

A27 Chichester Bypass

Scheme Assessment Report

343538-90-060-RE-002

February 2017

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Contents	Page
Glossary	1
Executive Summary	2
Report Purpose	2
PCF Context	2
Background.....	3
Need for Intervention.....	3
Planning Factors	4
Project Objectives.....	4
Stage 1 Options	5
Interim Review	5
Stage 2 Options	6
Traffic Assessment.....	6
Economic Assessment.....	8
Operational Assessment	9
Maintenance Assessment	10
Environmental Assessment.....	10
Public Consultation.....	11
Conclusion and the Recommended Option.....	11
1. Existing Conditions	12
1.1. The Existing Chichester Bypass.....	12
1.2. The Problem	13
1.3. Existing Conditions and Constraints.....	13
1.4. Scheme Brief.....	16
2. Planning Factors.....	17
2.1. Chichester Local Plan (2014-2029)	17
2.1.1. Existing Transport Links and Economy	17
2.1.2. Strategic Development Areas.....	18
2.2. Coastal West Sussex and Greater Brighton Local Strategic Statement (2013-2031) 19	
2.3. South Downs National Park Local Plan (draft).....	20
2.4. Arun Local Plan (2011 – 2031).....	20

**A27 Chichester Bypass
Scheme Assessment Report**

2.5.	West Sussex Transport Plan (2011-2026).....	20
2.6.	Highways England Delivery Plan (2015-2020)	21
2.7.	National Environmental Policies	21
2.8.	National Planning Policy Framework (March 2012)	22
2.9.	National Policy Statement for National Networks	22
3.	Do Nothing Consequences	24
4.	Alternative Options	26
4.1.	Stage 1 Options	26
4.2.	Factors Considered in Options Development	26
4.3.	Options Sifting	27
4.4.	Stage 2 Value Management Workshop	28
4.5.	Stage 2 Options	28
4.5.1.	Option 1.....	28
4.5.2.	Option 1A.....	29
4.5.3.	Option 2.....	30
4.5.4.	Option 2A.....	31
4.5.5.	Option 3.....	32
4.5.6.	Option 3A.....	32
4.5.7.	Option 4.....	33
4.5.8.	Option 5.....	34
4.5.9.	Option 6.....	35
4.6.	Interim Review of Options	36
5.	Traffic, Economics and Costs	37
5.1.	Traffic Forecasting	37
5.1.1.	Study Area	37
5.1.2.	Model Validation	37
5.1.3.	Impact on Road Network	38
5.1.4.	Comparison of route times on existing A27 Bypass and within Chichester	39
5.1.5.	Comparison of Journey Times through Chichester	41
5.2.	Economic Assessment.....	43
5.2.1.	Transport economic efficiency (TEE), Public accounts (PA) and Analysis of monetised costs and benefits (AMCB)	44
5.3.	Buildability	46

Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

5.4.	Option Cost Estimate	47
5.4.1.	Risk Registers.....	47
6.	Operational Assessment	48
6.1.	Microsimulation Modelling Assessment	48
6.1.1.	Methodology	48
6.1.2.	Option 1.....	49
6.1.3.	Option 1A.....	54
6.1.4.	Option 2.....	60
6.1.5.	Option 3.....	65
6.1.6.	Option 3A.....	67
6.1.7.	Options Performance Summary	72
6.2.	Road Safety Audit.....	72
6.2.1.	Non Motorised Users (NMU's)	72
7.	Technology and Maintenance Assessment.....	74
7.1.	Technology Assessment	74
7.2.	Maintenance Assessment	74
8.	Environmental Assessment and Environmental Design.....	77
8.1.	Air Quality	77
8.2.	Cultural Heritage	78
8.3.	Landscape	78
8.4.	Nature Conservation	79
8.5.	Geology and Soils.....	79
8.6.	Materials.....	79
8.7.	Noise and Vibration	80
8.8.	Effects on All Travellers	80
8.9.	Community and Private Assets	81
8.10.	Road Drainage and the Water Environment	81
8.11.	Combined and Cumulative Effects.....	82
8.12.	Carbon Assessment	83
9.	Public Consultation.....	84
9.1.	Effectiveness of the Public Consultation	84
9.2.	Questionnaire Response Analysis	84
9.3.	Summary of Responses from Local Organisations	86

**A27 Chichester Bypass
Scheme Assessment Report**

9.4.	Other factors concerning the Public Consultation	86
10.	Appraisal Summary Table (AST)	88
11.	Comparison of Options	89
11.1.	Intermediate Assessment	89
11.2.	Appraisal Methodology	90
11.2.1.	Comparison 1: Option 1 with Option 1A	90
11.2.2.	Summary of Comparison	90
11.2.3.	Comparison 1 Result.....	91
11.2.4.	Comparison 2: Option 1A with Option 2	91
11.2.5.	Summary of Comparison 2	92
11.2.6.	Comparison 2 Result.....	93
11.2.7.	Comparison 3: Option 2 with Option 3	93
11.2.8.	Summary of Comparison 3	93
11.2.9.	Comparison 3 Result.....	94
11.2.10.	Comparison 4: Option 2 with Option 3A	94
11.2.11.	Summary of Comparison 4	95
11.2.12.	Comparison 4 Result.....	95
11.2.13.	Project Objectives Analysis.....	96
12.	Conclusion and Recommended Route.....	99
12.1.1.	Public Consultation Feedback	99
12.1.2.	Risks in Preferred Route Selection	100
13.	Confidential Consultations.....	1
Appendix A	Stage 2 Option Plans	2
Appendix B	2035 AM/PM Peak Flows – Compared to Do Minimum	3
Appendix C	Comparison of 2035 AM Peak Hour Journey Time.....	9
Appendix D	Sector Distribution of Time and VOC Benefits.....	13
Appendix E	Significance of Environmental Effects During Construction and Operation ..	17
Appendix F	Appraisal Summary Tables	19
Appendix G	Comparison of Appraisal Summary Tables	20

List of Figures

Figure 0.1: Study Area.....	7
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A27 Chichester Bypass Scheme Assessment Report

Figure 1.1: A27 South Coast Route	13
Figure 5.1: Study Area.....	37
Figure 5.2: Location of journey time routes measured for comparison.....	40
Figure 5.3: Location of modelled zones between which journey time is measured for comparison.....	42
Figure 5.4: TUBA Sectors.....	44
Figure 6.1: Option 1 – Extent.....	49
Figure 6.2: Option 1 – A259 Cathedral Way / Fishbourne Road East during the AM peak....	50
Figure 6.3: Option 1 – A286 Stockbridge Road / A27 Chichester Bypass during the AM peak	51
Figure 6.4: Option 1 – B2145 Whyke Road / A27 Chichester Bypass during the PM peak ...	52
Figure 6.5: Option 1 – Bognor roundabout during the PM peak	52
Figure 6.6: Option 1 - Portfield Roundabout during the PM peak.....	53
Figure 6.7: Option 1A – Extent	54
Figure 6.8: Option 1A – A259 Cathedral Way / Fishbourne Road East during the AM peak .	55
Figure 6.9: Option 1A - Stockbridge Road / A27 Chichester Bypass during the AM peak	57
Figure 6.10: Option 1A – B2145 Whyke Road / A27 Chichester Bypass during the PM peak	58
Figure 6.11: Option 1A - Portfield Roundabout during the AM peak.....	59
Figure 6.12: Option 2 – Extent.....	60
Figure 6.13: Option 2 – A259 Cathedral Way / Fishbourne Road East during the AM peak..	61
Figure 6.14: Option 2 - New link / A286 Birdham Rd roundabout during the AM peak	62
Figure 6.15: Option 2 – A27 westbound congestion caused by the new link / A286 Birdham Rd roundabout during the PM peak	62
Figure 6.16: Option 2 - New link road / B2145 / B2166 roundabout during the PM peak.....	63
Figure 6.17: Option 2 - Portfield roundabout during the AM peak	64
Figure 6.18: Option 3 – Extent.....	65
Figure 6.19: Option 3 – Fishbourne Roundabout during the AM peak	66
Figure 6.20: Option 3 – Bognor roundabout during the PM peak	66
Figure 6.21: Option 3A – Extent	67
Figure 6.22: Option 3A – Fishbourne Roundabout during the AM peak	68
Figure 6.23: Option 3A – A286 Stockbridge Rd / A27 Chichester Bypass junction during the AM peak	69
Figure 6.24: Option 3A – Bognor Roundabout during the AM peak	70
Figure 6.25: Option 3A - Portfield Roundabout during the PM peak.....	71
Figure 9.1: Public Consultation Response – Preferred Option	85
Figure 9.2: Proportion of respondents that refer to a new bypass (by preferred option)	86

List of Tables

Table 0.1: Summary of Economic Assessment Results – Core Scenario (£m)	8
Table 0.2: Junctions with operational issues in 2035	Error! Bookmark not defined.
Table 5.1: Comparison of Journey Times - 2035 Core	41
Table 5.2: Capital Cost and Headline Benefits Summary - Core Scenario, £m	43

Table 5.3: Summary of Economic Assessment Results – Core Scenario, £m	46
Table 5.4: Option out-turn of costs	47
Table 6.1: Vehicle Speed Colour Correspondence	49
Table 6.2: Junctions exceeding capacity in 2035.....	72
Table 6.3: Summary of potential safety implications for proposed options	73
Table 7.1 Summary of potential maintenance implications for proposed options	75
Table 8.1: Air Quality Effects of the Options	Error! Bookmark not defined.
Table 8.2: Carbon Emission Summary	83
Table 11.1: Advantages of Option 1 and Option 1A Advantages	90
Table 11.2: Advantages of Option 1A and Option 2	92
Table 11.3: Advantages of Option 2 and Option 3	93
Table 11.4 Advantages of Option 2 and Option 3A.....	95
Table 12.1 Summary of Public Consultation responses.....	99

Glossary

AADT	Average Annual Daily Traffic
AONB	Area of Outstanding Natural Beauty
AQMA	Air Quality Management Areas
BCR	Benefit Cost Ratio
CDC	Chichester District Council
CRF	Congestion Reference Flow
DMRB	Design Manual for Roads and Bridges
DfT	Department for Transport
LMVR	Local Model Validation Report
MMSJV	Mott MacDonald Sweco Joint Venture
NMUs	Non Motorised Users
NO2	Nitrogen Dioxide
PCF	Project Control Framework
RIS	Road Investment Strategy
SAC	Special Areas of Conservation
SLR	Stockbridge Link Road
SNCI	Site of Nature Conservation Interest
SRN	Strategic Road Network
WSCC	West Sussex County Council
WebTAG	Transport Analysis Guidance

Executive Summary

Report Purpose

This report describes the development of the A27 Chichester Bypass Improvement scheme under the current PCF (Project Control Framework) through Stage 2; collating the current context, future conditions, design options considered, traffic, economics and costs, as well as the environmental assessment and a summary of the Public Consultation.

It also provides a summary of the Technical Appraisal Report (report no. 343538-90-060-RE-002-P02) and the Public Consultation Report (report no. 343538-90-120-LF-003) and recommends an emerging Preferred Route / Option for consideration.

PCF Context

Highways England's Project Control Framework sets out the methodology for delivery of a major highways scheme. The process is in 8 stages, of which this scheme is currently in Stage 2, as follows:

- **Stage 0** (Strategy, Shaping and Prioritisation) – problem definition, scheme requirements and strategic business case;
- **Stage 1** (Option Identification) – option identification and sifting out of options that are likely to perform less well compared to others;
- **Stage 2** (Option Selection) – detailed option assessment and selection of the preferred option, including detailed public consultation on the options;
- **Stage 3** (Preliminary Design) – scheme development including design of the preferred option in sufficient detail to produce draft orders and preparation of the Environmental Assessment;
- **Stage 4** (Statutory Procedures and Powers) – gaining authority to construct the scheme through the normal statutory processes as laid down in legislation;
- **Stage 5** (Construction Preparation) – procurement of the construction contractor and detailed design of the scheme;
- **Stage 6** (Construction) – construction of the scheme;
- **Stage 7** (Handover and Close-Out) – project close out.

Proposals for improvements had been developed over a number of years but had most recently been stopped as part of the Comprehensive Spending Review in 2010. The current scheme to provide improvements to the A27 Chichester Bypass was announced as part of the 2013 Spending Round (SR13) where the improvements were described as '*Upgrading 6 junctions on the existing 3.5m bypass*' and confirmed in the Road Investment Strategy in December 2014 where the improvements were described as '*upgrading the four junctions on the Chichester Bypass*'.

Background

The A27 Chichester Bypass is a five and a half kilometre section of trunk road passing to the south of Chichester and is part of the only strategic route along the South Coast of England. This section has six at-grade junctions along its length, with roundabouts at Fishbourne, Stockbridge, Whyke, Bognor Road and Portfield, and with a signal controlled cross-roads at Oving. Congestion occurs daily during peak time along this stretch of road causing delays to the travelling public and constraining the local economy. In addition to the existing traffic levels and predicted future increase, the Chichester District Council (CDC) Local Plan 2014 to 2029 outlines the creation of a large number of new homes and expanding the economy, likely to put further pressure on an already congested section of the strategic road network.

Need for Intervention

The congestion around Chichester acts as an economic deterrent for the region and a constraint to travel for traffic between Portsmouth, Southampton (and the ports there), as well as other locations to the West and locations to the East such as Worthing, Brighton, Hastings and Eastbourne.

The six junctions on the Bypass are where the radial routes between the south coast (Manhood Peninsula and Bognor Regis) and the city centre cross the Bypass. Junction spacing varies from 0.5km to 1.1km and is identified as a key limitation for the options proposed. The average annual daily traffic on the links between junctions is in the order of 35-45,000 vehicles, below the standard value for link capacity, which indicates that the current delays and queues are caused by insufficient junction capacities.

Although intended to act as a strategic route, in reality the long-distance (through) traffic on Chichester Bypass competes for access at the junctions with the local traffic, either wanting to cross the Bypass or join it for short trips. These local trips, defined as having both their origin and destination within Chichester District, are assessed to be approximately 12% out of all journeys using the Bypass. A further 42% of trips on the Bypass are for journeys with either an origin or destination inside the Chichester District boundary. Traffic data indicates that approximately 46% of traffic using the Bypass, or parts of it, is estimated to be through traffic with both the origin and destination outside of the Chichester District.

It is therefore a combination of the close proximity of the junctions and the conflict between the competing north-south and east-west traffic flows that result in significant congestion and extensive queuing at most of the junctions at peak times, disrupting the mainline flow of the road and compromising its operation as a strategic route.

Other problems associated with congestion on the Bypass include rat-running through residential areas, commercial areas and on minor roads, causing congestion through local villages.

The Chichester Local Plan (2014) identifies the need for around 6900 new homes in the city and the immediate area to be delivered by 2029. This large number of additional homes is

likely to further exacerbate the problem, with the A27 being the closest strategic route to these developments but already with insufficient junction capacity.

It is therefore evident that due to congestion the Bypass acts as a constraint to development in and around Chichester.

Planning Factors

The A27 and more specifically Chichester Bypass, features on a series of current or draft planning documents and policies at local, regional and national level.

At local level, Chichester Bypass is located within the Chichester District, also bordering closely with the Arun District to the east and the South Downs National Park to the north. As such, it is integrated in the Local Plans of these three authorities in policies for transport links and strategic infrastructure as well as access, communication, environment and wider aspects related to the economy such as employment, mobility and services. The Bypass is also key to the policies for homes and the Strategic Development Areas identified, particularly in the Chichester Local Plan, which are considered constrained by traffic congestion linked to junctions on the Bypass.

At regional level, the A27 is essential to policies for planning factors such as Coastal West Sussex and Greater Brighton Local Strategic Statement and the West Sussex Transport Plan that manage spatial planning issues with impact on more than one local planning area. These recognise as a priority the improvements needed to road infrastructure facilitating the east-west movement along the A27 corridor through the region, in order to improve reliability and safety and increase the competitiveness of local businesses and attract investment.

