.4 Given the policies in the NN NPS are the primary tests against which the Scheme will be determined, significant weight should be attached to whether an option is policy compliant or not. The options analysis highlighted that all options had, to one degree or another, risk associated with them in terms of compliance with the NN NPS. However, a key factor is the strong presumption in the NN NPS against development in designated areas (including National Parks).

17.11.2.5 The policy states that the Secretary of State should refuse development consent for a Scheme within a designated area except in 'exceptional circumstances' and where it can be demonstrated that the Scheme is in the public interest (paragraph 5.151). Consideration of such applications should include:

- the need for the development, including in terms of any national considerations, and the impact of consenting, or not consenting it, upon the local economy;
- the cost of, and scope for, developing elsewhere, outside the designated area, or meeting the need for it in some other way; and
- any detrimental effect on the environment, the landscape and recreational opportunities, and the extent to which that could be moderated.

[14] As set out in section 5(1) of the National Parks and Access to the Countryside Act 1949, of conserving and enhancing the natural beauty, wildlife and cultural heritage of the national park, and of promoting opportunities for the understanding and enjoyment of the special qualities of the national park by the public

17.11.2.6 There is a strong presumption against any significant road widening or the building of new roads in a National Park, unless it can be shown there are compelling reasons for the new or enhanced capacity and with any benefits outweighing the costs very significantly (paragraph 5.152). This is a very high bar.

17.11.2.7 The duty to have regard to the purposes of nationally designated areas also applies when considering applications for projects outside the boundaries of these areas which may have impacts within them. Paragraphs 5.154-5 of the NN NPS require consideration of the effects of a scheme on a designated area, from outside of that designated area. However, this (paragraph 5.154) does not employ the same 'very high bar' as prescribed for a scheme within the boundaries of a designated area (under paragraphs 5.150 to 5.153), that is the fact that a proposed project will be visible from within a designated area should not in itself be a reason for refusing consent.

17.11.2.8 In this respect options that can be shown not to engage the presumption against development in designated areas contained in the NN NPS should be distinguished from those which do. In considering whether "exceptional circumstances" exist, " the cost of, and scope for, developing elsewhere, outside the designated area, or meeting the need for it in some other way" requires assessment. Thus, the selection of a preferred route first requires examination and careful consideration of whether there is scope for developing options outside the SDNP.

17.11.3 Summary of the options - Option 5BV1

17.11.3.1 Option 5BV1 is the only option that lies entirely outside of the SDNP and therefore does not trigger the presumption against development in designated areas referred to above and this is a key factor that needs to be considered in decision making. And as set out above, there is also a requirement that the effects from outside the park, on the purposes of the park, are taken into account. Considering the NN NPS policy tests which would need to be met in terms of development within the SDNP and the loss of ancient woodland Option 5BV1 is considered to be the most NN NPS compliant and the best compromise between environmental and community impacts.

17.11.3.2 In addition, Option 5BV1 would perform positively in terms of addressing the Scheme objectives, including in relation to safety, capacity and congestion, although not materially so when compared to other options, particularly those that are also situated offline. Furthermore Option 5BV1 does not directly lead to any ancient woodland take, performed better than the other offline options for biodiversity and landscape and performed better than the online options for noise and other community impacts including townscape and results in less disruption during construction.

17.11.3.3 Also, Option 5BV1 has better support from WSCC and Arun DC than the online options. Though was not identified by either as their preferred option.

17.11.3.4 However, Option 5BV1 also has its own risks in terms of compliance with the NN NPS (for example in respect of the historic environment). In addition, Option 5BV1 raises a number of negative factors that need to be weighed in the balance, namely:

- In isolation, it has a low level of public and stakeholder support – only 7% of respondents noted it as their preferred option and it is not the preferred option for either Arun DC or WSCC.
- There are a greater number of properties within 100m of Option 5BV1 with potential for significant noise effects during construction, than there are within 100m of Option 4/5AV1, Option 4/5AV2 and Option 3V1.
- During construction and operation Option 5BV1 will result in significant adverse effects on a greater number of existing dwellings than would result from the other offline options; in particular Option 5BV1 will have a significant adverse effect on a greater number of existing properties in Walberton.
- As it is an offline option, it will cause greater adverse environmental impacts than online options in relation to biodiversity, landscape and cultural heritage.
- The response to the Further Public Consultation from Natural England shows that it is questionable whether the necessary licenses and agreements required for a successful DCO application would be obtained. Though the option analysis shows that of the offline options it is likely to have the least adverse effects on bats, securing the necessary protected species licence would still be particularly challenging.
- Whilst it is not the only option being considered that falls outside the current allocated budget for the Scheme, it is the most expensive.

17.11.3.5 Highways England's extensive experience in promoting new road schemes makes clear that a lack of local stakeholder and public support presents a very significant challenge. Indeed, other schemes along the A27 corridor have had to be paused or cancelled for this very reason. Given this, significant weight should be attached to whether a scheme attracts public and local authority support, or not. As highlighted above Option 5BV1 has a low level of public support (7%) as the preferred option, but it is noted that views are polarised with only 9% of respondents identifying it as their least preferred choice. In addition Option 5BV1 is not the preferred option of WSCC or Arun DC.

17.11.3.6 As such, whilst Option 5BV1 does perform better than the other options in terms of compliance with the NN NPS and performs well in meeting the Scheme objectives, the fact that there are also negative factors associated with it necessitates the consideration of the suitability of the remaining options which is undertaken below. These all perform equally in terms of lack of compliance with the NN NPS in relation to development in designated areas, as they all involve development within the SDNP, albeit to varying degrees.

17.11.4 Summary of the options – Option 1V5 and Option 1V9

17.11.4.1 The two online options, 1V5 and 1V9, have some advantages over the offline options under consideration. Whilst there are differences in performance between the two, generally they would perform better than the offline options in terms of adverse effects on the historic environment, biodiversity and landscape. At current estimates, they are also broadly both within the current allocated budget for the Scheme. These are all material factors that need to be considered.

17.11.4.2 However, both online options have a materially worse impact on Arundel communities during construction and operation than the offline options. For example, c.425 residential properties have the potential to experience significant noise effects during construction for both online options, when compared to the offline options. This is clearly a material difference and consideration should be attached to the impacts on the local communities. Both options would also lead to ancient woodland take.

17.11.4.3 Whilst in operational terms Option 1V5's performance is similar to the offline options (for example in terms of capacity and journey time savings), Option 1V9's performance is markedly poorer.

17.11.4.4 Whilst Option 1V9 attracted the highest proportion of support from the public (27% of respondents chose it as their preferred option, meaning it was the most supported), only 12% of respondents selected Option 1V5 as their preferred option. Neither the district or county councils supported either of the online options, with Arun DC saying that they did not support them and WSCC stating that, if the offline variants were to remain unaffordable, it would prefer to 'do nothing'. However, it should be noted that whilst the South Downs National Park Authority registered a holding objection to all the proposals, they did consider the online options to be potentially the least damaging. Nevertheless, some importance should be attached to this lack of key local stakeholder support for the online solutions which in Highway England's experience, has some relevance to the successful delivery of road improvement schemes.

17.11.4.5 Lastly, both online options also present significant constructability challenges. Constructing either of Option 1V5 or Option 1V9, whilst trying to keep the A27 flowing, would be difficult in engineering terms and would severely disrupt daily traffic and life in Arundel. Given Highway England's duties to keep the strategic road network running effectively, this factor needs to weigh heavily in the balance.

17.11.4.6 Given all of this, whilst both Option 1V5 and Option 1V9 have factors in their favour, including lower historic environment, biodiversity and landscape adverse effects when compared to the other options, as well as cost, they also have significant drawbacks. Both online options would require development in the National Park, would result in the loss of more than one hectare of ancient woodland and as required for all options, will need to obtain EPS licenses. Both have the potential to affect a significantly greater number of residential properties in noise terms for both construction and operation, when compared to the offline options and both have constructability challenges.

17.11.4.7 Option 1V5 attracted poor levels of public support (12% of respondents to the Further Public Consultation selected Option 1V5 as preferred). Whilst Option 1V9 did attract reasonable public support (27% of respondents identified Option 1V9 as preferred), it performs the worst operationally out of all the options (although it still improves the situation when compared to a do-nothing scenario). It is considered that the public support it attracts does not outweigh the comparatively lesser improvements to the road network. Neither online option received support from the county or district councils.

17.11.4.8 Given all of this, it is considered that on balance, the negative factors of pursuing an online route as the preferred option outweigh the positives. The combination of; development within the National Park; a lack of support from the county and district councils, the impact on Arundel, the constructability challenges and a comparatively lesser improvement in terms of operational performance (for Option 1V9 only); would not outweigh the lower scheme costs and comparatively lesser adverse effects on historic environment, biodiversity and the landscape.

17.11.5 Summary of the options - Option 3V1

17.11.5.1 Option 3V1 reconnects with the existing A27 to the east of the other offline options closer to the end of the online options (Option 1V5 and Option 1V9), utilising more of the existing dual carriageway. It passes closer to the southern edge of Arundel and through a larger area of ancient woodland and the SDNP than the other offline routes (Option 4/5AV2, Option 4/5AV1 and Option 5BV1).

17.11.5.2 Option 3V1 does have advantages as an option for the Scheme. In terms of operational performance, it performs better than Option 1V9 and, whilst not offering the same advantages as Option 5BV1, Option 4/5AV2 or Option 4/5AV1 does show marked improvements when compared to the 'do-nothing' scenario. In addition, it is predicted to perform similarly to the other options in terms of reducing traffic volumes on local roads and would have lower community impacts. As an offline option, it also presents a solution that is better from a constructability standpoint, when compared to the online options. However, when considered cumulatively, the level of benefit Option 3V1 has over the other options under consideration is not material.

17.11.5.3 This then needs to be weighed against the significant negative factors that relate to Option 3V1. It would have a very large adverse effect in terms of biodiversity and would impact a significantly higher portion, than other options, of woodland including 9.20 ha of ancient woodland meaning implementing suitable environmental mitigation would be complex. The response to the Further Public Consultation from Natural England shows that it is questionable whether the necessary licenses and agreements required for a successful DCO application would be obtained. There would be a very large adverse effect on bats for Option 3V1, and hence securing protected species licences may be particularly challenging. It also consists of the greatest extent of development within the SDNP. Estimates also put the cost of Option 3V1 outside of the Scheme's current allocated budget.

17.11.5.4 It also attracted a very low level of public and stakeholder support. Out of the key stakeholder organisations, two Parish Councils indicated support for Option 3V1 (Slindon and Walberton) but it attracted no support from Arun DC or WSCC. In addition, it attracted only 3% of respondents to the consultation questionnaire as a preferred option, the second lowest.

17.11.5.5 Given all of this, it is considered that on balance, the negative factors of pursuing Option 3V1 significantly outweigh the positives, particularly having regard to the level of support and the greater impacts and adverse effects for certain environmental topics. The limited benefits of this option are not of such a magnitude as to outweigh the material negative factors.

17.11.6 Summary of the options – Option 4/5AV2

17.11.6.1 In terms of network performance, Option 4/5AV2 is an attractive option – it is predicted to have broadly similar performance in terms of capacity and journey time savings when compared to the other best performing offline options (Option 4/5AV1 and Option 5BV1) and it is predicted to have a more positive impact on the local road network than some other options (e.g. Option 4/5AV1). It also presents an easier solution to construct when compared to the online options.