At national level, Highways England Delivery Plan 2015-2020 includes Chichester Bypass alongside other schemes on the A27 corridor, where the Chichester Bypass is part of a package of 26 schemes announced in June 2013 and anticipated to start construction by end 2019/20. The National Environmental Policies, National Planning Policy Framework and the National Policy Statement for National Networks also set policies that have a bearing on the A27 as part of the Strategic Road Network (SRN), mainly related to environment, ecology, landscape, social and community aspects and associated requirements for sustainable development.

Project Objectives

The project objectives were derived in cooperation with West Sussex County Council (WSCC) and Chichester District Council (CDC) and are set out in the Client Scheme Requirements. The key objectives are as follows:

- Reduce congestion on the Chichester Bypass
- Improve road safety, during construction, operation and maintenance for all, as defined in DMRB Volume 0 Section 2 Part 3 GD 04/12:
 - Road workers
 - Road users

**A27 Chichester Bypass
Scheme Assessment Report**

- Other parties
- Reduce adverse environmental impacts & eliminate where possible:
 - Address existing Air Quality Management Areas (AQMAs) and ensure no further AQMAs are created as a result of the selected option
 - Address existing noise priority areas and ensure no further noise priority areas as a result of the selected option
- Improve journey time reliability on the Strategic Road Network (SRN)
- Improve capacity and support the growth of regional economies:
 - Facilitate timely delivery of the scheme to enable provision of housing demand in line with the Chichester Local Plan
 - Improve regional connectivity
 - Improve accessibility to areas with tourist activity.
- Improve the safety and security of the route to all road users, including vulnerable groups and non-motorised traffic

Stage 1 Options

During Stage 1 (Option Identification) over 20 options were identified, including mainly road-based solutions as well as a number of alternative solutions involving a tunnel, a collector distributor road, or a combination of public transport measures. The alternative solutions were discounted prior to the sifting process as they were deemed unviable due to either the substantial cost, buildability issues or lack of alignment to the project objectives. As such, 17 road-based options were considered further in Stage 1 and taken through the sifting process.

The sifting process was carried out in line with the Department for Transport's (DfT) Transport Appraisal Process guidance, and resulted in six options identified as potential candidates for meeting the project objectives and were taken forward to Stage 2. Details of the sifting process can be found in the Options Assessment Report (343538-09-101-RE-003). The six sifted options taken forward from Stage 1 were as follows:

- Options 1, 2 and 3 – Online improvements
- Options 4 and 5 – Offline new Bypass routes to the north of Chichester
- Option 6 – Hybrid option consisting of online improvements and an offline Bypass to the south east of Chichester

Early in Stage 2 a Value Management Workshop was held to identify elements of the six options that could be improved further. With concerns raised over the proximity of the Stockbridge Link Road element of Option 2 to Chichester Harbour Conservancy, an alternative option was put forward to investigate the use of a link road running parallel to the existing A27. This alternative option was named Option 2A.

Interim Review

In February 2016, an interim review of all the Stage 2 options was undertaken reflecting on the detailed information gathered throughout this Stage. From this, it was decided to

discontinue the new Bypass route options namely Option 4, Option 5 and the hybrid Option 6 as they were found to exceed the upper threshold of Road Investment Strategy's budget range (£100m to £250m). Option 4 and 5 were also found to impact on the South Downs National Park (SDNP). The SDNP Authority raised serious reservations in this regard. At the same time, Option 2A was excluded as it was found to be inferior in performance to the original Option 2.

Two sub-options (Option 1A and Option 3A) were also introduced as part of this review to examine alternatives that could offer value at the lower end of the budget range and can contribute to meeting the project objectives.

Stage 2 Options

The remaining five options, namely Option 1, Option 1A, Option 2, Option 3 and Option 3A, were then subject to further assessment in all areas to prepare for the public consultation and subsequent selection of a preferred option.

All five options were presented at public consultation between July and September 2016.

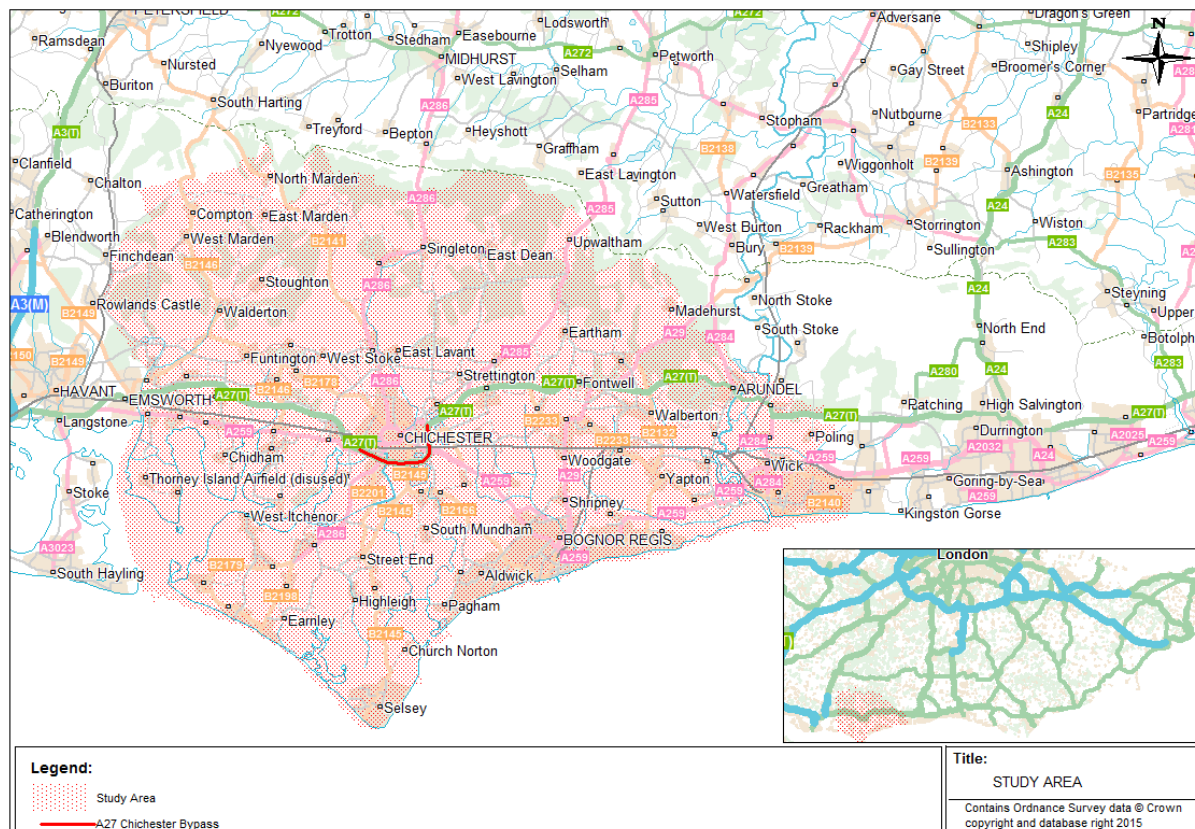
Traffic Assessment

The study area for traffic model, which was defined and agreed with West Sussex County Council and Chichester District Council, was developed to cover the area directly affected by the options being tested, with the potential to assess some peripheral impacts on strategic routes in the vicinity.

The study area comprised the south of Chichester District (to the northern edge of the South Downs) and a portion of Arun District west of Arundel including the River Arun as shown in Figure 0.1.

Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Figure 0.1: Study Area



The network model was calibrated and the flows and journey times compared to independent surveyed flows, to validate the model. The results produced fulfilled the Design Manual for Roads and Bridges (DMRB) and the Department for Transport (DfT) WebTAG model validation criteria. Further details are provided in the Local Model Validation Report (LMVR).

A comparison of the link flows across the Chichester network was undertaken between the Do Minimum¹ scenario and each option using the 2035 Design Year² AM/PM Peak flows. In general, it can be seen that the increase in capacity on the A27 in each option increases traffic flows on the strategic route compared to the Do Minimum scenario. For each option there is a reduction in traffic travelling through Chichester City, to the North via East Lavant, to the east via Drayton Lane and via Whyke Road to the south that had been previously used as diversion (rat-running) routes to avoid the delays on the A27. There are also specific differences between the options, with restricted movements or the removal of junctions creating re-assigned / diverted traffic and increased volumes on adjacent roads. An outline summary of each option is provided below.

This comparison shows that, compared with the 2035 Do Minimum scenario, Option 1 has long distance savings (between Havant and Fontwell) but showed some minor delays in local

¹ Do Minimum: defined as the continuation of the existing road conditions from the 2014 Base Year traffic model to 2035, without improvements, apart from those already committed in adopted planning documents – refer to Traffic Forecast Report.

² Design Year: defined as based on the opening year for the scheme, assumed to be 2020 plus 15 years as required in the Design Manual for Roads and Bridges Vol 12.2.1.

journeys to the south, (due to the banned right turns at the Stockbridge and Whyke junctions) and minor improvements elsewhere.

Option 1A shows similar journey time savings as Option 1, but generally the overall savings are smaller and there are delays in some long distance journeys and journeys from the south, due to the increased congestion at the Stockbridge and Whyke Roundabouts which are unchanged.

Option 2 has the largest long distance improvements in journey times and generally the largest improvements in local journey times. There are some small increases in journey times to/from Birdham area south of Chichester due to the increase in traffic now approaching the new Stockbridge Link road.

Option 3 shows minor improvements in journey times between most areas. However, a few local movements show small increases, due to the removal of right turns at Stockbridge and Whyke junctions. The improvements are generally smaller than the increases seen in Do Minimum compared to the Base Year, showing that Option 3 does not represent in 2035 an improvement on the 2014 situation.

Option 3A shows some improvement in journey times compared to Option 3 particularly on some longer distance journeys, for example between Oving and Fishbourne, Oving and Havant and Bognor Regis and Fishbourne. The savings from Fishbourne are created by the improvement to Terminus Road, which reduces congestion at Fishbourne roundabout. Local movements show increases in journey times.

Economic Assessment

An economic assessment has been undertaken over a 60-year period in accordance with the requirement of DfT's Transport Analysis Guidance (TAG) Unit A1.1 to facilitate the quantification and monetisation of scheme costs and benefits. The full economic assessment is shown in the Economic Assessment Report. A summary of the Economic Assessment Results can be seen in Table 0.1 below. All values are discounted to 2010.

Table 0.1: Headline of Economic Assessment Results – Core Scenario (£m)

Scheme Options	Present Value of Benefits (PVB)	Present Value of Costs (PVC)	BCR
Option 1	£349	£137	2.55
Option 1A	£279	£112	2.49
Option 2	£551	£207	2.66
Option 3	£185	£45	4.13
Option 3A	£308	£136	2.27

Note: All monetary values are discounted to 2010 and in 2010 market price unit of account.

Overall, Option 2 has the highest Present Value Benefits (PVB) of around £551m, but also the highest Present Value Costs (PVC) of around £207m, providing it with a Benefit Cost Ratio (BCR) of 2.66, second only to Option 3. Option 3 has the highest BCR of 4.13, aided

by the PVC only being £44.8m, but subsequently the PVB are only £185m, a third of those delivered by Option 2. All of the options presented at public consultation have a BCR above 2.

It should be noted that the accident assessment shows a decrease in accidents overall for Options 1A, 2 and 3, whilst there is a slight increase of accidents for Option 1 and Option 3A over a 60-year assessment period.

Operational Assessment

To understand the operational aspects of the scheme a microsimulation model was produced for each option. This model was supplementary to the strategic SATURN model that was used to assess the wider implications and produce economic assessment and instead identifies potential operational issues with individual design elements and their interaction with surrounding elements.

Broadly the modelling identified the following operational issues in 2035 with the proposed design options:

- Option 1, 1A and 2 - the new roundabout on Cathedral Way between Fishbourne Road East and Terminus Road shows long queues in the AM peak as vehicles leaving Fishbourne Road East fail to compete with other traffic on the roundabout. This roundabout off the Bypass can adopt the design as in Option 3A to address this aspect.
- Option 3 and 3A – Fishbourne roundabout in a through-about / ‘hamburger’ configuration causes queuing on the A259 (Fishbourne Road West) due to the large number of arms and short distances between stop lines making the signal timing design sub-optimal. This may need further enlargement or grade-separation.
- Option 1 and 3A – Stockbridge signal controlled cross-roads shows queues on the northbound approach. Provision of additional lanes on the approach may be required subject to mitigating space constrained.
- Option 1A – Stockbridge and Whyke roundabouts are retained as per original arrangements which also retains some of the capacity associated issues. There is potential entry lane(s) widening / signalisation to further mitigate but this may only offer limited improvement.
- Option 1 – Bognor Road junction begins to experience queuing on the northbound off-slip road, which could potentially be eliminated with widening or signalisation of the slip road / roundabout arm.
- Option 3 – Bognor Road roundabout reaches capacity limit in 2035 and causes significant queuing in all directions, tailing back through other junctions such as Whyke and Oving. The junction size becomes inadequate for the volume of traffic it carries and number of arms and may need further enlarged or grade-separated.
- Option 3A – Bognor Road junction experiences queuing on the new roundabout between Vinnetrow Road and the A259. This may be improved with signalisation of that roundabout or additional entry lanes. Alternatively repositioning of new Vinnetrow Road roundabout further east could reduce or eliminate queuing.
- Option 1, 1A, 2 and 3A – Portfield junction experiences queuing on the westbound approach. Widening the roundabout and a more efficient configuration could help

**A27 Chichester Bypass
Scheme Assessment Report**

alleviate this problem, subject to modification to Shopwhyke Lake development access proposals.

- Option 2 – Roundabouts on the proposed link road have not yet been optimised and so show queuing during peak periods. These may need wider entries or additional entry lanes.

This information should be considered in relation to a selected Preferred Option and the issues identified addressed in the next stage of design.

Maintenance Assessment

Through consultation with representatives from the Area 4 Managing Agent Contractor, the current maintenance issues within the scheme extents were discussed to address any concerns with the proposed options. Key to improving the maintainability of the route is addressing the concerns raised by the Area 4 representatives, as well as ensuring that features in the design do not create any further hazards for the maintenance operatives and road users.

In summary, the maintenance implications of all the options are largely similar. Because the options are essentially upgrades along the existing Bypass, the improvements that can be made to the maintainability of the road are constrained to this. However, larger improvements can be made in Option 2 due to the new offline link road section – Stockbridge Link Road.

In all options the maintainability of the A27 can initially be improved through better access, providing maintenance laybys at suitable locations throughout the scheme, setting up cross-over points for contraflow operation to aid in temporary traffic management, or installing permanent variable message signs that reduce the risk to operatives in setting up any traffic management. These can also be used to warn road users of incidents ahead, any seasonal changes in traffic due to touristic activities or local events.

Environmental Assessment

The environmental assessment covered a wide range of topics and is presented in detail in the Environmental Study Report. The key headings assessed are Air Quality, Cultural Heritage, Landscape, Nature Conservation, Geology and Soils, Materials, Noise and Vibration, Effects on all Travellers, Communities and Private Assets, Road Drainage and Water Environment, Combined Effects and Cumulative Effects.

Once operational, effects would, on balance, be neutral for Options 1, 1A and 3, as beneficial effects associated with some of the proposed options combine with any adverse effects and lead to an overall cumulative neutral effect. Options 2 and 3A would be anticipated to have an, on balance, cumulative non-significant adverse effect during operation, due to the more adverse effects anticipated for landscape and ecology.

Public Consultation

Sixteen Public Consultation events were held during July to September 2016 with a total of 5,388 visitors attending. Following these, 4,869 responses were received either via the questionnaire directly at events or via email/letter. This rate of engagement demonstrates the high level of local interest in the scheme. From the feedback obtained, 90% of respondents agreed that congestion is a problem on the A27 Chichester Bypass and it is also cited as the issue that most concerns respondents.

When asked to express their preference in terms of the options, 47% of respondents chose not to select one of the five options, and instead selected 'No Option'. Option 2 with 31% was the next largest response. Less than 6% of respondents chose any of the 4 other options. Option 3A was the least chosen option with 2%. 85% of the 'No Option' responses and 56% of the overall responses commented that a new bypass should be implemented, commonly referring to the two options to the north of Chichester that had previously been discounted.