17.11.6.2 However, Option 4/5AV2 also has significant drawbacks. Given its offline nature, it would impact 5.33 ha of woodland, including approximately 1.83 ha of ancient woodland and would have significant adverse effects on biodiversity (for example habitat severance), and landscape and cultural heritage. The response to the Further Public Consultation from Natural England shows that it is questionable whether the necessary licenses and agreements required for a successful DCO application would be obtained. There would be a very large adverse effect on bats for Option 4/5AV2, and hence securing protected species licences may be particularly challenging. In addition it requires development within the National Park.

17.11.6.3 In terms of public and stakeholder support, it attracted the lowest level of support from the further consultation respondents as a preferred option (2%) and no local authority expressed support for it.

17.11.6.4 Option 4/5AV2 is, based on current estimates, also the second most expensive option being considered, with a central estimate of c.£358 million (outside the Scheme's current allocated budget).

17.11.6.5 Given all of this, it is clear that the negative factors associated with Option 4/5AV2 are many and need to be given significant weight. In particular, significant negative weight attaches to the cumulative factors of the extent of public and stakeholder support, the large adverse effect on biodiversity, and development within the National Park. Option 4/5AV2 does have positive factors, but these are not considered to be of material weight when compared to the benefits of other options. As such, it is considered that the negative factors associated with Option 4/5AV2 outweigh the positive factors.

17.11.7 Summary of the options – Option 4/5AV1

17.11.7.1 As with the other offline options, Option 4/5AV1 performs positively when compared to the Scheme objectives and is predicted to have significant operational benefits when compared to the 'do-nothing' scenario. It also presents a lower construction risk when compared to the online options.

17.11.7.2 However, in terms of environmental impacts and adverse effects, Option 4/5AV1, as with the other offline options, would result in significant adverse effects in respect of landscape, cultural heritage and biodiversity. The response to the Further Public Consultation from Natural England shows that it is questionable whether the necessary licenses and agreements required for a successful DCO application would be obtained. There would be a large adverse effect on bats for Option 4/5AV1, and hence securing protected species licences may be particularly challenging. In addition it requires Development within the National Park. It is noted out of all of the options, aside from Option 5BV1, it involves the least amount of development within the SDNP and, again aside from Option 5BV1 (which results in no loss of ancient woodland), would cause the least amount of ancient woodland take.

17.11.7.3 Although in terms of environmental impacts and adverse effects it can be seen to perform better than Option 3V1 and Option 4/5AV2 it does not perform as well as the online options or Option 5BV1. When contrasted with Option 5BV1 it was assessed to have greater adverse effects on biodiversity due to its effects on Binsted Wood Complex LWS, loss of ancient woodland and increased adverse effects on associated woodland species, including bats. In addition, it had greater adverse effects on landscape and cultural heritage than 5BV1.

17.11.7.4 In terms of public and stakeholder support, both Arun DC and WSCC expressed support for Option 4/5AV1. In addition, 22% of the further consultation respondents considered Option 4/5AV1 to be their preferred route option choice – the second highest after Option 1V9. However, importantly Option 4/5AV1 also received the highest proportion of 'least preferred' responses by a significant margin (37% compared to 15% for Option 1V5, the next highest), demonstrating the polarised nature of responses to the further consultation.

17.11.7.5 Option 4/5AV1 is the third most expensive option being considered, with a central estimate of c.£340 million, which sits outside of the Scheme's allocated budget of £250 million. It is c.£44 million less than Option 5BV1, c.£18 million less than Option 4/5AV2 but c.£20 million more than Option 3V1.

17.11.7.6 As with all the options under consideration, Option 4/5AV1 would have some negative environmental effects and community impacts. The environmental effects can be seen to be lesser in magnitude than for Option 3V1 and 4/5AV2. While the community impacts can be seen to be greater than the other offline options other than for Option 5BV1. Option 4/5AV1 attracted the most support, in terms of offline options, from the public and was identified as the preferred option by WSCC and Arun DC. However, it was also identified as the least preferred option by the greatest percentage of respondents. Given all of this, and taking in to account the complex and inter-related issues which impact all of the options, it is considered that on balance, the negative factors of pursuing 4/5AV1 as the preferred option outweigh the positives. The combination of; development within the National Park and the resulting considerable policy constraints; environmental impacts and adverse effects; and risks with respect to EPS licencing ultimately outweigh the WSCC and Arun DC support for this option.

17.11.8 The Preferred Route

17.11.8.1 A detailed comparison of the performance of the six options as presented at the Further Public Consultation has been undertaken.

17.11.8.2 The methodology used to compare options has followed relevant standards and guidance. It is based around the Transport Business Case Five Case Model criteria and uses the Option Assessment Framework contained within the Web-based Transport Analysis Guidance (WebTAG) Transport Appraisal Process.

17.11.8.3 The comparison process concluded that Option 5BV1 best meets overall the Scheme Objectives. It would achieve the objectives to improve safety, reduce congestion, increase capacity and reduce accessibility.

17.11.8.4 There is a clear case for the Scheme in preference to the 'do nothing' scenario. However, it is also clear that selecting a preferred option for the Scheme is challenging. Option 5BV1 has a very considerable advantage in that it lies outside the SDNP and does not result in loss of ancient woodland. There is a strong policy presumption against building of new roads in a National Park and the NN NPS policy is that the Secretary of State should not grant development consent for any development that would result in the loss or deterioration of ancient woodland unless the national need for and benefits of the development in that location clearly outweigh the loss. However, Option 5BV1 is not the preferred route of WSCC and Arun DC, it received low public support and is the most costly of the options.