Key Stakeholders, businesses and other organisations were typically in favour of Option 2, while Local Authorities (West Sussex County Council and Chichester District Council) and Parish Councils favoured "No Option", with Option 2 the next favoured response. All the Local Authorities and Parish Councils that favoured "No Option" requested the discounted Northern Bypass be reinstated.

Conclusion

All the five options considered give a 'high' or 'very high' return in economic terms as defined by DfT Value for Money terminology. They vary in level and magnitude of intervention as well as impacts and benefits, therefore contributing to meeting the project objectives in various degrees and requiring different mitigations to the effects introduced.

Taking into consideration the factors presented throughout this report and the comparative analysis between the options in economics, traffic, environment, social and safety terms it is evident that Option 2 performs better when compared against all the competing options. This option also contributes more than its competitors to meeting the project objectives as agreed between Highways England and the Local Authorities and it has also garnered a significant level of support in the Public Consultation. The performance of this option is discussed in detail in the report and summary in provided in Section 11, where all options are compared against one other.

1. Existing Conditions

1.1. The Existing Chichester Bypass

The A27 Chichester Bypass is a five and a half kilometre (three mile) section of trunk road passing round the south of Chichester and is the only strategic route along the South Coast of England. This section has six at-grade junctions along its length, with roundabouts at Fishbourne, Stockbridge, Whyke, Bognor Road and Portfield, and a signal controlled cross-roads at Oving. Congestion occurs daily during peak times along this stretch of road causing delays to the travelling public and constraining the local economy.

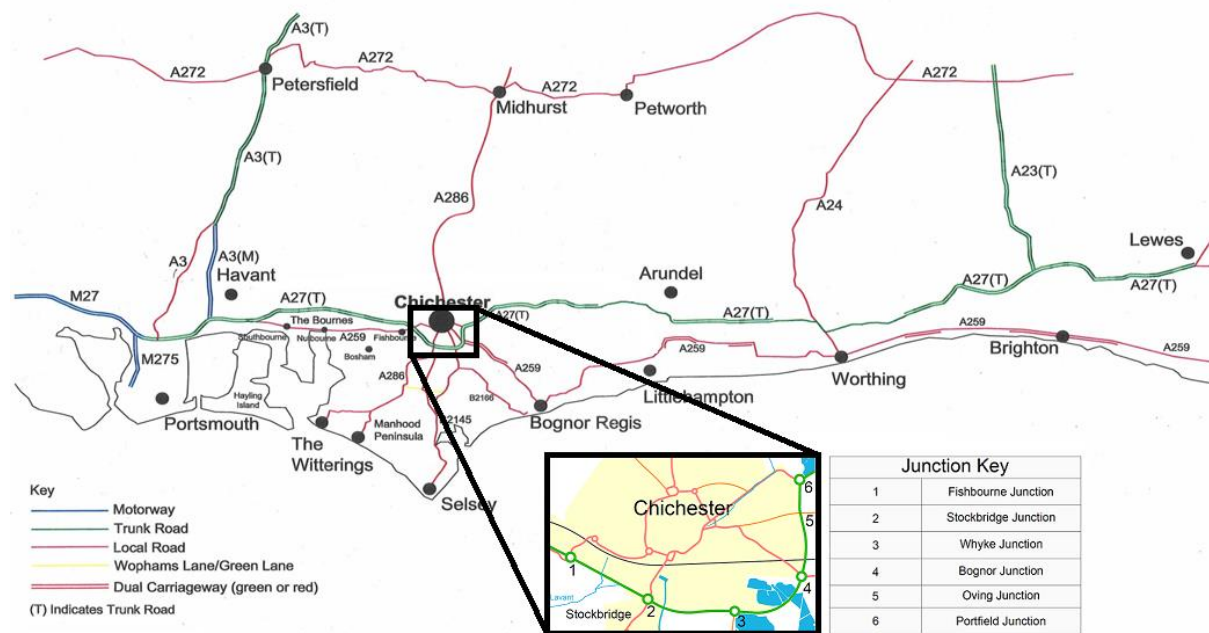
The primary cause of the congestion is the significant conflict between local and strategic traffic at the six junctions where the local traffic either moves directly across the bypass, competing with through traffic on the A27, or enters at one junction and leaves at another, utilising the Bypass as a collector-distributor road around Chichester.

The traffic model developed for this scheme has identified four different types of trips for vehicles travelling on the A27 Chichester as below:

- 12% local trips - with an origin and destination within the Chichester District.
- 42% other local trips - with an origin or destination within the Chichester District.
- 36% through traffic - with an origin and destination outside the Chichester District and travelling on the A27 throughout the district.
- 10% of other through traffic, with an origin and destination outside the Chichester District and travelling on the A27 for part of their journey.

Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Figure 1.1: A27 South Coast Route



Source: MMSJV

1.2. The Problem

The key operational challenge is the increasing level of traffic on this already congested section of the A27, leading to significant queues during the AM and PM peaks on a number of links and approaches to junctions.

In addition to the existing traffic levels and future forecast increase, the Chichester District Council Local Plan 2014 to 2029 identifies the need for around 6900 new homes and plans for expanding the economy, likely to put further pressure on this section of the strategic road network.

1.3. Existing Conditions and Constraints

The existing A27 Chichester Bypass has had a number of schemes proposed over the last two decades with no substantial improvements having taken place in this time. There are a number of key constraints to any potential schemes that limit the range of options available. One of these is the close proximity of the existing junctions, the average spacing being 1.1km, with only around 400 metres between Portfield and Oving. Due to safety considerations, the minimum weaving length (the distance from the end of taper of a merging slip road and the start of the taper of the next diverging slip road) required by the Design Manual for Roads and Bridges (DMRB) is 1km (DMRB, Volume 6, Section 2, TD22/06 Layout of Grade Separated Junctions, Para 4.36). These requirements and the spacing between the existing junctions rules out grade separation of all junctions due to the safety implications of having insufficient weaving length.

The existing alignment is bordered by residential and industrial areas along its entire northern boundary, and some urban developments and bodies of water to the southern side,

as well as several commercial properties that are connected directly to the carriageway. These factors restrict the ability to expand much beyond the current footprint in key areas and so exclude certain junction designs. These restrictions also mean that choice of junction layout is limited, particularly at Stockbridge and Whyke, which connect into local roads with railway level crossings to the north or local access routes to tourist areas to the south.

Although still subject to capacity issues, the junctions with some lateral space available and without direct interference with the existing railway crossings are Fishbourne and Portfield. However, the geometry configuration of these junctions and proximity of environmental sensitive areas pose also various constraints.

The junction at Portfield is also a particular constraint as the roundabout enables the carriageway to turn from a north-south to east-west direction. Replacing this junction with a grade-separated design to modern standards would encroach upon the new housing development proposed at Shopwhyke Lakes as well as existing properties on Oving Road or would encroach on the lakes / old gravel pits to the north of the A27. Improvements at Portfield are also limited by the proposed access arrangements for the housing development.

Oving traffic signal controlled cross-roads, just south of Portfield, as well as Portfield itself, are also subject of changes related to the proposed Shopwhyke Lakes housing development, which has to be recognised by any improvement option for the Bypass. The proposed changes here are:

- Amendments to Portfield roundabout by provision of a dedicated left lane to the mainline westbound approach.
- Removal of traffic signals and all right turns at Oving junction, except from Oving Road East and removal off vehicle access to / from Oving Road East, except buses.
- New left-in / left-out access to the Bypass south of Portfield roundabout
- New left-in / left-out access to the Bypass north-east of Portfield roundabout
- New pedestrian and cycle bridge crossing on A27 south of Portfield roundabout
- Improvements to pedestrian and cycle facilities crossing at A27 / Oving Road East.

In addition to traffic related conditions, the environmental sensitivity of the local area with the Chichester Harbour AONB to the south and South Downs National Park to the north places further constraints on any scheme.

Although it has an urban character, the Bypass is surrounded by a large number of ecological and environmental constraints including landscapes with multiple national and European designations, historic townscape, visual aspects and scheduled monuments, flood plains, ancient woodlands, key receptors and significant ecology habitat sites. Important watercourses and waterbodies are also present in the study area, such as the Chichester Canal, Fishbourne Canal and the River Lavant as well as a number of lakes and ponds.

The designated sites in the study area include Solent Maritime SAC, Chichester and Langstone Harbours SPA and Ramsar, Chichester Harbour SSSI, River Lavant SNCI, River Lavant Marsh SNCI, River Lavant SNCI, Chichester Canal SNCI, Hunston Copse SNCI, Leythorne Meadow SNCI or Fishbourne Meadows SNCI.

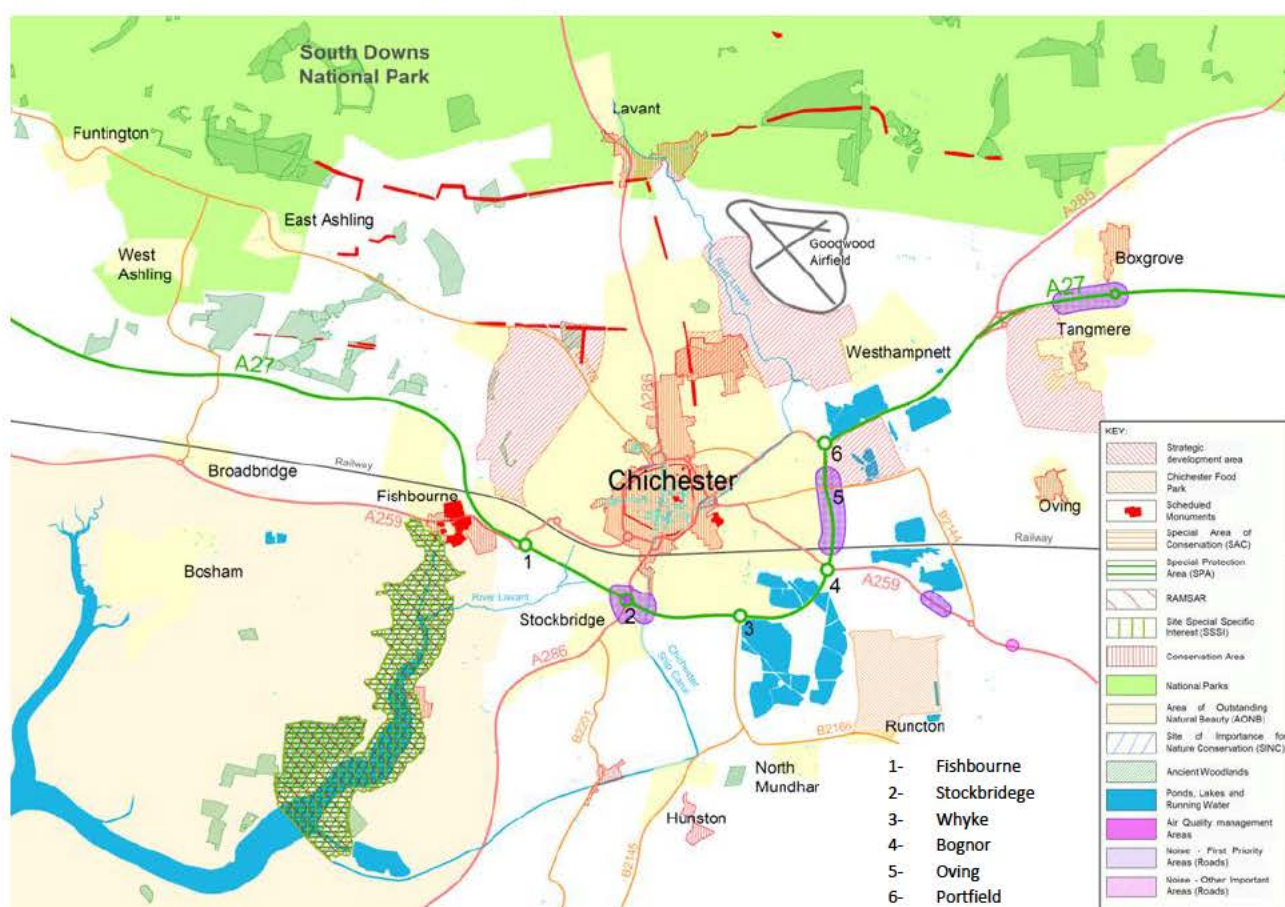
Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

The cultural heritage of the area is also significant with important historic environment receptors located close to the Bypass such as Stockbridge House Grade II listed building, buried archaeological remains, Fishbourne and Chichester Conservation Areas.

Air quality annual mean criterion are being exceeded for nitrogen dioxide (NO₂) with the area to the west of Stockbridge roundabout identified as being at risk of non-compliance with the EU limit value. In addition, some of the Bypass junctions are identified as a Important Areas by DEFRA strategic noise maps and the whole area is highly noise-sensitive.

The key environmental constraints are illustrated in the Figure below with further details in the Environment Study Report.

Figure 1.2: Study Area - Illustrative map of key environmental constraints



1.4. Scheme Brief

The scheme brief is to upgrade four of the junctions on the existing A27 Chichester Bypass, as laid out in the DfT's Road Investment Strategy for the 2015/16 – 2019/20 road period. The high level objectives are to improve and enhance the performance of the A27 Chichester Bypass as part of the Highways England Strategic Road Network, and to support the proposed development growth, particularly housing, within Chichester's Local Plan.

The Client Scheme Requirements (343538-90-010-RE-001) contains details the project objectives as follows:

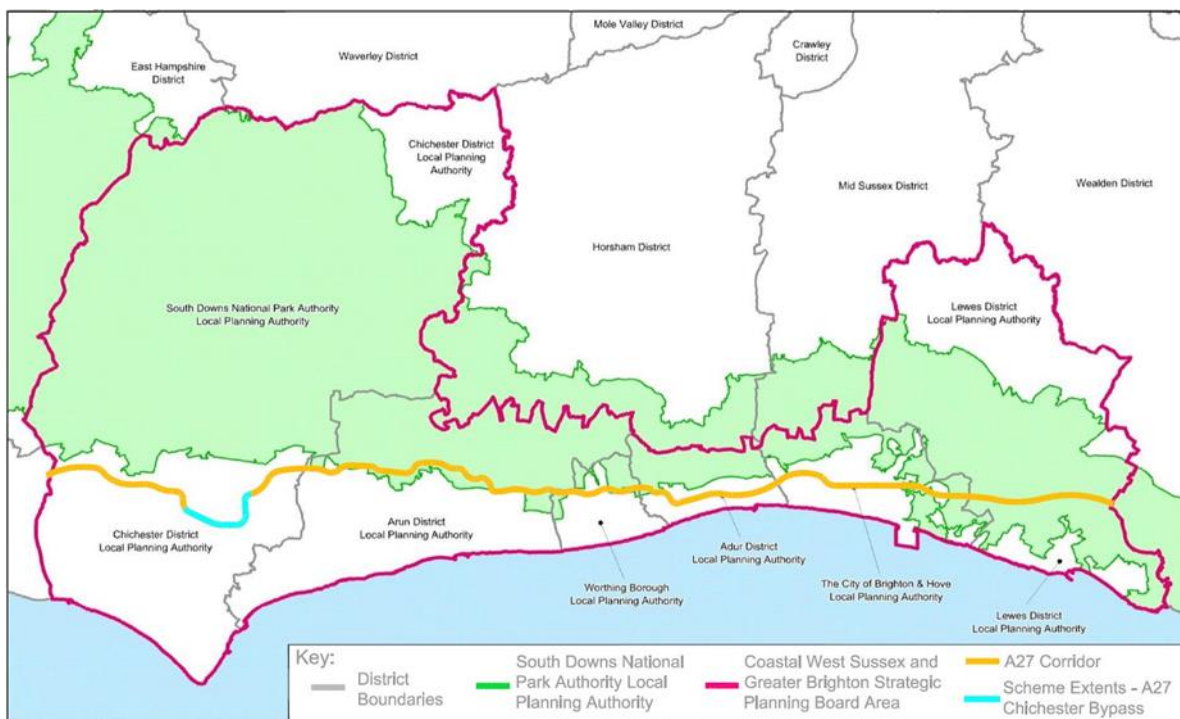
- Reduce congestion on the Chichester Bypass
- Improve road safety, during construction, operation and maintenance for all, as defined in DMRB Volume 0 Section 2 Part 3 GD 04/12:
 - Road workers
 - Road users
 - Other parties
- Reduce adverse environmental impacts & eliminate where possible:
 - Address existing Air Quality Management Areas (AQMAs) and ensure no further AQMAs are created as a result of the selected option
 - Address existing noise priority areas and ensure no further noise priority areas as a result of the selected option
- Improve journey time reliability on the Strategic Road Network (SRN)
- Improve capacity and support the growth of regional economies:
 - Facilitate timely delivery of the scheme to enable provision of housing demand in line with the Chichester Local Plan
 - Improve regional connectivity
 - Improve accessibility to areas with tourist activity.
- Improve the safety and security of the route to all road users, including vulnerable groups and non-motorised traffic

2. Planning Factors

As part of this study a review of the current planning policies concerning the scheme has been undertaken. This review looks at Local Planning Policies, as well as Regional and National Policies. The A27 Chichester Bypass falls within the Chichester District, but also borders closely with the Arun District to the east and the South Downs National Park to the north.

Figure 2.1 shows these Planning Authority Boundaries surrounding the A27 corridor.

Figure 2.1: Planning Authority Boundaries surrounding the A27 corridor



2.1. Chichester Local Plan (2014-2029)

As the existing A27 Chichester Bypass is a key transport link within the district it features in the Chichester Local Plan in several areas.

2.1.1. Existing Transport Links and Economy

Paragraph 3.31 relates to the strategic infrastructure in the area and states the Local Plan should “support and promote initiatives to mitigate the impacts of congestion and manage traffic flows on the road network, especially the A27.” Paragraph 3.32 highlights the need for improved alternative transport measures, stating the Plan is to “Encourage greater use of public transport, cycling and walking to help reduce the need to travel by car and improve access to jobs, homes and services”.

In the section relating to Transport, Access and Communications, Paragraph 8.3 highlights that road congestion is a major issue affecting parts of the plan area, particularly within the city and the junction on the A27 Chichester Bypass and mostly during peak periods, with knock on effects with traffic rerouting causing congestion elsewhere and posing safety issues. It also states that “congestion at the A27 junctions...act as a barrier to movement around the city, and between the city and the Manhood Peninsula to the south”. This has in turn has had “a detrimental impact on air quality in the city, which has resulted in the designation of three Air Quality Management Areas (AQMAs)”. These are at Stockbridge Roundabout, St Pancras and Orchard Street.

Paragraph 8.5 refers to the Transport Study in 2013 which indicated that “even without additional new development, there is likely to be just over 20% growth in trips by 2031 compared to the 2009 base”. It continues that with the new housing and employment proposed in the Local Plan this would increase further, “leading to further congestion and increased queuing times around the A27 junctions and within Chichester city”.

Paragraph 8.6 discusses the A27 Chichester Bypass and Highways England scheme added as part of the 2013 Spending Review, but at this stage the improvements are unknown. It also states that “it will also be necessary to coordinate Local Plan transport improvements with the Highways England scheme for the A27 when this is known, both physically and in terms of funding”. This is also stated in Policy 8. Paragraph 8.7 furthers this by describing how the Council has worked with Highways England, the County Council and major development promoters to identify a coordinated package of transport measures to mitigate the projected traffic impacts using 6 junction improvements to the existing A27 Chichester Bypass. Paragraph 8.8 states that this is in addition to a Strategic Infrastructure Package to support planned new development, which incorporates measures to reduce congestion and encourage sustainable modes of transport.

Paragraph 8.12 to 8.14 address the Air Quality Management areas within the Plan area, stating that “it is the responsibility of the Local Authority to monitor air quality, designate Air Quality Management Areas (AQMAs) and develop Air Quality Action Plans” and that “New development has the potential to have an adverse impact on air quality through increased transport movements and congestion”.

Policy 11 relates to the Employment Sites in and around the Chichester City. It states that additional sites should be “well located to provide good access to the A27 Chichester Bypass and strategic road network”.

Paragraph 12.17 states that “planning for transport is a key issue for Chichester city, due to road congestion during peak periods on the A27 and associated with the A27 junctions”. This is furthered in Policy 13 which puts forward a proposed measure or introducing bus lanes and bus priority measures along key routes (including the A259 Bognor Road approaching its junction with the A27).

2.1.2. Strategic Development Areas

Paragraph 3.20 discusses the need for increased housing supply within the Plan area, and states that the Plan should “make provision for new homes of the right quality, location, type,

size and tenure". This aligns with the provision of the Strategic Development Locations discussed later in the Plan.

Paragraph 7.9 relates to Housing Provision within the district. It acknowledges that whilst the plan accommodates a significant increase in housing it does not meet the objectively assessed need for housing. This is limited by a number of factors that are currently uncertain, one of which is "the government's proposals for improvements to the A27 around Chichester". Paragraph 7.10 details that the Local Plan "makes provision to deliver 7,388 homes over the period 2012-2029", of which 509 homes have been built in the period 2012-2014. Policy 4, "Housing Provision", details that 6,156 of new homes are along the East-West Corridor.

Table 7.2 details the key Strategic Sites in the area. Of relevance to this scheme are the Shopwhyke (500 homes), West of Chichester City (1,250 homes by 2029, 1,600 in total), Westhampnett (500 homes) and Tangmere (1,000 homes) sites.

Paragraph 7.18 states that in relation to housing the "development over the Plan period is also constrained by issues of traffic congestion in and around Chichester city, particularly linked to junctions on the A27 Bypass". Further to this, Paragraph 7.19 states that "to address this position, development contributions will be used to help fund a package of proposed improvements to the six junctions on the A27 Chichester Bypass". Additionally, "phasing of development in and around Chichester city will need to be coordinated in conjunction with delivery of these proposed transport improvements".

Policy 15 relates to the West of Chichester housing proposals, and states that the proposals should "provide or fund mitigation for potential off-site traffic impacts through a package of measures...including improved access to the A27".

Policy 16 relates to the Shopwhyke housing proposals, and states that the proposals should "provide or fund mitigation for potential off-site traffic impacts...including improved access to the A27 and changes to the A27 Oving Road and Portfield junctions".

2.2. Coastal West Sussex and Greater Brighton Local Strategic Statement (2013-2031)

The Coastal West Sussex and Greater Brighton Local Strategic Statement (2013-2031) aims to identify and manage spatial planning issues that impact on more than one local planning area, and to support better integration and alignment of strategic spatial and investment priorities within the area.

Strategic Objective 3 in this document relates to investment in infrastructure, highlighting the improvements needed to road infrastructure facilitating the east-west movement along the A27/A259 corridor through the area, as well as north-south linkages between them.

Spatial Priority 2 considers Chichester City, Tangmere and Bognor Regis. Within this it states that one of the priorities includes improvements to junction on the A27 Chichester Bypass.

2.3. South Downs National Park Local Plan (draft)

There are only a few references to the A27 within the South Downs National Park Local Plan, which is currently under consultation, and none directly to the A27 Chichester Bypass.

Paragraph 4.57 states that a challenge for the Local Plan is ensuring that settlements along the coast and adjacent to the boundary are able to access the park, are not entirely car dependent or cut off from the park by the A27 corridor.

Paragraph 6.23 refers to the Position Statement on Strategic Road improvements within the National Park, which is summarised by stating that “a balance needs to be struck nationally between the need for accessibility and mobility and the need to safeguard the National Park landscapes and communities. This balance must be struck by Government based on robust evidence on both”.

2.4. Arun Local Plan (2011 – 2031)

The Arun Local Plan refers to the Coastal West Sussex and Greater Brighton Local Strategic Statement (2013-2031) and re-iterates the priority within that for the improvements to junctions on the A27 Chichester Bypass in paragraph 2.11.

Paragraph 15.3.6 states that “one of the aims for Arun's road network includes major improvements to the A27 at Arundel, to reduce congestion and to improve safety” and discusses in Policy T SP3 the need to safeguard the line of the Pink/Blue Route of the A27 Arundel Bypass as shown “in the Department for Transport's planning document the 'A27 Arundel bypass - Statement of the Secretary of State's decision on the Preferred Route' dated July 1993”.

2.5. West Sussex Transport Plan (2011-2026)

The first priority listed in West Sussex Transport Plan is “improvements to the A27 trunk road and complementary public transport improvements to the current bottlenecks at Chichester, Arundel and Worthing (not currently programmed) to increase capacity, improve reliability and safety and increase the competitiveness of local businesses and attract investment”. This also features as part of their objectives as well as part of the Long Term Strategy to improve the performance of the infrastructure along Coastal West Sussex.

In Part 1 – Long Term Strategy, Section 1.4.1 has a series of paragraphs listed as “A27 Issues” which detail the concerns along the A27, not just around Chichester but also at Arundel, Worthing and Lancing, where “bottlenecks cause congestion, high accidents rates, severance and diversion onto unsuitable routes”. It also states that delivery of effective improvements is something that they consider a high priority. In relation to Chichester the Plan states that “high traffic levels are responsible for an AQMA” as well as detailing the conflict between east-west and north-south traffic, and the peak period congestion which worsens in the summer months from the impact of tourism.

**A27 Chichester Bypass
Scheme Assessment Report**

In Part 2 – Implementation Plan, Section 2.3.2 states the barrier the A27 presents to the community in and around Chichester with a lack of safe crossing points and states their aim to work with Highways England to secure a package of improvements to the junctions on the A27 at Chichester which reduce congestion, improve journey times for public and private transport and improve air quality.

2.6. Highways England Delivery Plan (2015-2020)

The Highways England Delivery Plan (2015 to 2020) ³ acts as a national strategic document and details how Highways England will deliver its strategic outcomes and how success is measured. There are five strategic outcomes namely:

- to support economic growth,
- to provide a safe and serviceable network,
- a more free-flowing network,
- an improved environment, and
- an accessible and integrated network.

These are all assessed against a series of Key Performance Indicators, Performance Indicators and Requirements included within the Plan.

The A27 Chichester Bypass is listed in the delivery plan as starting construction in 2018/2019 and consisting of “upgrades on the A27 at Chichester through junction improvements and a bypass, removing congestion from the local villages”. This does differ with the original Road Investment Strategy description as being “upgrades to four junctions on the Chichester bypass”.

2.7. National Environmental Policies

The Noise Policy Statement for England ⁴ (NPSE) states that noise can have an impact on health through annoyance and disturbed sleep. The elevated structures associated with some of the options have the potential to increase noise levels. Traffic speed and road surface are two other considerations that can impact on noise level.

The Air Quality Regulations came into force in June 2010 and sets limits for pollutants such as NO₂. Three Air Quality Management Areas (AQMAs) have been designated in Chichester to contribute towards meeting such targets. Improving the A27 at Chichester is highlighted in Measure Code: Chichester District Council_42 of the Air Quality Plan for the achievement of

³ Highways England Delivery Plan:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/424467/DSP2036-184_Highways_England_Delivery_Plan_FINAL_low_res_280415.pdf (Date accessed: 7/11/16)

⁴ Noise Policy Statement for England (NPSE)

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69533/pb13750-noise-policy.pdf (Date accessed: 11/11/16)

EU air quality limit value for nitrogen dioxide (NO₂) in South East (UK0031)⁵ as being key to reducing air quality issues associated with stationary traffic.

The National Planning Policy Framework 2012⁶ (NPPF) gives direction on the effects on landscape character and visual amenity. It states that proposed development should contribute to and enhance the natural and local environment by protecting and enhancing valued landscapes, geological conservation interest and soils. It extends further by stating that great weight should be given to conserving landscape and scenic beauty in AONBs and National Parks.

The Wildlife and Countryside Act 1981⁷ (WCA) (as amended) consolidates and amends existing national legislation to implement the EC Habitats Directive and the Birds Directive in the UK. The WCA is divided into 17 Schedules which detail the protection of wildlife (birds, some animals and plants), the countryside, National Parks, the designation of protected areas, (including, but not limited to, Site of Special Scientific Interest (SSSI) and Site of Nature Conservation Importance (SNCI)) and Public Rights of Way in England (and Wales). Identified within the NPPF, the UK Government has committed to promoting sustainable development by ensuring that biological diversity is conserved and enhanced as an integral part of any development. It clearly states that development should seek to minimise impacts on biodiversity, provide net gains in biodiversity and establish coherent ecological networks that are more resilient to current and future pressures.

2.8. National Planning Policy Framework (March 2012)

The National Planning Policy Framework has a focus on achieving sustainable development. It highlights the importance of the three pillars of sustainability, economic, social and environmental, that are mutually dependant and should be considered together when planning schemes. Due to its nature there are numerous paragraphs which apply to this scheme, particularly around maintaining the local environment and considering the strategic priorities within the local plans.

2.9. National Policy Statement for National Networks

The National Policy Statement for National Networks (NPSNN) sets out policy the Scheme should comply with and the environmental policies are covered in more detail in the Environmental Study Report.

Paragraph 3.17 states that the Government expects road schemes to use reasonable endeavours to address the needs of cyclists and pedestrians in their design, and identify

⁵ Air quality plan for reducing nitrogen dioxide (NO₂) in South East (UK0031)
<https://www.gov.uk/government/publications/air-quality-plan-for-reducing-nitrogen-dioxide-no2-in-south-east-uk0031> (Date accessed: 11/11/16)

⁶ National Planning Policy Framework
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf (Date accessed September 2015)

⁷ *Wildlife and Countryside Act (WCA) 1981* <http://www.legislation.gov.uk/ukpga/1981/69> (Date accessed: 25/11/16)

opportunities to correct historic problems where the network severs communities or acts as a barrier to walking or cycling.

Paragraph 4.31 states that “good design should meet the principal objectives of the scheme by eliminating or substantially mitigating the identified problems by improving operational conditions and simultaneously minimising adverse impacts. It should also mitigate any existing adverse impacts wherever possible, for example, in relation to safety or the environment”.

Paragraph 4.60 states that the opportunity should be taken to improve safety on highway development schemes.

3. Do Nothing Consequences

As the A27 is the strategic route along the South East Coast of England, the congestion surrounding Chichester acts as a constraint to travel between Portsmouth, Southampton (as well as other locations to the West) and locations to the East such as Worthing, Brighton, Hastings and Eastbourne and ultimately Folkestone and Dover.

The six junctions on the Chichester Bypass are where the routes between the south coast (Manhood Peninsula and Bognor Regis) and the city centre cross the Chichester Bypass, with junction spacing varying from 0.5km to 1.2km. The Average Annual Daily Traffic (AADT at 2014 level) on the links between junctions is in the order of 32-46,000 vehicles per day, below Congestion Reference Flow (CRF) of approximately 67,000 (TA 46/97 – Design Manual for Roads and Bridges, Volume 5) for Dual 2 Lane All Purpose (D2AP) roads, which indicates that the current delays and queues are due to insufficient capacity at junctions.

Although intended to act as a strategic route, being designated as a trunk road and under the remit of Highways England, in reality the long-distance (through) traffic on Chichester Bypass competes for access at the junctions with the local traffic accessing Chichester and villages to the north or the Manhood Peninsula to the south and Bognor Regis to the east. It is therefore a combination of the close proximity of the junctions and the conflict between the competing north-south and east-west traffic flows that result in significant congestion and extensive queuing at most of the junctions at peak times, disrupting the mainline flow of the road and compromising its operation as a strategic route.

Delays to strategic traffic impact on the wider UK economy, impacting productivity.. At the local level, other problems associated with congestion on the Bypass include 'rat-running' through residential areas, commercial areas and on minor roads, causing congestion through local villages and safety concerns.

The Chichester Local Plan (2014) identifies the need for around 6900 new homes in the city and the immediate area to be delivered by 2029. The traffic generated by these additional homes is likely to further exacerbate the current problem. Considering the confirmed local plan developments, the traffic model developed for this scheme has identified a traffic demand increase of 25% in the study area by 2035 over the 2014 Base Year. However, changes on the Bypass links are much lower due to capacity constraint through all of the junctions on the Bypass. This in turn increases congestion on the surrounding local road network

It is therefore evident that due to congestion, the capacity of the bypass acts as a constraint to development within Chichester. Lack of capacity and present traffic delays are unlikely to assist the Bypass in meeting the scheme brief outlined in Section 0 and the Road Investment Strategy 2015/16 – 2019/20 targets of '*supporting the smooth flow of traffic*', '*encouraging economic growth*' or '*improving user satisfaction*', without an intervention that can accommodate both current traffic levels and future traffic growth.