17.11.8.5 As such, a balancing exercise has been undertaken, taking into account all the positive and negative factors identified for the options to come to a judgement as to the preferred option.

17.11.8.6 The response to the Further Public Consultation shows that there is a polarity of views between communities directly affected and a wider concern about the environmental impact of the Scheme. The statutory environmental bodies and SDNP consider that the online options would be least environmentally damaging. WSCC and Arun DC have both supported Option 4/5AV1 as the best balance between traffic, economic and social benefits and environmental impacts.

17.11.8.7 The online options have lower adverse effects on biodiversity, landscape and cultural heritage than Option 5BV1 as they are following, in part, the existing A27 corridor. Both online options would require development in the National Park, would result in the loss of ancient woodland and as required for all options, will need to obtain EPS licenses. The online options increase the traffic levels and width of the highway corridor through Arundel resulting in overall greater community impacts with a higher number of properties affected by noise. The online options would also result in significantly greater disruption during construction.

17.11.8.8 Option 5BV1 is the only option which avoids development within the SDNP and loss of ancient woodland. This is given significant weight considering the NN NPS policy tests which would need to be met in terms of development within the SDNP and the loss of ancient woodland for all the other options. Of the offline options Option 5BV1 has the lowest adverse effects on biodiversity and landscape. However Option 5BV1 still has major environmental impacts and adverse effects and risks of non-compliance with the NN NPS (Cultural Heritage) and has higher community impacts than the other offline options.

17.11.8.9 Overall **Option 5BV1, Grey** is considered the best compromise between environmental and community impacts of all the options and, particularly having regard to national planning policy, and **should be taken forward as the preferred route**.

17.11.8.10 Option 5BV1 is the most expensive of the options and is above the Scheme budget. This in and of itself is not a reason to discount that particular option, provided that other positive factors out-weigh the higher cost. In taking forward this option Highways England will need to secure the necessary additional funding.

17.11.8.11 Though considered the best balance between community, environmental and key planning policy requirements, Option 5BV1 still has major environmental impacts and risks of non-compliance with the NN NPS. The project team will work closely with Natural England regarding obtaining protected species licences. In addition, further work will need to be carried out in developing the Scheme in the next stage of Scheme development to reduce impacts and address local concerns. .Option 5BV1, the recommended preferred route, is shown in Figure 17-3.