**A27 Chichester Bypass
Scheme Assessment Report**

From the evidence detailed within the paragraphs above, it is clear that the existing Chichester Bypass is facing growing demands from increased traffic due to normal growth and the proposed developments in the local area. Without intervention the severity of the key issues outlined above are likely to increase.

4. Alternative Options

4.1. Stage 1 Options

During Highways England's Project Control Framework (PCF) Stage 1 (Options Identification), over 20 options were identified. These were mainly road-based solutions but also included a number of alternative solutions including a tunnel option, a parallel collector distributor road and a combination of public transport measures. The alternative solutions were discounted prior to the sifting process as it was determined that they were unviable due to either the substantial cost or buildability issues or because they did not achieve the project objectives. As such, 17 road-based options were developed during Stage 1 – Options Identification.

4.2. Factors Considered in Options Development

The existing constraints identified along the Chichester Bypass, as discussed in Section 1 above, are fundamental in determining the type of improvements that could be incorporated in the options developed. In essence, the competing strategic and local traffic flows at all junctions on the Bypass indicate that grade-separation solutions should ideally be favoured as junction arrangements. However, grade-separation at all junction is prevented by the density of the junctions, which does not provide sufficient space for standard weaving lengths between consecutive slip roads, as required by the DMRB. The choice in junction's layouts and type is also restricted by close proximity of residential and business buildings to both the mainline and some of the side roads.

As such, the junctions identified with most stringent capacity issues, Fishbourne and Bognor were prioritised as candidates for grade-separated solutions in most of the options developed. These two junctions are also in locations where some lateral space is available that can accommodate such solutions deemed to considerably increase the existing footprint. However, careful consideration is required to sensitive areas in close proximity such as the Chichester Harbour Conservancy, south of Fishbourne or the lakes south of Bognor and the railway line just to its north.

Stockbridge and Whyke junctions are located in areas surrounded by even more residential and commercial properties than the other junctions. This key constraint, together with the weaving length requirements, leave three solutions at these junctions, retention of the current arrangements, removal of the junction with the local roads flying over the Bypass, or the conversion of the roundabouts into traffic signal cross-road junctions. After initial modelling was carried out on full movement traffic signal junctions at Stockbridge and Whyke, it was found that they did not have enough capacity and would cause extensive queueing, for this reason the provision for right hand turns was removed as it offered the greatest increase in capacity and improved the junction operation.

Improvements at Oving junction and Portfield roundabout need to recognise the changes introduced by the approved Shopwhyke Lake housing development, south-east of Portfield. These, together with the relatively sharp angle in horizontal alignment present at Portfield

along the mainline, prevent substantial improvements at these junctions, therefore the majority of options developed considers minor improvements or modifications here.

4.3. Options Sifting

The Stage 1 consisted of the further development of the 17 road-based options and concluded with a sifting process designed to identify the better performing ones based on their merit and potential for meeting the project objectives. The sifting process was carried out in line with the DfT's Transport Appraisal Process guidance, and resulted in six sifted options being taken forward to Stage 2. Details of the sifting process and option selection as well as all the options considered in Stage 1 can be found in the Options Assessment Report (343538-09-101-RE-003).

The six sifted options taken forward from Stage 1 were as follows:

Options	Fishbourne	Stockbridge	Whyke	Bognor	Oving	Portfield
Option 1	Grade-separated (A27 elevated)	Roundabouts converted to traffic signal controlled cross-roads with prohibited right turns		Grade-separated (A27 elevated)	Minor amendments implemented by the Shopwhyke Lake Development	
Option 2	Grade-separated (A27 elevated)	Grade-separated (side roads elevated and existing roundabouts removed)		grade-separated (A27 elevated)	Minor amendments to current Shopwhyke Lake Development	
	New link road to the south – Stockbridge Link Road.					
Option 3	Through-about / hamburger roundabout with signals	Roundabouts converted to traffic signal controlled cross-roads with prohibited right turns		Enlarged roundabout with traffic signals	Improvements delivered by Shopwhyke lade development	
Option 4	<p>New route alignment north of Chichester with a new interchange with A286 south of Lavant and new high speed tie-in links to the existing A27 at each end.</p> <p>Approximately 9.5km in length, the alignment passes north of West Broyle village and proposed West of Chichester development site, before crossing the A286 and Lavant River after which it overlaps New Road for around 2.0km bordering onto the South Downs National Park and the Goodwood Aerodrome.</p>					
Option 5	<p>New route alignment north of Chichester with a new interchange with A286 south of Lavant and new high speed tie-in links to the existing A27 at each end.</p> <p>Approximately 8.5km in length, the alignment passes south of West Broyle village through a marginal area of proposed West of Chichester development site, before crossing the A286 and Lavant River after which it overlaps New Road for around 2.0km bordering onto the South Downs National Park and the Goodwood Aerodrome.</p>					

Options	Fishbourne	Stockbridge	Whyke	Bognor	Oving	Portfield
Option 6	Grade-separated (A27 elevated)	Grade-separated (side roads elevated and existing roundabouts removed)		New route alignment south-east of Chichester utilising Bognor roundabout in a grade-separated format where it passes over Bognor Road, the railway line and the lakes each side bypassing Oving and Portfield junctions to the east of Oving and Shopwhyke villages, before reconnecting into existing A27 / A285 interchange.		
	New link road to the south – Stockbridge Link Road.					

Further details of the five options and the key engineering aspects are detailed further in the layouts included in Appendix A.

4.4. Stage 2 Value Management Workshop

Feedback from key stakeholders during an early Stage 2 Value Management Workshop, raised questions over the close vicinity of the proposed Stockbridge Link Road (SLR) in Option 2 to the Chichester Harbour Conservancy and its associated landscape and ecological designations (SAC, SPA, Ramsar, SSSI and AONB). In response, it was agreed to develop a further option that investigated the use of extensive parallel routes alongside the mainline with partial use of existing road network as an alternative to the SLR. The derived option was named Option 2A and presented the following features:

- Mainline components as per Option 2
- Stockbridge Link Road proposed adjacent to the existing A27 to minimise impacts on the Chichester Harbour Conservancy assets.

The six sifted options from Stage 1 alongside this additional option were then subject to further assessment throughout PCF Stage 2.

4.5. Stage 2 Options

The Options reviewed during Stage 2 are described further below. A plan showing the indicative designs of each option considered in Stage 2 is contained in Appendix A.

4.5.1. Option 1

Option 1 is an entirely online option developed along the existing Bypass. It considers grade-separating Fishbourne and Bognor Road roundabouts by elevating the A27 mainline over the roundabouts, converting Stockbridge and Whyke into a traffic signal controlled cross-roads with prohibited right turns. It also removes the signals at Oving junction and access to / from Oving Road East while retaining the left-in left-out movement to Oving Road West on the eastbound A27 carriageway. Portfield roundabout is improved using line marking changes to increase the capacity on the circulatory carriageway. Amendments proposed at Oving and Portfield are only modifications to the Shopwhyke Lake housing development access arrangements.

The key engineering problem in this option is creating enough extra capacity at the junctions for future demand and to support the housing allocation in CLP, whilst retaining the majority

of movements to prevent re-routing on the local road network which has already pressures from local traffic. As with all the online options during implementation, the other engineering problem is the disruption caused by the improvements during the construction period, currently expected to take around 3 ½ years for this option. This is in relation to building the elevated sections of the A27 and associated slip roads at Fishbourne and primarily at Bognor junction where a new bridge will be required over the railway to accommodate this junction's north facing slip-roads. Given the already congested nature of the route, this could severely impact upon the economy of the local area, especially during the summer period or during events at Goodwood.

The key benefits of this option are grade-separation of Fishbourne and Bognor, two of the busiest junctions on the Bypass and key accesses gates to Chichester via Cathedral Way / Terminus Road, Fishbourne and adjacent villages and Manhood Peninsula via A259 Bognor Road. These will contribute to improving capacity at these two junctions primarily by segregating the through traffic, on an elevated mainline, from the local movements retained at the ground level, improving journey time reliability overall for all road users. Accessibility and regional connectivity will also improve as well as road safety at these locations.

The improvements at Stockbridge and Whyke are constraint by proximity of built up areas, therefore the solutions proposed here seek to have a minimum impact on the local residential buildings where possible. Also the space between these two junctions and the preceding and subsequent ones prevent their grade-separation. As such, considering these space constrains and associated congestion issues, the movements at these two junctions had to be simplified to improve capacity and operational efficiency by removing the right turns and only retaining the left turns and ahead movements. A simplified junction at Stockbridge should also improve the air quality at this Air Quality Management Area (AQMA). Dedicated left turn lanes are provided to facilitate these movements and the prohibited right turns which will need to take place via the next junctions on the Bypass, either Fishbourne or Bognor, where all movements are permitted in the grade-separated format. However, extra movements will be generated on the mainline and adjacent local roads which may have safety implication overall.

The traffic, economic, environmental and operational aspects of this option are detailed in the relevant sections later on.

4.5.2. Option 1A

Option 1A is a sub-option of Option 1, proposing a reduced online scheme. In this respect, Fishbourne and Bognor are presented again as grade-separated junctions. However, Stockbridge and Whyke roundabouts are retained as per existing arrangements, recognising the fact that these are also key access points to Chichester at north and Manhood Peninsula at south, primarily during the summer season which attracts increased traffic volumes to the region. Oving and Portfield junctions are also presented as in Option 1.

Therefore, bearing in mind the space constraints identified at Stockbridge and Whyke, this option seeks to test whether changes at these junctions are essential to producing a scheme that meets the objectives. It also strives to potentially find savings in cost and disruption during construction compared to Option 1.

The overall key engineering problems are the same as in Option 1. However the reduced set of improvements in Option 1A, although with less construction implications, raises further capacity problems at Stockbridge and Whyke with concerns in performance as congestion is already identified as an issue here. The solution may also not be sufficient to address the Stockbridge AQMA.

The key benefit of this option is the reduced capital cost and reduced construction programme, estimate at around 2 years, reducing the disruption to existing road users during the scheme's implementation. These are in addition to the benefits introduced at Fishbourne and Bognor by the grade-separated arrangements, although overall these benefits can be somewhat diminished by retaining the roundabouts at Stockbridge and Whyke.

The traffic, economic, environmental and operational aspects of this option are detailed in the relevant sections later on.

4.5.3. Option 2

Option 2 is primarily the more substantial option in the improvements introduced, designed to take away the conflict between local and strategic / through traffic where possible. This is achieved by grade-separating Fishbourne and Bognor junctions, removing the junctions at Stockbridge and Whyke and providing instead flyovers over the A27 for the local roads with access straight in / out of Chichester. At Oving the traffic signals and access to / from Oving Road East are removed while the left-in left-out movement to Oving Road West on the eastbound A27 carriageway is retained. Portfield roundabout is improved using line marking changes to increase the capacity on the circulatory carriageway. Amendments proposed at Oving and Portfield are only modifications to the Shopwhyke Lake housing development access arrangements.

In compensation for the lost access to / from A27 at Stockbridge and Whyke, a new single carriageway "Stockbridge Link Road" is proposed to the south. This connects Fishbourne junction down to the A286 south of Stockbridge village, and ends at the B2145 south of the Whyke junction. This link road, connected with the existing road network allows traffic previously joining / leaving the A27 at Stockbridge or Whyke to use either Fishbourne or Bognor grade-separated junctions where all movements are permitted.

Further to the construction aspects related to Fishbourne and Bognor grade-separation mentioned already for Option 1, the key engineering problem in Option 2 is the construction of the flyovers for the local roads at Stockbridge and Whyke. The close proximity of housing provides a severe constraint on the construction methods and alignment choices available here for the flyovers. Although the alignment geometry has been relaxed, the number of building units requiring demolition is still high at approximately 20 units, including Stockbridge House – a grade II listed building. The disruption construction period is expected to be around 3 ½ years for this option, and given the already congested nature of the route could severely impact upon the economy of the local area, especially during the summer period or during events at Goodwood. The elevated structures at Fishbourne, Stockbridge, Whyke and Bognor could also pose a visual intrusion to local residents and key views into Chichester and surrounding areas while elevating noise levels from the road that can propagate further.

Additionally, the construction of the Stockbridge Link Road is through an area of flood plain which could slow construction and prove difficult due to ground conditions. Its effect on the natural landscape, especially with the proximity to Chichester Harbour Conservancy and its associated landscape and ecological designations (SAC, SPA, Ramsar, SSSI and AONB) will require significant mitigations. The link road however, can reduce to some extent the construction disruptions if built first, as it can offer a viable diversion route for the traffic on the mainline while the elevated structures are built at the grade-separated junctions, a diversion route alternative that currently does not exist.

The key benefits of this option are the reduction in number of junctions and the removal of all traffic signals from the route which will enhance the strategic status of the Chichester Bypass. As a result, all conflict points between the through traffic and the local traffic will be removed with the exception of Portfield which remains largely unchanged. The addition of the new link road, to take traffic away from the bypass that at present may use it only as a collector / distributor route, will further enhance these benefits for components of the local traffic as well as the through traffic. This segregation and improved flow of traffic will therefore provide reduced travel times and improved journey times reliability for all road users with better road safety conditions and reductions in air quality issues which overall could better accommodate the future traffic demand and the requirements of the CLP for hosing allocation.

The traffic, economic, environmental and operational aspects of this option are detailed in the relevant sections later on.

4.5.4. Option 2A

Option 2A contains the same elements as Option 2, in as far as the main alignment is concerned.

The Stockbridge Link Road is replaced in this Option with an alternative route that runs alongside the Bypass mainline utilising some of the local roads. For the first part, Terminus Road, north of Fishbourne junction is now being used as part of the alternative Stockbridge Link Road. This joins existing Stockbridge Road north of Stockbridge junction. From here a new Link Road section is proposed running adjacent to the Bypass to the north until it meets Whyke junction where, via Whyke road it crosses over the Bypass. The alternative Link Road then runs alongside to the south of the Bypass, all the way to Bognor junction where it connects to the existing Vinnetrow Road, via a new junction, before meeting the A259 Bognor Road into a new roundabout, part of the proposed Bognor interchange.

The intention of this option is to remove concerns over the proximity of the Stockbridge Link Road to the Chichester Harbour Conservancy and its multiple protective designations. This alternative corridor whilst very tight and potentially requiring removal of buildings in certain locations and the new Whyke Footbridge would still meet its original function of connecting together the A286, B2145 and A259, this time with the environmental impacts kept in the same area as the existing Bypass.

The key challenges of this option are very similar to Option 2. However, these are exacerbated by the provision of new Link Road sections adjacent to the built up area that

surrounds the existing Bypass where space is already limited. These new links would have a direct impact on the local road network and the nearby buildings as well as presenting a visual intrusion at the elevated sections, with further impact on the air quality and noise levels. The construction duration and impact on Stockbridge House would still be as per the original Option 2.

The key benefits provided by Option 2 are this time supplemented by the reduced impacts on the Chichester Harbour Conservancy assets and less impact on the flood plains south of Chichester.

The traffic, economic, environmental and operational aspects of this option are detailed in the relevant sections later on.

4.5.5. Option 3

Option 3 is a low-cost option and so has a lowered impact on the capacity of the route. It consists of a through-about / “hamburger” at-grade signalised roundabout at Fishbourne, traffic signalised junctions at Stockbridge and Whyke with prohibited right turns, an enlarged signalised roundabout at Bognor, access restrictions at Oving and a dedicated left turn lane from the A27 westbound at Portfield, as per the Shopwhyke Lakes housing developer’s plans.

The key engineering problem of this scheme is providing enough capacity to enable smooth traffic flow, with no grade-separation taking the through traffic away from the radial traffic accessing Chichester, while meeting the demand of future traffic flows and facilitating the housing allocation in CLP.

The key benefits of this option are the reduced cost compared to other options, reduced construction period, estimated at around 15 months and the reduced visual intrusion by not having any grade-separation.

The traffic, economic, environmental and operational aspects of this option are detailed in the relevant sections later on.

4.5.6. Option 3A

Option 3A is a sub-option of Option 3, proposing improvements identical to Option 3, building on the initial results of the traffic modelling showing increased link flows from the banned movements at Stockbridge and Whyke, as well as long delays at the signalised Bognor Road roundabout. To mitigate these, it has been proposed to widen the existing A27 to 3 lanes between Fishbourne and Bognor Road, accommodating the extra link flows, through lane gain and lane drops, maintaining 2 lanes through the junctions. Bognor Road junction is proposed to be grade-separated, as in Option 1, 1A and 2, for increased capacity. Other more minor changes are the diversion of Terminus Road on to Cathedral Way at Fishbourne into a cross-road format rather than new roundabout, potentially improving the operation of the “Hamburger” roundabout there, and the removal of the amendments at Oving junction and Portfield junction, saving capital costs to this scheme, by retaining the Shopwhyke Development’s plans as proposed.

**A27 Chichester Bypass
Scheme Assessment Report**

The key challenges of this option are similar to Option 3 plus the delivery of the scheme within a lower cost profile, as the grade-separation of Bognor Road junction is inherently expensive compared to the Option 3, due to the new junction itself and also the new bridge over the railway immediate to its north. The proposed lane between Fishbourne and Bognor will also complicate delivery due to construction issues related to building in the soft estate adjacent to main line and business / residential areas.

The key benefits of this option is the potential to deliver a scheme that meets the objectives but at a reduced capital cost while substantially improving a key junction – A259 with Bognor Road.

The traffic, economic, environmental and operational aspects of this option are detailed in the relevant sections later on.

4.5.7. Option 4

Option 4 considers a complete new Bypass to the north of Chichester. The alignment would diverge from the existing A27 shortly before the Clay Lane underbridge and bears north to cross Clay Lane. The route then continues north east, passing just to the north west of West Broyle village and crossing the B2178. The route here deviates to the east to cross Hunters Race, and runs adjacent to the existing road corridor of Hunters Race before it curves east to cross the A286, and continuing east through the corridor between Chichester and Lavant. Here the route overlays the existing New Road for approximately 2.0km running along the northern edge of Goodwood Airfield and the southern edge of the South Downs National Park. After crossing Claypit Lane at its junction with New Road the route crosses the A285 to the south of Strettington after which it re-joins the existing A27 just east of the existing interchange with A258 where some components are re-utilised.

In terms of connectivity with the local road network, this option proposes high speed tie-in points at each end with the existing Bypass, in a direct merge / diverge only fashion, without providing facilities for a ring-road around Chichester. Where the route meets A286, a new grade-separated interchange is proposed with all movements permitted via a new roundabout that would sit over the mainline which is lowered below ground levels. Other alternatives are also provided where the mainline severs local roads by providing re-connectivity arrangements to the local routes without access to the mainline.

The key challenges of a route away from the existing Bypass and north of Chichester are related to impacts of constructing new infrastructure in areas with direct impact or close proximity to ancient woodland such as Chalcroft Copse or Stocker's Copse, Chichester Dyke scheduled monuments, archaeological sites, a Roman road, historic and listed buildings, conservation areas, environmentally sensitive areas, an airfield identified as a local heritage asset part of the Goodwood Estate, a registered park and garden etc. Also areas allocated to new housing development such as West of Chichester and Westhampnett are alongside this route.

To minimise impacts on these assets and reduce visual intrusion of the new route, the alignment was designed in a moderate cutting for as much of its length as possible from its western starting point, bearing in mind ground conditions, potential underground water levels

**A27 Chichester Bypass
Scheme Assessment Report**

and other local obstacles such as Lavant River. This approach was also taken in areas close to sensitive receptors such as the South Downs National Park, where the section that impacts its southern boundary sits below the ground levels, continuing in this manner all the way to the eastern meeting point with the existing A27. However, having the mainline in cutting increases in turn the overall footprint, due to lateral features such as earth slopes, retaining structures and surface drainage, with increased impacts on adjacent land intruding further into the National Park. The proposed interchange south of Lavant, also considers the mainline in a cutting profile to reduce the height of the roundabout with A286 proposed above and associated slip roads.

In addition to the engineering challenges, the cost of constructing a new route of approximately 9.5km also poses significant pressure on the budget available. The construction cost is further increased by the cost of land required and mitigations on this environmentally sensitive area.

In terms of benefits, the new route would segregate the strategic traffic from the local traffic leaving the existing Bypass to act as an urban collector / distributor route to the south with increased capacity. In addition to the capacity benefits, the air quality problems and noise issues currently experienced on the Chichester Bypass should also improve together with overall safety. However, the new route may require further mitigations in places to ensure these issues are not replicated elsewhere to other receptors.

The construction duration of the new road estimated at around 24 months is also a key benefit of Option 4 with potentially less impact on the existing Bypass.

Another benefit would be the increased resilience of the strategic road network during maintenance activities, response to road incidents or during summer events in the regions, when the existing and the new road could act as alternative diversion routes to each other.

The traffic, economic, environmental and operational aspects of this option are detailed in the relevant sections later on.

4.5.8. Option 5

Option 5 is also a new Bypass route to the north of Chichester following a very similar corridor as Option 4. The differences are contained in the first half. After diverging off from the existing A27, the alignment seeks to shorten the route up to the new interchange with A286 in an effort to provide a more cost effective route. In this respect, in comparison with Option 4, it passes this time to the south of West Broyle village, before crossing the B2178 further south of Hunters Race. From the interchange with A 286, the route is identical to Option 4.

The same principle was applied with regards to the vertical profile where the route was designed in a moderate cutting for as much of its length as practical.

However, due to its amended first half alignment, this option has a direct impact on land allocated to West of Chichester housing development, albeit marginal and a section of the Chichester Dyke, a scheduled monument, situated just south of B2178. These are in addition

to the direct impact on the South Downs National Park already mentioned in relation to Option 4 above.

The engineering challenges discussed for Option 4 are also applicable to this option. Although, efforts have been made to reduce the length of the alignment, the cost concerns still remain, with the construction duration being estimated at around 24 months again.

The same benefits introduced by Option 4 would also apply to this option with a potential marginal reduction in cost.

The traffic, economic, environmental and operational aspects of this option are detailed in the relevant sections later on.

4.5.9. Option 6

Option 6 is a hybrid option that utilises the section of the existing Bypass from Fishbourne junction to just in advance of Bognor junction, where it diverges away from the existing road in a south-east direction bypassing Oving and Portfield junction to the east of Shopwhyke village. The new section would tie back into the existing A27 via a high speed interchange at the current grade-separated interchange with the A285. The tie-in would incorporate the existing dumbbell junction arrangement, allowing existing A27 Eastbound traffic to merge onto the new A27 Eastbound via the dumbbell interchange and permitting traffic heading west on the A27 to either continue on to the new bypass, or to leave via the same junction and proceed along the existing A27 to Portfield roundabout.

For its first part, this option proposed the same junction arrangements at Fishbourne, Stockbridge and Whyke as Option 2, please see above. Also, for the same reason, due to removal of access to / from the Bypass at Stockbridge and Whyke, the new Stockbridge Link Road is proposed in the same format as in Option 2.

Where the new section diverges away from the existing A27, prior to Bognor roundabout and crosses over the A259 and the railway, a grade-separated dumbbell interchange is created at this location by using the existing roundabout with A259 Bognor Road and by creating a new roundabout on the A259. Vinnetrow Road is then diverted onto this new roundabout.

The main challenges of this option are similar to Option 2 for its first half before it diverges away from the existing Bypass. From here, however the new section crosses over the A259, three lakes and the West Coastway railway line, as well as the Chichester Flood Relief Channel, making this section an elevated structure for a considerable length. Due to the nature of the poor ground conditions associated with the lakes and the coastal flood plains here, the construction of a substantial structure would put serious pressures on the budget available for the scheme, in addition to the cost required for land purchase. Due to the complexity introduced by the new section, the construction duration is estimated at around 46 months.

As well as the engineering and financial concerns, the new section would also pass in close proximity to listed buildings in Oving and Shopwhyke villages. The challenges commented on in relation to the Stockbridge Link Road in Option 2 above also relate to this option.

Similarly, the benefits introduced by Option 2 also apply, substantiated this time by the new section which overall would provide a Bypass of improved standards, with conflicts between strategic and local traffic removed and the associated benefits in safety, air quality and noise, albeit mitigations may be required to ensure these issues are not replicated elsewhere on the new section.

The traffic, economic, environmental and operational aspects of this option are detailed in the relevant sections later on.

4.6. Interim Review of Options

In February 2016, an interim review of all the Stage 2 options was undertaken reflecting on the detailed information gathered throughout this Stage. From this, it was decided to discontinue the new Bypass route options namely Option 4, Option 5 and the hybrid Option 6 as they were found to exceed the upper threshold of Highway England's £120m to £250m scheme budget range. Option 4 and 5 were also found to impact on the South Downs National Park who raised serious reservations in this regard. At the same time, Option 2A was excluded as it was found to be inferior in performance to the original Option 2.

Two additional options were also introduced as part of this review to explore alternatives that can offer value at the lower end of the budget range and can contribute to meeting the project objectives. The derived additional options were as follows:

- Option 1A
 - As Option 1, but with no works proposed at Stockbridge or Whyke junctions.
- Option 3A
 - As Option 3, but with Terminus Road diverted onto Cathedral Way into a traffic signalised junction to improve capacity at Fishbourne junction, grade separation at Bognor Road junction and three lanes in both directions between Fishbourne and Bognor Road junctions to mitigate the restricted turning movements at Stockbridge and Whyke.

The options for which the Stage 2 assessment was completed on and then presented in the Public Consultations are:

- Option 1
- Option 1A
- Option 2
- Option 3 and
- Option 3A

Therefore, the following sections of this report only detail findings on these five options.

5. Traffic, Economics and Costs

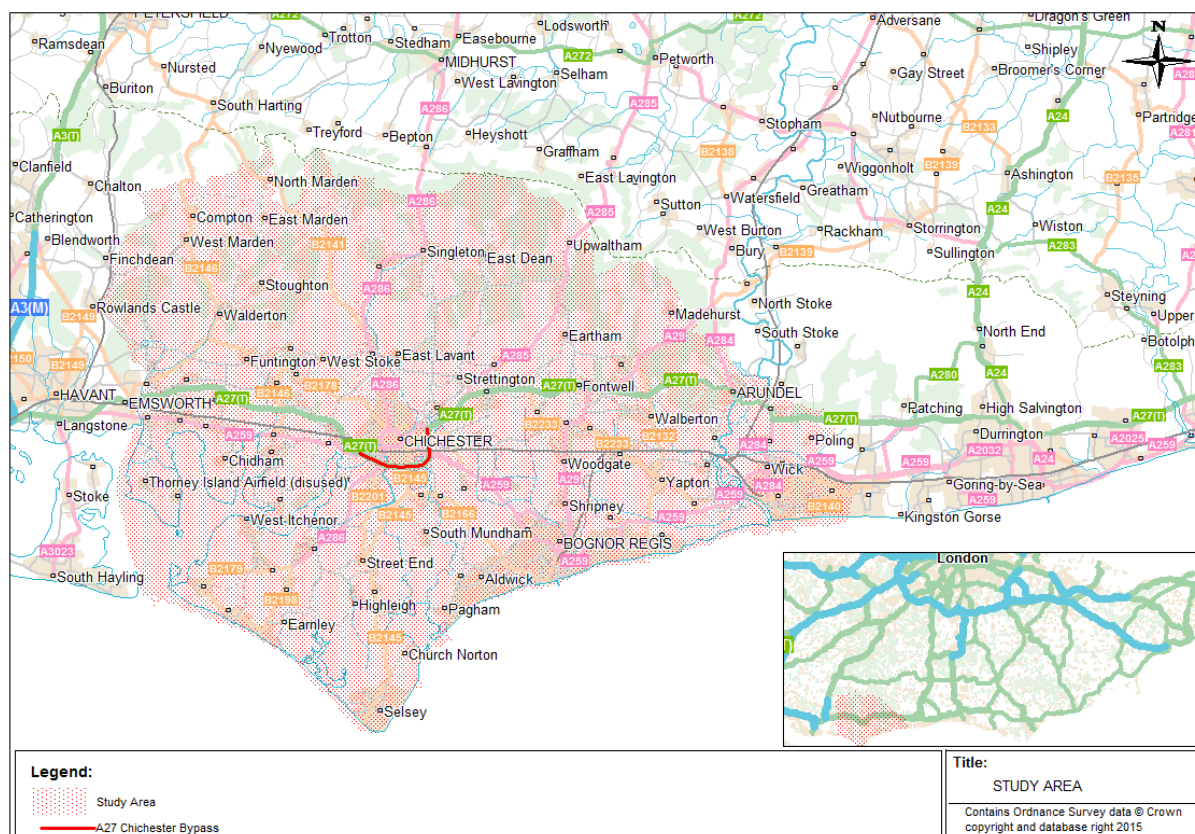
5.1. Traffic Forecasting

5.1.1. Study Area

The Stage 2 traffic model was developed to cover the area directly affected by the options being tested, with the potential to assess some peripheral impacts on strategic routes in the vicinity.

The study area was defined taking into consideration the area which would be affected by the implementation of the scheme and was agreed with the key stakeholders. The study area comprised the south of Chichester District (to the northern edge of the South Downs National Park) and a portion of Arun District west of Arundel including the River Arun as shown in Figure 5.1 below.

Figure 5.1: Study Area



5.1.2. Model Validation

The defined assignment model was calibrated and the flows and journey times were validated against independently surveyed flows. The results produced fulfilled the DMRB and WebTAG model validation criteria. Further details are provided in the Local Model Validation Report (LMVR).

It was agreed with Highways England that, given the strategic location of the scheme and the scale of improvement, Variable Demand Modelling (VDM) would be undertaken to predict and quantify any changes to the traffic conditions that would cause change in demand. It was recognised that a scheme can provide extra capacity to the road network and can lead to traffic being induced through reassignment, redistribution, trip generation, modal switch or change in land use, in the same way, if there is shortage of capacity in future.

VDM was therefore undertaken to determine how demand will be potentially affected by the proposed options. This is an incremental origin-destination based model using the same purpose definitions as the main assignment model. The distribution response (destination choice) is included in the VDM, together with a frequency response for optional (other purpose) trips. The spatial coverage of the VDM is the same as the main assignment model and they both use the same zone system and generalised cost parameters.

Further information on the VMD is provided in the Traffic Forecast Report.

5.1.3. Impact on Road Network

A comparison of the link flows across the Chichester network was undertaken between the Do Minimum scenario and each option using the 2035 AM/PM Peak flows. 2035 is defined as the 'design horizon year' which is 15 years beyond the 'the reference year' of 2020 which is the earliest year in which any of the options assessed would be opened to traffic. The 'Do Minimum scenario' is defined as the continuation of the existing road to 2035, without any improvements apart from those already committed to as part of the committed developments in CLP (refer to Traffic Forecast Report for further details).

In general, the results show that all options increase capacity on the A27 which in turn increases the traffic flows on the strategic route compared to the Do Minimum scenario. For each option there is a reduction in traffic travelling through Chichester City, to the north via East Lavant, to the east via Drayton Lane and to the south via Whyke Road, all of which are currently used as diversion routes to avoid the delays on the A27.

There are also increases in traffic where the reduction in congestion at key junctions increases the amount of traffic away from the diversionary routes mentioned above. These specifically are all the roads approaching the Bognor Road A27 junction, where the increase in capacity allows higher traffic flows and a reduction in delays.

In Options 1, 3 & 3A right turns are banned at the Stockbridge and Whyke junctions. This primarily affects traffic to and from the south of Chichester, which is reflected in the lower level of benefits for these areas in the economic assessment, compared to the higher benefits overall. Some journeys will be required to take longer routes on the local road network to access the Fishbourne or Bognor junctions, or alternatively travel along the A27 in the wrong direction prior to turning around at either of these junctions. This diverts traffic onto the road network to the south of Chichester increasing flows on Vinnetrow road on the approach to the Bognor Junction, and the A259 on the approach to Fishbourne junction.