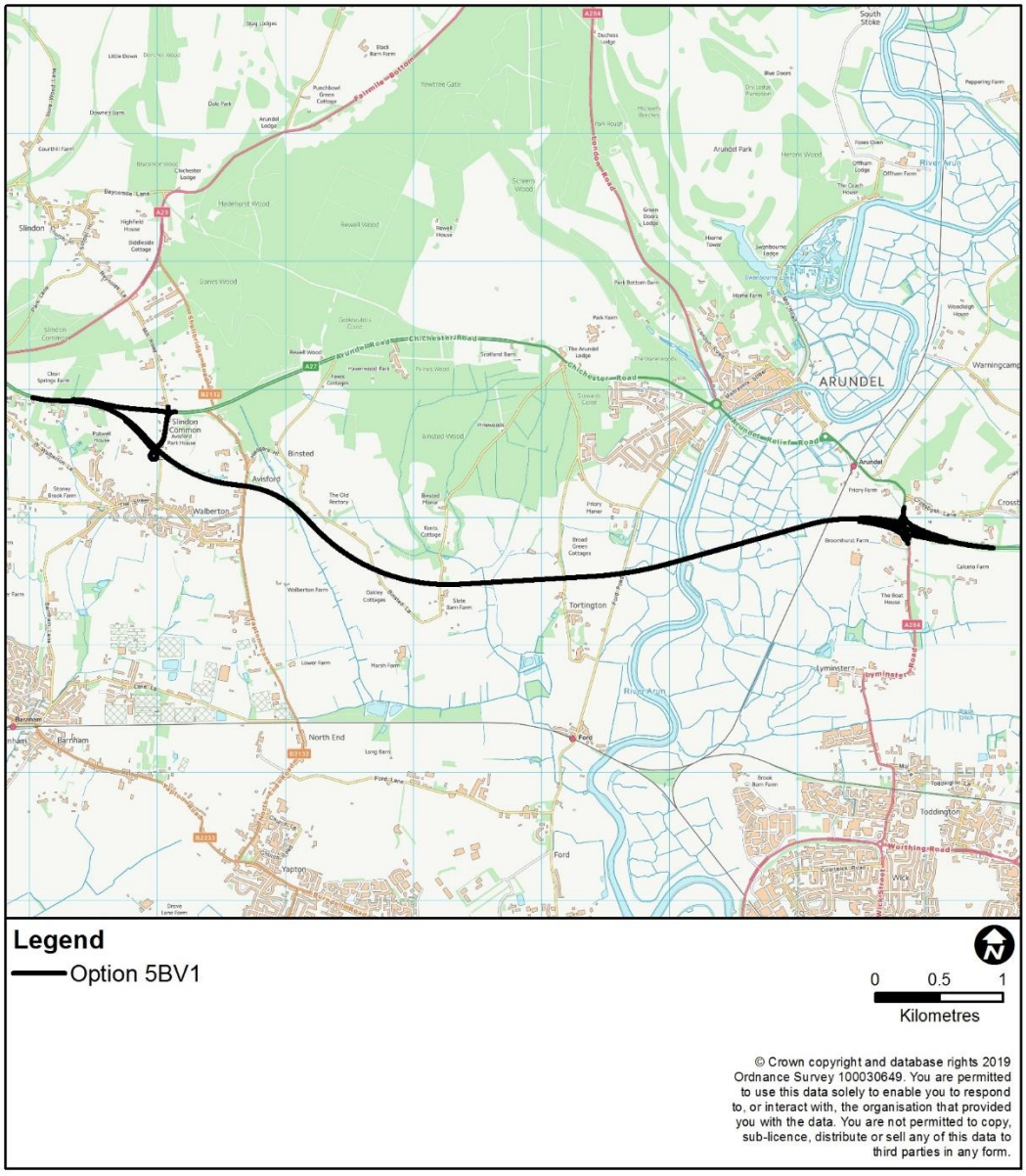


Figure 17-3 - Option 5BV1 - Recommended Preferred Route

Abbreviations

Abbreviation	Explanation
Arun DC	Arun District Council
BCR	Benefit Cost Ratio
DCO	Development Consent Order
DMRB	Design Manual for Roads and Bridges
EAR	Environmental Assessment Report
GHG	Greenhouse gases
LWS	Local Wildlife Site
NN NPS	National Networks National Policy Statement
NSIP	Nationally Significant Infrastructure Projects
RIS	Road Investment Strategy
SDNP	South Downs National Park
SIA	Social Impact Assessment
SoS	Secretary of State
WebTAG	Web-based Transport Appraisal Guidance
WSCC	West Sussex County Council

A27 Arundel Bypass Scheme Assessment Report

Chapter 18 –Conclusion

October 2020

CONTENTS

TABLE OF FIGURES

18 Conclusion

18.1 Introduction

18.1.1.1 This Scheme Assessment Report (SAR) summarises the further PCF Stage 2 assessments of the A27 Arundel Bypass Scheme identified in the Road Investment Strategy (RIS) 1 and 2.

18.1.1.2 This SAR report:

- Brings together the traffic, economic, safety, operational, technical, maintenance and environmental assessments undertaken.
- Provides a summary of the Report for the Further Consultation held between 30 August 2019 and 24 October 2019.
- Sets out the conclusions from this work and recommends a preferred option.

18.2 Scheme Development

18.2.1.1 An initial consultation on options for a proposed A27 Arundel Bypass took place in 2017. A modified option of one of the three options put forward as part of this initial consultation, known as Option 5AV3, was subsequently announced as the preferred route choice in May 2018.

18.2.1.2 The preliminary design of this preferred route then began, to further develop the design and progress the Scheme towards applying for development consent from the Secretary of State. This included looking at design refinements for minimising impacts on protected ancient woodland and biodiversity at the western end of the route.

18.2.1.3 During this process new information was discovered which led Highways England to decide to undertake a further public consultation on route options to ensure the public's views on the Scheme were based on the latest available information.

18.2.1.4 Following an initial sifting of a wide range of possible route alignments according to how well they meet the Scheme Objectives and legal and national planning policy tests, six dual carriageway options were presented at the Further Public Consultation. For ease of reference these are shown in Figure 18-1 – Further Consultation Options.