In Option 2, traffic can no longer access the A27 or local roads at the Stockbridge and Whyke junctions and is encouraged to divert to the Fishbourne junction via the Stockbridge

Link Road. This results in an increase in traffic on the A285 and B2145 from the City to the link road. There are also increases in the traffic on the approach roads to the Fishbourne and Bognor junctions within the City Centre along Terminus Road, Quarry lane and Bognor Road.

The new Stockbridge Link Road (SLR) experiences high flow (over 1000 vehicles per hour) in the AM Peak hour from Stockbridge to the Fishbourne junction. This link is heavily used by traffic travelling to and from the south and results in an increase in traffic along the B2166 through North Munden toward the south coast. The link road also attracts traffic away from rat-running along Apuldrum Lane and the B2145, but increases traffic along the A286 from the south as traffic takes a direct route to the SLR.

The 2035 AM/PM peak flows are presented in Appendix B. The green bandwidths represent an increase in traffic and the blue bandwidths a reduction in traffic.

5.1.4. Comparison of route times on existing A27 Bypass and within Chichester

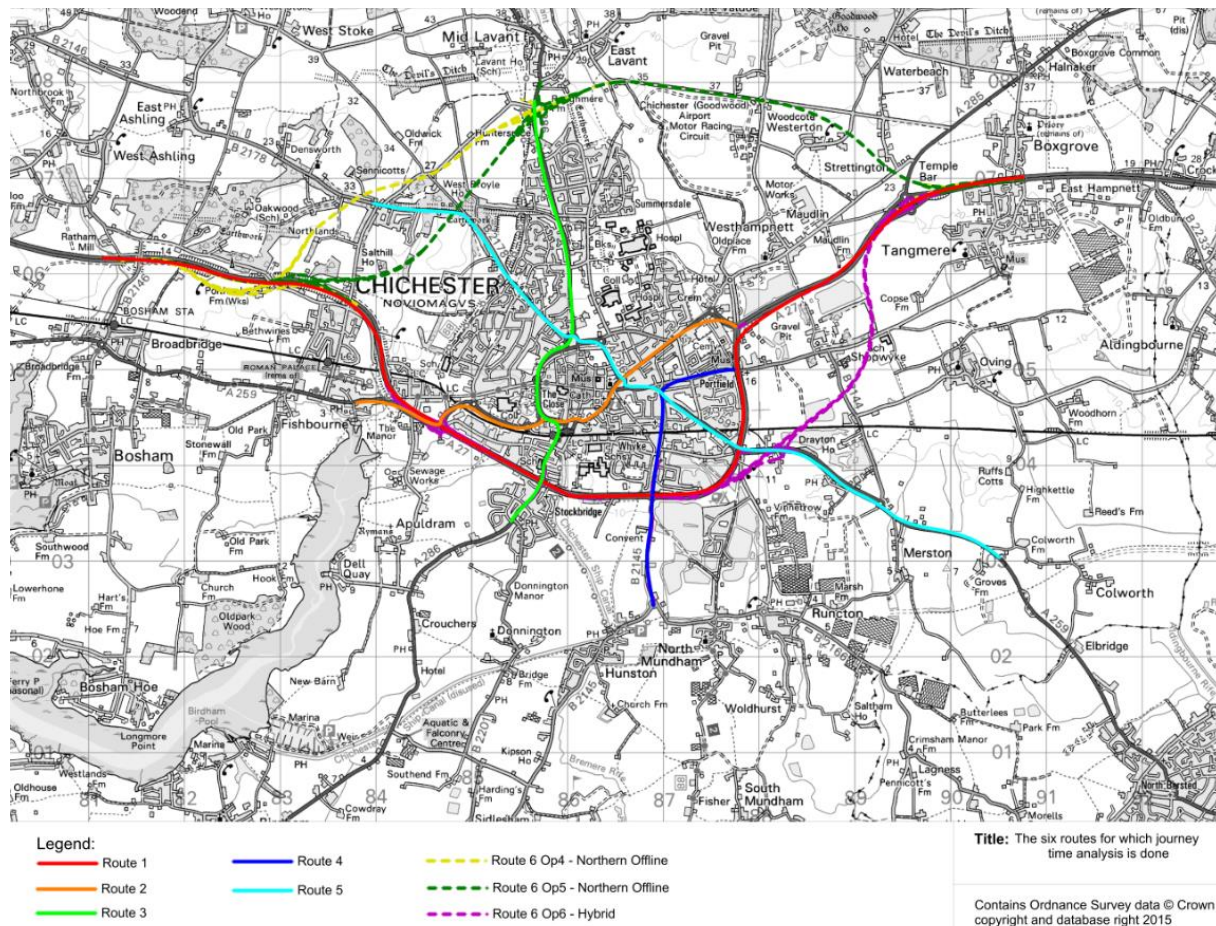
A comparison of the 2014 journey times between fixed points on the existing A27 Chichester Bypass with the forecast year Do Minimum and Do Something scenarios was undertaken, where the Do Something scenario is the road improved as suggested in each of the options considered. The five routes assessed were as follows:

- Route 1: represents a journey on the A27 Bypass between a fixed point 4.2km west of Fishbourne roundabout on A27 and Tangmere/Boxgrove roundabout east of Chichester.
- Route 2: represents a journey between a point just west of Fishbourne roundabout and Portfield roundabout.
- Route 3: represents a journey between a fixed point 3.4km south of Whyke roundabout and Oving junction.
- Route 4: represents a journey between a fixed point 3.5km south of Stockbridge roundabout and a point near East Lavant.
- Route 5: represents a journey between a fixed point 3km northwest of Chichester and a fixed point 2.8km east of Bognor roundabout.
- Route 6: represents a journey with the same start and end locations as Route 1, however the route is via the new offline/hybrid alignments as oppose to the A27.

The locations of the routes are shown in Figure 5.2 over page. All the network changes for Do Something scenarios occur between these points and the network beyond these points are the same for all options.

Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Figure 5.2: Location of journey time routes measured for comparison



The comparison of 2014 Do Minimum scenario shows that journey times will increase considerably by 2035. It also shows that all options excluding Option 1A and Option 3 are quicker than the Do Minimum scenario.

For route 1 – the A27 Chichester Bypass, Option 2 performs very well in reducing the journey time during peak journey times. Option 3 shows least improvement when compared against both the 2014 base and Do Minimum scenarios. It can also be seen that Option 3 in 2035 is slower than the 2014 journey time.

On all other routes, Options 2 shows a substantial improvement in journey time compared to the Do Minimum scenario. On routes 2 to 5, Option 3 shows the least improvement compared to the Do Minimum scenario. In Option 1A, route 3 & 4 are slower than 2014 journey time. This is due to the junctions at Stockbridge and Whyke remaining unchanged.

The 2035 journey times for each of the above routes is presented in Table 5.1.

Table 5.1: Comparison of Journey Times - 2035 Core

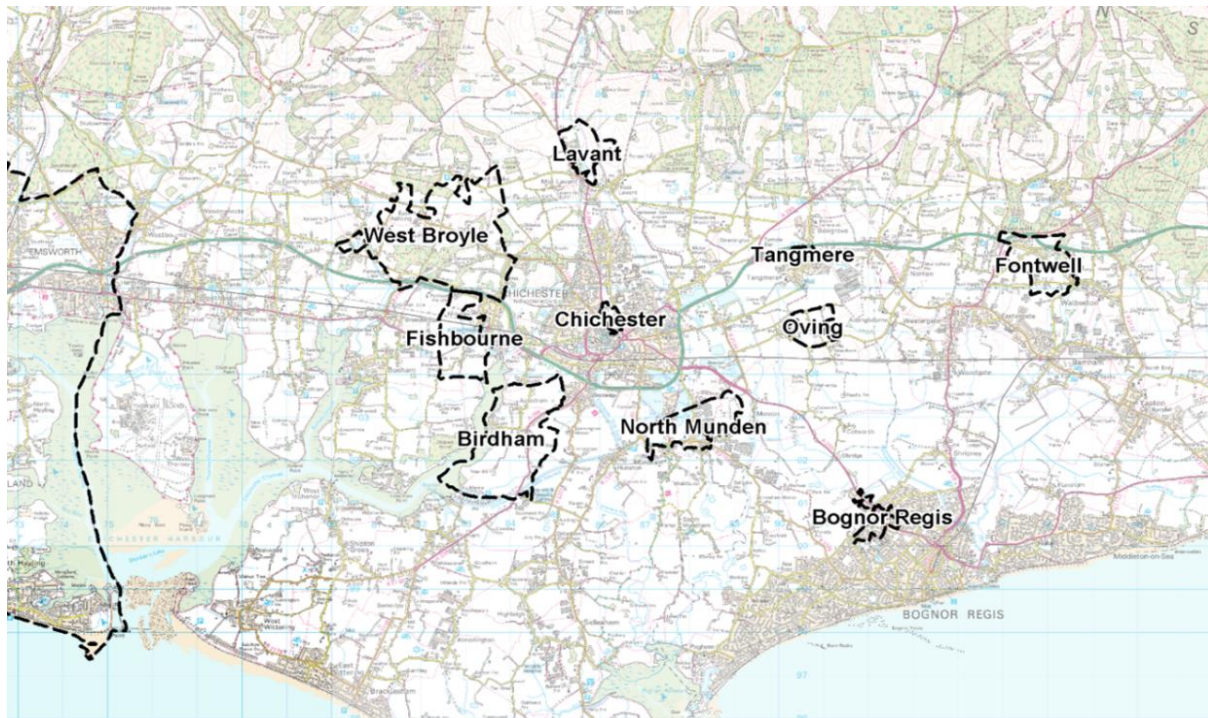
	Base 2014	Do Min	Option 1	Option 1A	Option 2	Option 3	Option 3A
Eastbound AM							
Route 1 - Minutes	12.5	15.3	12.1	13.3	11.4	12.7	11.4
Route 2 - Minutes	12.4	14.5	11.4	9.3	13.7	13.3	12.5
Route 3 - Minutes	10.1	11.3	11.1	11.0	9.8	12.1	10.8
Route 4 - Minutes	6.4	6.4	6.2	6.5	5.8	6.4	6.2
Route 5 - Minutes	11.3	12.8	12.0	11.5	12.1	13.0	12.1
Westbound AM							
Route 1 - Minutes	13.7	17.3	12.7	13.9	11.3	14.8	13.0
Route 2 - Minutes	9.2	11.5	8.8	9.2	9.0	10.7	9.1
Route 3 - Minutes	9.5	10.9	9.5	12.8	8.6	10.3	10.0
Route 4 - Minutes	7.5	8.1	7.2	9.4	6.6	7.5	7.7
Route 5 - Minutes	13.5	15.9	11.2	11.5	11.1	15.9	11.3
Eastbound PM							
Route 1 - Minutes	12.7	15.5	12.4	14.2	10.8	12.9	13.1
Route 2 - Minutes	10.0	13.2	11.3	10.4	12.7	12.2	13.9
Route 3 - Minutes	11.2	13.9	15.0	13.6	9.3	15.0	14.1
Route 4 - Minutes	6.6	9.0	10.0	9.5	5.9	10.1	8.8
Route 5 - Minutes	13.7	16.8	17.5	16.0	14.5	15.9	16.9
Westbound PM							
Route 1 - Minutes	15.5	19.8	13.1	14.7	11.8	15.8	14.1
Route 2 - Minutes	10.7	14.3	9.6	10.5	10.7	10.9	9.1
Route 3 - Minutes	9.4	10.1	9.9	11.5	9.0	10.0	10.1
Route 4 - Minutes	6.6	7.6	7.4	8.7	6.4	7.5	7.5
Route 5 - Minutes	11.6	14.0	10.4	10.5	10.3	13.6	10.4
Eastbound IP							
Route 1 - Minutes	11.2	12.8	10.2	11.9	9.4	10.6	10.0
Route 2 - Minutes	8.0	9.8	8.1	7.8	10.6	9.6	9.1
Route 3 - Minutes	9.9	11.5	11.1	10.7	9.1	11.6	10.6
Route 4 - Minutes	6.6	7.2	6.6	7.4	5.9	6.9	6.6
Route 5 - Minutes	11.1	13.2	12.2	12.0	11.9	12.4	12.4
Westbound IP							
Route 1 - Minutes	12.2	15.8	10.7	13.4	9.8	13.0	11.2
Route 2 - Minutes	8.0	10.4	8.1	8.3	8.5	8.6	8.4
Route 3 - Minutes	9.2	9.8	9.1	9.6	8.4	9.5	9.2
Route 4 - Minutes	6.9	6.8	6.5	6.7	6.1	6.9	6.9
Route 5 - Minutes	11.3	12.9	10.1	10.2	10.1	12.4	10.2

5.1.5. Comparison of Journey Times through Chichester

A comparison of the average journey times between the zones shown in Figure 5.3 was undertaken between the Do Minimum scenario and each option using the 2035 AM/PM Peak journey times.

Comparison of journey times between Do Minimum and Do Something⁸ shows that there is generally a significant journey time reduction in trips to Chichester, Havant, Fontwell, Bognor Regis, Lavant, North Mundham, Apuldrum, Fishbourne and West Broyle. However, its magnitude varies according to the option.

Figure 5.3: Location of modelled zones between which journey time is measured for comparison



The comparison shows that in relation to the 2035 Do Minimum scenario, Option 1 has long distance savings (between Havant and Fontwell) but showed some minor delays in local journeys to the south, (due to the banned right turns at the Stockbridge and Whyke junctions) and minor improvements elsewhere.

Option 1A shows similar journey time savings as Option 1, but generally the overall savings are smaller and there are delays in some long distance journeys and journeys from the south, due to the increased congestion at the Stockbridge and Whyke Roundabouts which are unchanged in this option.

Option 2 has the largest long distance improvements in journey times and generally the largest improvements in local journey times. There are some small increases in journey times to/from Birdham area south of Chichester due to the increase in traffic now approaching to the new Stockbridge Link Road.

Option 3 shows minor improvements in journey times between most areas. However, a few local movements show small increases, due to the removal of right turns at Stockbridge and Whyke junctions reducing accessibility between areas to the south and elsewhere. It can be

⁸ Do Something: the road improved by on one of the options considered by this scheme.

seen the improvements are generally smaller than the increases seen in Do Minimum compared to the 2014 Base Year. Showing that Option 3 doesn't represent in 2035 an improvement on the 2014 situation.

Option 3A shows some improvement in journey times compared to Option 3 particularly on some long distance journeys, for example between Oving and Fishbourne, Oving and Havant and Bognor Regis and Fishbourne. The savings from Fishbourne are created by the improvement to Terminus Road which reduces congestion at Fishbourne roundabout. Local movements remain problematic and show increases in journey times. A summary of the results is presented in Appendix C.

5.2. Economic Assessment

An economic assessment has been undertaken over a 60 year period in accordance with the requirement of TAG Unit A1.1 to facilitate the quantification and monetisation of scheme costs and benefits. The full economic assessment is shown in the Economic Assessment Report. Overall, schemes are assessed against the following relevant government objectives:

- provide good value for money in relation to impacts on public accounts;
- improve transport economic efficiency for business users and transport providers;
- improve transport economic efficiency for consumer users; and
- improve reliability.

Table 5.2 Table 5.2: Capital Cost and Headline Benefits Summary - Core Scenario, £mbelow presents a summary of the BCR for each option for core scenario.