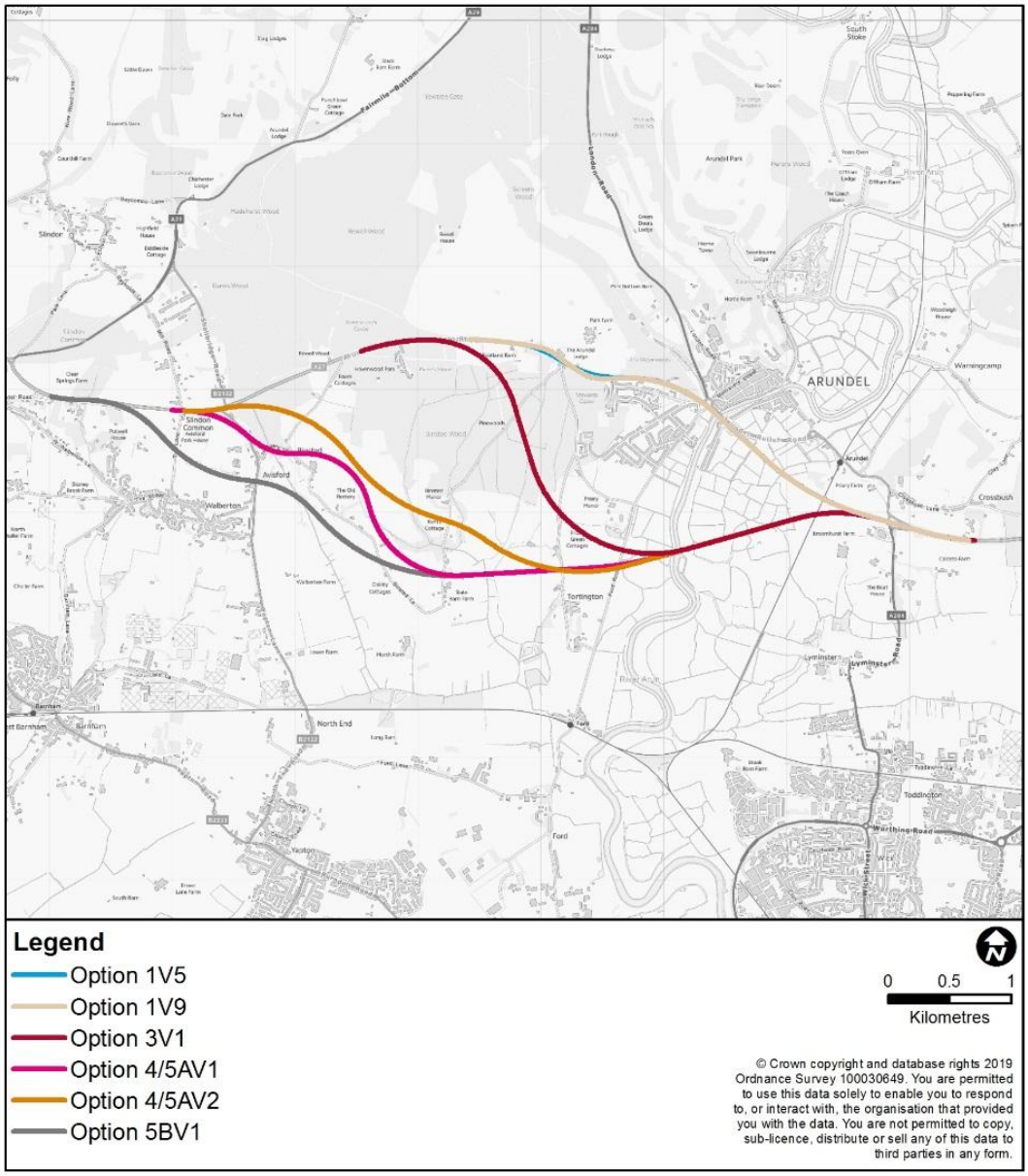


Figure 18-1 – Further Consultation Options

18.2.1.5 The Web-based Transport Analysis Guidance (WebTAG) assessment of the six options are detailed in Chapters 9 to 12 of the SAR and summarised in the Appraisal Summary Tables presented in Appendix F. While the safety operational, technology and maintenance assessment are detailed in Chapters 13 to 14 of the SAR.

18.2.1.6 The Further Public Consultation took place between 30 August and 24 October 2019. A total of 4,945 consultation response forms were completed during the consultation period, comprising 4,245 online and 700 paper copies. In addition, 113 other written responses were received via letter or email, 59 of which were submitted by individuals, and 54 came from organisations.

18.2.1.7 Two email response campaigns opposing the proposals were also launched by third parties during the further consultation: one in support of the 'Arundel Alternative' (an alternative online wide single carriageway option that was promoted locally) prompted 575 emails. The other, led by the Woodland Trust, objected to all of the proposed options put forward as part of the further consultation due to environmental impacts and prompted 1,449 emails.

18.2.1.8 During the consultation period, some corrections were necessary to the technical documents that underpinned the principal consultation materials. After the consultation had closed, further anomalies in the technical information were identified. These primarily related to the presentation of environmental impact analysis in the Environmental Assessment Report and consultation materials. Consultees were again informed of these changes through letters and email bulletins and between 3 February and 1 March 2020 the public were given the opportunity to review the corrections and to confirm if they affected their response to the further consultation.

18.2.1.9 Analysis of the consultation responses revealed a distinct polarisation of views between different sections of the community (see Chapter 16, Section 16.4). When asked to identify their preferred option if all are brought into an affordable range the level of support for each option was as follows:

- Beige (Option 1V9) at 27%
- 'Do nothing' at 25%
- Magenta (Option 4/5AV1) at 22%
- Cyan (Option 1V5) at 12%
- Grey (Option 5BV1) at 7%
- Crimson (Option 3V1) at 3%
- Amber (Option 4/5AV2) at 2%
- 'Don't know' at 1%

18.2.1.10 Respondents were asked to consider their least preferred (last choice) option, should all options be brought into an affordable range. The results further demonstrated that respondent opinions were polarised. Of the respondents who answered the question:

- 37% least preferred Magenta (Option 4/5AV1)
- 15% least preferred Cyan (Option 1V5)
- 12% least preferred Beige (Option 1V9)
- 11% least preferred 'do nothing'
- 9% least preferred Crimson (3V1)
- 9% least preferred Grey (5BV1)
- 2% least preferred Amber (4/5AV2)

18.2.1.11 The views of organisations responding were also polarised to some extent (see Chapter 16, Section 16.5). West Sussex County Council (WSCC), Arun District Council (Arun DC) and Arundel Town Council all favoured Option 4/5AV1. The statutory environmental bodies, including the Environment Agency, Forestry Commission, Historic England and Natural England, expressed significant concerns about the potential impacts of all options, though suggested that Option 1V5 and Option 1V9 would be least damaging from an environmental perspective.

18.3 Comparison of Options and Recommended Route

18.3.1.1 A detailed comparison of the performance of the six options presented at the Further Public Consultation has been undertaken.

18.3.1.2 The methodology used to compare options has followed relevant standards and guidance. It is based around the Transport Business Case Five Case Model criteria and uses the Option Assessment Framework contained within the WebTAG Transport Appraisal Process. The methodology used to appraise the route options is further detailed in Chapter 17.

18.3.1.3 A summary of the comparison process is shown in Figure 18-2 - Summary of Pairwise Comparison. The best performing option considering performance against Scheme Objectives, planning policy, value for money and deliverability was Option 5BV1. The next best two performing options were Option 4/5AV1 and Option 1V5. The findings of the pairwise process together with the financial case was reviewed as part of the Highways England's governance process for deciding on the preferred route which is described in detail in Chapter 17 of this report and summarised below.

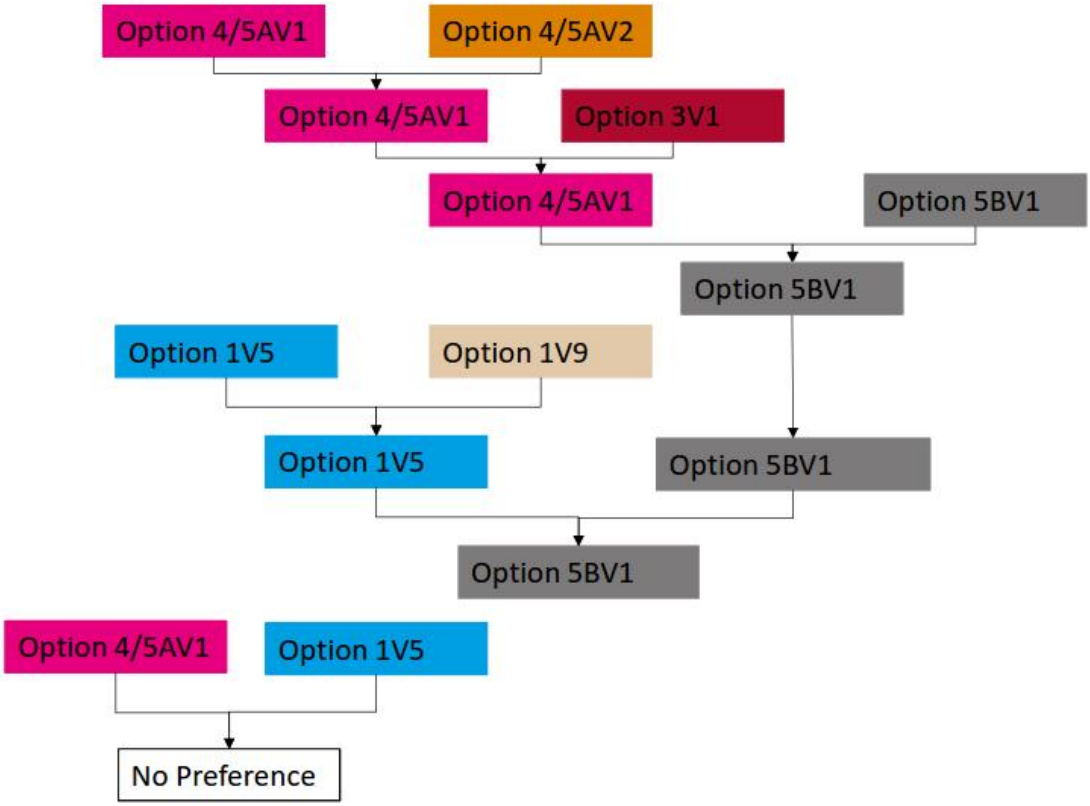


Figure 18-2 - Summary of Pairwise Comparison

18.4 Preferred Route

18.4.1.1 There is a compelling case for the Scheme and the Road Investment Strategy 2020-2025 (RIS2) made a commitment to replace "the existing single carriageway road with a dual carriageway bypass, linking together the two existing dual carriageway sections of the road". In addition, 67% of respondents to the Further Public Consultation agreed that there is a need to improve the A27 around Arundel.

18.4.1.2 From the analysis undertaken, it is clear that the factors to be taken into account in determining options selection raises complex and inter-related issues. The policy constraints are considerable and the feedback from the further public consultation shows that stakeholders are polarised with no single option which generates a majority of support. As such, Highways England has had to consider each of the relevant factors, and undertake a balancing exercise of those factors to determine a preferred route.

18.4.1.3 Based on the assessment undertaken it is considered that on balance, **Option 5BV1 (Grey)** should be further developed as the preferred route. Whilst it does have its own issues, not least in terms of cost and adverse environmental effects, it does have positive factors when compared to the other options under consideration which are considered to outweigh the negative factors.

18.4.1.4 Option 5BV1 is the only option presented which avoids development within the South Downs National Park (SDNP) and loss of ancient woodland[1]. This is given significant weight considering the National Policy Statement for National Networks policy tests which would need to be met in terms of a road development within the SDNP and the loss of ancient woodland for all the other options. It also performed better than the other offline options for biodiversity and landscape and performed better than the online options for noise and other community impacts including townscape and is predicted to result in less disruption to road users and the residents of Arundel during construction.

18.4.1.5 On balance, considering the positive and negative factors of 5BV1 in comparison to the other options, it is considered that Option 5BV1 is the best performing option overall when evaluated against the Scheme Objectives, value for money, deliverability and planning policy.

18.4.1.6 It is acknowledged that as with all options, Option 5BV1 does present its own challenges - for example, in relation to community impacts, environmental mitigation, and protected species licences. Such challenges will be fully taken into account at Stage 3 as the Scheme development is progressed.

18.4.1.7 Option 5BV1 delivers the Scheme Objectives as follows:

- **Improving Safety** – The new A27 would provide a safer dual carriageway route than the existing single carriageway with its numerous junctions and accesses and regular congestion. The Scheme would also improve safety by encouraging road users to use the new A27 rather than seeking alternative routes to avoid congestion.
- **Enhancing Communities and Improving Customer Services** – Option 5BV1 would retain the full length of the bypassed section of the

[1] Ancient woodland loss refers to areas defined and mapped by Natural England's Ancient Woodland Inventory. The term ancient woodland used throughout this chapter refers to this inventory.

existing A27 to allow local traffic access to the east and west. It would also reduce congestion and severance in the town of Arundel.

- **Reducing Congestion** – The Scheme would reduce the existing traffic congestion on the A27 around Arundel. By reducing congestion and increasing capacity the Scheme would improve journey times and journey time reliability on the A27.
- **Increasing Capacity** – The Scheme would provide additional capacity on the A27. The average daily two-way traffic flows on the existing A27 through Arundel would be approximately 21,300 in 2041 compared to approximately 40,000 if the Scheme was not built. By reducing congestion and increasing capacity the Scheme would improve connectivity between local towns contributing to economic growth and facilitate local authorities in meeting their housing plans.
- **Improving Accessibility** – Reduced severance of the Public Right of Way network caused by the existing A27 within the SDNP and reduced traffic levels within Arundel will improve local accessibility.
- **Minimise Environmental Impact** – Option 5BV1 is the only option which avoids the loss of ancient woodland. In general, it would reduce traffic levels on the existing A27 west of Arundel within the SDNP and reduce traffic on unsuitable roads within the SDNP from those seeking to avoid congestion at Arundel. However, as with all options, Option 5BV1 has significant adverse effects on the environment and challenges which will require an extensive and wide-ranging mitigation strategy to be developed as the Scheme progresses.
- **Respecting the SDNP** – Option 5BV1 is the only option that is wholly outside the boundaries of the SDNP but inevitably has an impact on the SDNP which will require a mitigation strategy. The Option also provides a significant new opportunity to reduce severance caused by the existing A27 within the Park and improve connections from the coast to the park.

18.4.1.8 Option 5BV1, the selected preferred route, is shown in Figure 18-3.

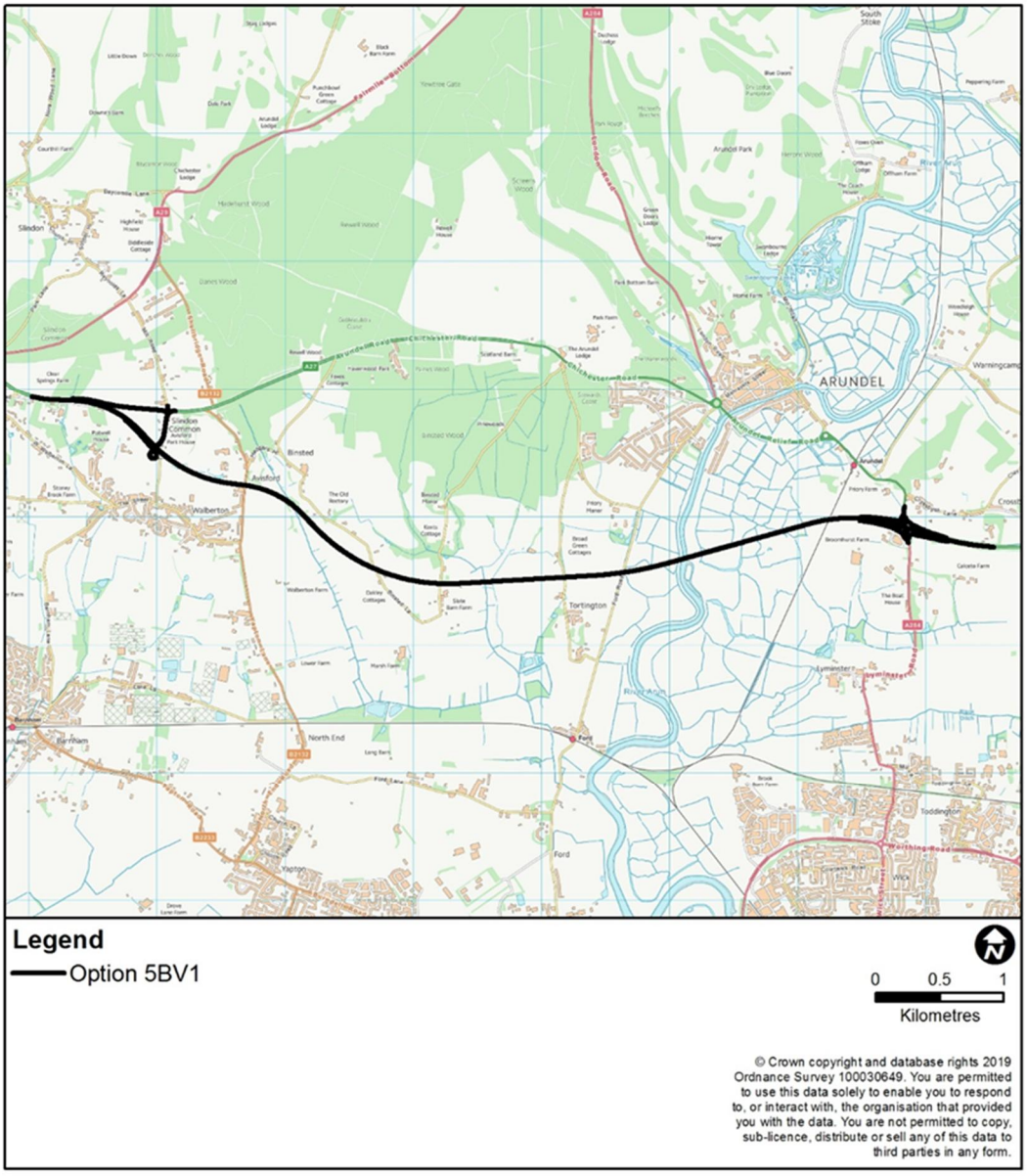


Figure 18-3 - Option 5BV1 - Preferred Route

18.4.1.9 The development of the preferred route will continue to be carried out in consultation with key stakeholders including WSCC, SDNP, Arun DC, Natural England, Environment Agency, Forestry Commission and Historic England. A statutory consultation will be held when the public and other stakeholders will have a further opportunity to comment on the development of the preferred route prior to applying for a Development Consent Order to seek authorisation to construct the Scheme.

18.4.1.10 The Further Public Consultation has highlighted several issues which Highways England will consider further in the next stage (PCF Stage 3) of the Scheme development. These include:

- Undertaking a landscape scale integrated assessment of the preferred route and to develop appropriate landscape scale mitigation measures.
- Assessing in more detail whether to cross the River Arun floodplain on a viaduct or embankment.
- Reviewing the need for the provision of an additional junction at Ford Road.
- Reviewing the development of sustainable transport measures on the existing A27 corridor in line with the RIS statements.
- Developing a legacy for both the local community and visitors.
- Developing an appropriate approach to Biodiversity Net Gain and Natural Capital.

Abbreviations

Abbreviation	Explanation
RIS	Road Investment Strategy
Arun DC	Arun District Council
RIS	Road Investment Strategy
SAR	Scheme Assessment Report
SDNP	South Downs National Park
WebTAG	Web-based Transport Appraisal Guidance
WSCC	West Sussex County Council
PCF	Project Control Framework