Table 5.2: Capital Cost and Headline Benefits Summary - Core Scenario, £m

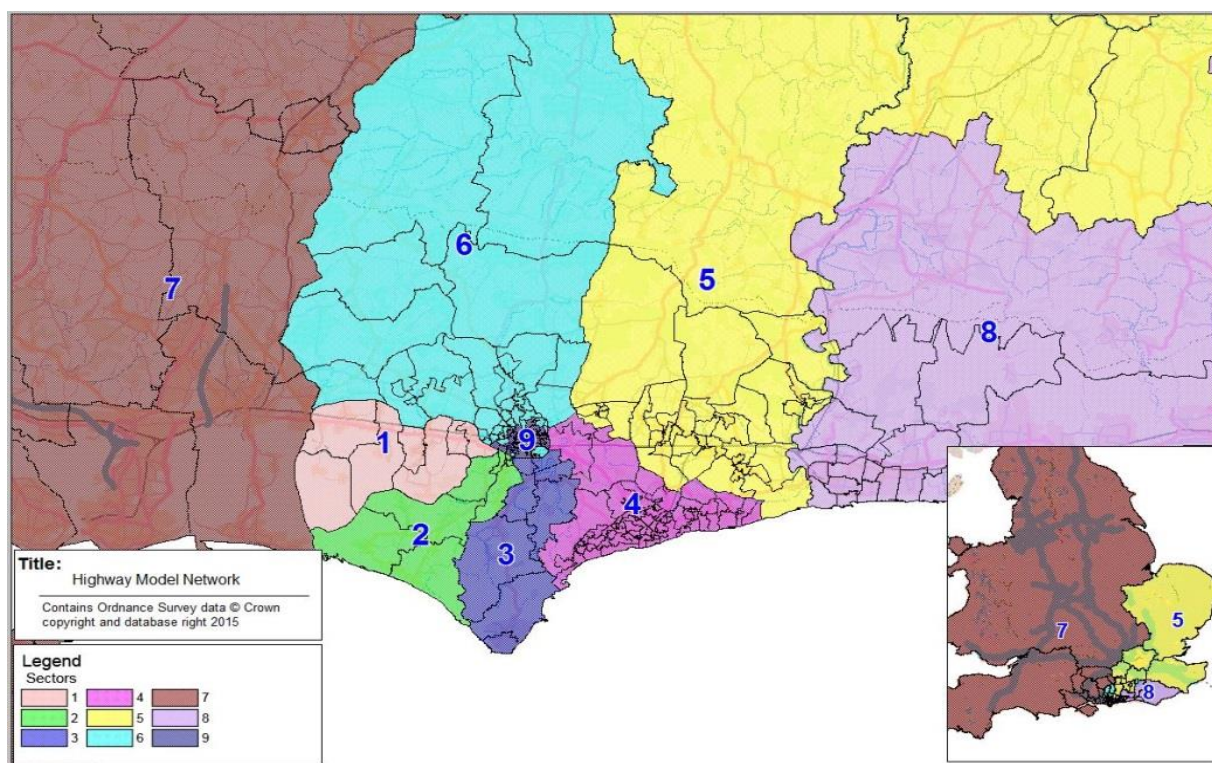
Scheme Options	Capital Cost (£m)	Present Value of Benefits (PVB)	Present Value of Costs (PVC)	BCR
Option 1	£182	£349	£137	2.55
Option 1A	£139	£279	£112	2.49
Option 2	£280	£551	£207	2.66
Option 3	£47	£185	£45	4.13
Option 3A	£172	£308	£136	2.27

Note: Capital costs shown at 2016 prices. All other monetary values are discounted to 2010 and in 2010 market price unit of account.

A Transport Users Benefit Appraisal (TUBA) assessment was undertaken to enable user benefits between each model zone origin-destination pair to be aggregated into larger geographical areas.

There were nine sectors defined for the appraisal of the A27 Chichester Bypass Improvement Scheme. These are shown in Figure 5.4.

Figure 5.4: TUBA Sectors



The sector to sector analysis shows that, as expected, the greatest benefits occur between the east-west sectors (East of Arun – Hampshire), north-east (Routes to NE) and south-east (Bognor Regis) Sectors and vice versa. Significant benefits also occur from the Centre of Chichester for the majority of the options. The percentage split of these benefits however varies between each option but in summary each option produces significant time savings through the elimination of congestion at the existing junctions on the A27 Chichester Bypass.

Trips originating in some of the sectors particularly sector 1 and sector 2 do not benefit much or even have negative user benefits overall, particularly in the case of Option 3. So for those sectors' trips, the Scheme has very limited to no influence. The sector distribution of time and Vehicle Operating Cost (VOC) benefits resulting from each option is presented in Appendix D.

5.2.1. Transport economic efficiency (TEE), Public accounts (PA) and Analysis of monetised costs and benefits (AMCB)

A summary of the key outputs from the economic appraisal for the core scenario is as follows:

- Travel time savings represent the majority of the benefits associated with the Scheme for all of options.
- The largest portion of the travel time benefits occurs during the IP peak (about 40%-44%) followed by PM (31%-36%) and AM peak (20%-26%) periods for all options.
- Journey distance increases as a result of the Scheme under the majority of the options. Partly as a result of this, across all user classes, time periods and years, overall travel

time benefits occur which are generally experienced at the expense of operating cost dis-benefits.

- Commuters and Other users experience journey time savings generally at the expense of VOC dis-benefits. Business users experience substantial overall savings.
- The patterns of sector to sector user benefits correlate well with expectations and the following associated considerations:
 - the location of the Scheme, within Sector 9 – Centre of Chichester;
 - the role of the Scheme in significantly reducing journey times for medium and long distance traffic from sectors to the west of the scheme and also north-east and south-east flows and vice versa;
 - at the same time, the Scheme results in some increases in traffic flows on other parts of the road network, with resulting dis-benefits to traffic between relevant sectors – such as sectors in south-west for example Bosham, Nutbourne, Southbourne and Emsworth and Wittering.
- The combination of the above patterns results in significant user benefits accruing between the east-west sectors (east of Arun – Hampshire), north-east (Routes to NE) and south-east (Bognor Regis) Sectors and vice versa. There are also significant benefits occurring from the Centre of Chichester for all of the options. Percentage splits of these benefits vary between each option but in summary each option produces significant time savings through the elimination of congestion at the existing junctions on the A27 Chichester Bypass.

Accident assessment shows a decrease in accident costs overall for Options 1A, 2 and 3 whilst there is a slight increase of accident costs for the Option 1 and Option 3A over a 60-year assessment period.

The results of the economic appraisal for each option is summarised Table 5.3 over page.

Table 5.3: Summary of Economic Assessment Results – Core Scenario, £m

			Costs/Benefits				
			Option 1	Option 1A	Option 2	Option 3	Option 3A
Benefits	Consumer Commuting User Benefits	Travel Time	£66.7	£51.3	£99.3	£35.1	£63.2
		VOC	-£2.9	£0.4	-£3.1	-£2.4	-£2.3
		Construction Delays	-£2.0	-£1.9	-£3.7	-£1.6	-£1.8
		Maintenance Delays	-£0.2	-£0.2	-£0.3	£0.0	-£0.1
		Net Consumer User Benefits	£61.6	£49.5	£92.1	£31.0	£58.9
	Consumer Other User Benefits	Travel Time	£167.0	£131.0	£255.0	£83.9	£154.7
		VOC	-£12.6	-£3.6	-£11.8	-£8.8	-£11.3
		Construction Delays	-£6.3	-£5.9	-£10.8	-£5.0	-£5.6
		Maintenance Delays	-£2.9	-£3.3	-£4.0	-£0.5	-£2.0
		Net Consumer User Benefits	£145.2	£118.0	£228.4	£69.7	£135.9
	Consumer Business User Benefits	Travel Time	£149.3	£115.0	£221.5	£75.7	£141.1
		VOC	£8.3	£7.5	£13.5	£3.8	£7.6
		Construction Delays	-£6.4	-£5.9	-£11.5	-£5.0	-£5.5
		Maintenance Delays	-£1.0	-£1.1	-£1.3	-£0.2	-£0.7
		Net Business User Benefits	£150.2	£115.6	£222.2	£74.3	£142.4
	Accidents Benefits		-£8.5	£1.9	£8.4	£5.8	-£24.1
	Indirect Tax Revenues		£3.7	-£1.1	£2.0	£4.6	£3.5
	Noise		-£5.7	-£5.3	-£4.0	-£3.3	-£9.6
	Air Quality		£2.9	£0.6	£2.2	£2.8	£1.0
	Total PVB (£m)		£349.4	£279.1	£551.3	£184.9	£308.0
Costs	Operating and Maintenance Costs		£13.8	£15.1	£15.8	£12.4	£15.7
	Investment Costs		£123.4	£97.0	£191.5	£32.3	£120.1
	Revenue Change		£0.0	£0.0	£0.0	£0.0	£0.0
	Total PVC (£m)		£137.2	£112.2	£207.3	£44.8	£135.9
Net Present Value (NPV)			212.2	166.9	344.0	140.1	172.2
Benefits to Cost Ratio (BCR)			2.55	2.49	2.66	4.13	2.27

Note: All monetary values are discounted to 2010 and in 2010 market price unit of account. Cells highlighted with blue colour are taken from the TUBA (Transport User Benefit Appraisal) assessment. Noise and Air Quality information is provided by Environmental Team within Mott MacDonald. User delays dis-benefits during construction and future maintenance are derived from QUADRO (QUEues And Delays at ROADworks).

5.3. Buildability

The Stage 1 and Stage 2 designs were reviewed by an appointed Delivery Partner / Contractor (Carillion and Morgan Sindall) to identify any construction obstacles from an early stage. The review concluded that all the options are capable of being constructed within the constraints of the scheme, albeit a number of risks and issues have been identified for each option.

The works along the existing Bypass are particularly challenging and are likely to require the temporary restriction of turning movements and/or constructing temporary carriageway and junctions as well as traffic management under narrow lanes and/or lane closures. Any sequence of construction online is likely to create a moderate disruption to users and prolong the construction duration.

New components such as the Stockbridge Link Road are mainly offline other than where it ties in with Fishbourne junction and the B2199 to the east and west respectively. There are no significant buildability issues envisaged at this stage apart from potential soft ground conditions.

5.4. Option Cost Estimate

The estimate costs were completed by an appointed Supplier on behalf of Highways England's Commercial Services Division in June 2016. The Expenditure Profiles for each option including those excluded during an interim review are presented in the Options Estimate Report Ref: 343538-90-ES-003-P02.

A summary of the estimated out-turn costs for the five options considered are presented in Table 5.4 below.

Table 5.4: Option out-turn of costs

Option	Range estimate Out-turn Costs		
	P10 (£M)	Most Likely (£M)	P90 (£M)
Option 1	£149.73	£181.87	£226.75
Option 1A	£114.39	£139.43	£195.51
Option 2	£230.84	£280.22	£350.87
Option 3	£38.46	£47.33	£59.05
Option 3A	£141.78	£171.86	£259.55

The estimates presented were used within the Traffic Model to determine the capital costs of the scheme and factors based on this figure, as well as to determine how the Options fit within the Highways England budget for the project.

5.4.1. Risk Registers

A project Risk Register was developed at the beginning of Stage 1 and has remained an evolving live document throughout the life of project. Instead of maintaining separate registers for each option with largely similar content, one central register was produced that details which risks apply to each option. A comparison was then made between the total of the risk costs for each option against that option's construction cost, to determine what percentage was risk based rather than capital expenditure.

For further details on the risks associated with each option see the project Risk Register Ref: 343538-90-030-RA-001.

6. Operational Assessment

6.1. Microsimulation Modelling Assessment

6.1.1. Methodology

The microsimulation modelling assessment in this project was supplementary to the strategic SATURN (Simulation and Assignment of Traffic to Urban Road Networks) model that was used to assess the wider impacts of the scheme. Microsimulation modelling was carried out using VISSIM software to identify potential operational issues with the proposed designs. Microsimulation modelling is capable of assessing individual design elements and mutual element interaction more accurately than SATURN. However, due to the high level of coding required, the microsimulation model was limited to the area immediately surrounding the proposed improvements in each option.

The vehicle demand is primarily based on the strategic SATURN model. The SATURN model was cordoned and relevant data was inserted into the microsimulation VISSIM model.

Thorough checks were carried out to ensure that the modelled flows were consistent between the SATURN and VISSIM models. The results of the SATURN and VISSIM models were also compared to check that they show similar traffic capacity issues.

It should be noted that despite the demand flows being identical in the SATURN and VISSIM models, the predicted queues and delays are different due to the different nature of the two models (macro vs micro simulation).

The VISSIM model was also used for the provision of individual vehicle trajectories that were utilised in the 3D photorealistic visualisations produced for the Public Consultation.












The following sections of this chapter indicate the issues that have been identified for each of the options predicted by the VISSIM model in 2035 and which will need further attention in the following stages for the Preferred Option. It should be noted that by resolving the listed issues, the flow levels in the network may alter and cause issues elsewhere in the network which should also be assessed.

It should also be noted that queue lengths are highly variable both day to day and minute to minute and similar flows may lead to different momentary queues and so the images provided throughout this chapter are indicative only.

In order to illustrate slower traffic in the network, the colour of vehicles was chosen to correspond with their speed as shown in Table 6.1. Pink and red vehicles are those stationary or slowly moving on the network.

The findings from VISSIM are discussed below for each key component in reference to the 2035 – Design Year conditions, for each option.

Table 6.1: Vehicle Speed Colour Correspondence

Min Speed (km/h)	Max Speed (km/h)	Colour
Minimum	10	
10	20	
20	30	
30	40	
40	50	
50	60	
60	80	
80	100	
100	120	
120	200	
200	MAX	

6.1.2. Option 1

The extent of this option model is shown below in Figure 6.1. The junction improvements are explained in detail in Section 4.

Figure 6.1: Option 1 – Extent

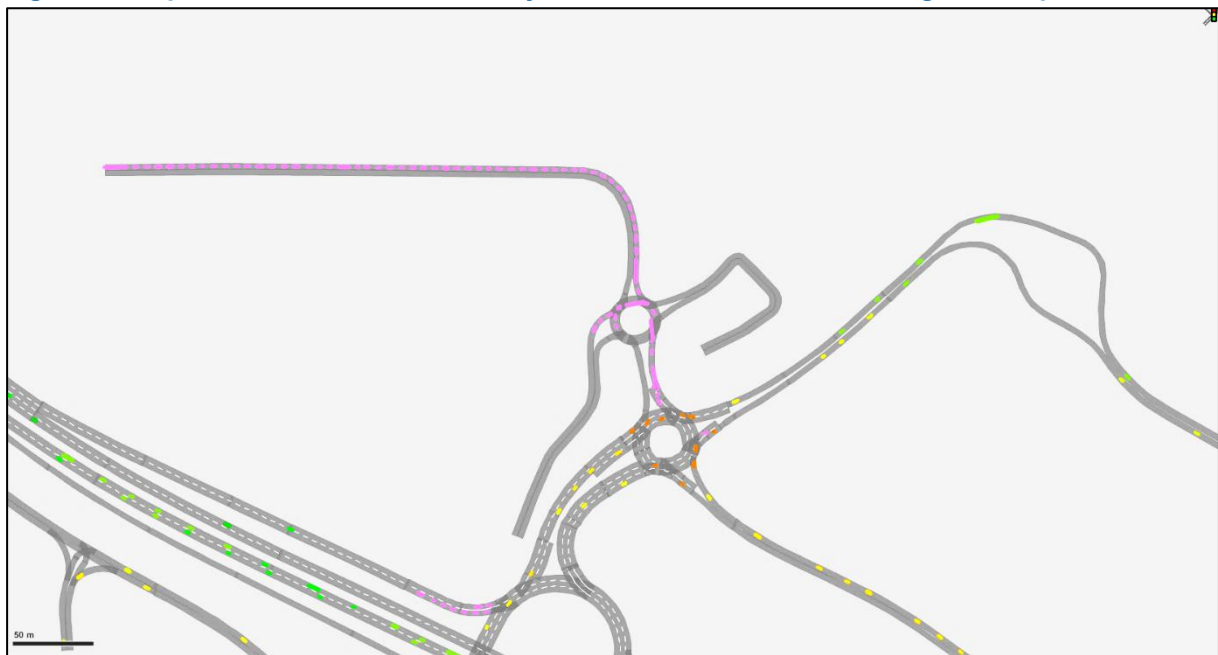


6.1.2.1. A259 Cathedral Way / Fishbourne Road East Roundabout

This option proposes converting the priority junction with restricted movements into a 3 lane roundabout with all movements possible. In addition, Terminus Road is proposed to be connected into this roundabout. With this configuration, vehicles arriving from Fishbourne Road East are unable to find sufficient gaps in traffic to enter the junction, and a long queue builds up in the AM peak as shown in Figure 6.2.

Therefore, a different type of junction should be considered instead of a conventional roundabout in order to increase the junction capacity. The signal controlled cross-roads proposed in Option 3A appears to address the problem and so could be applied here in Option 1 as well.

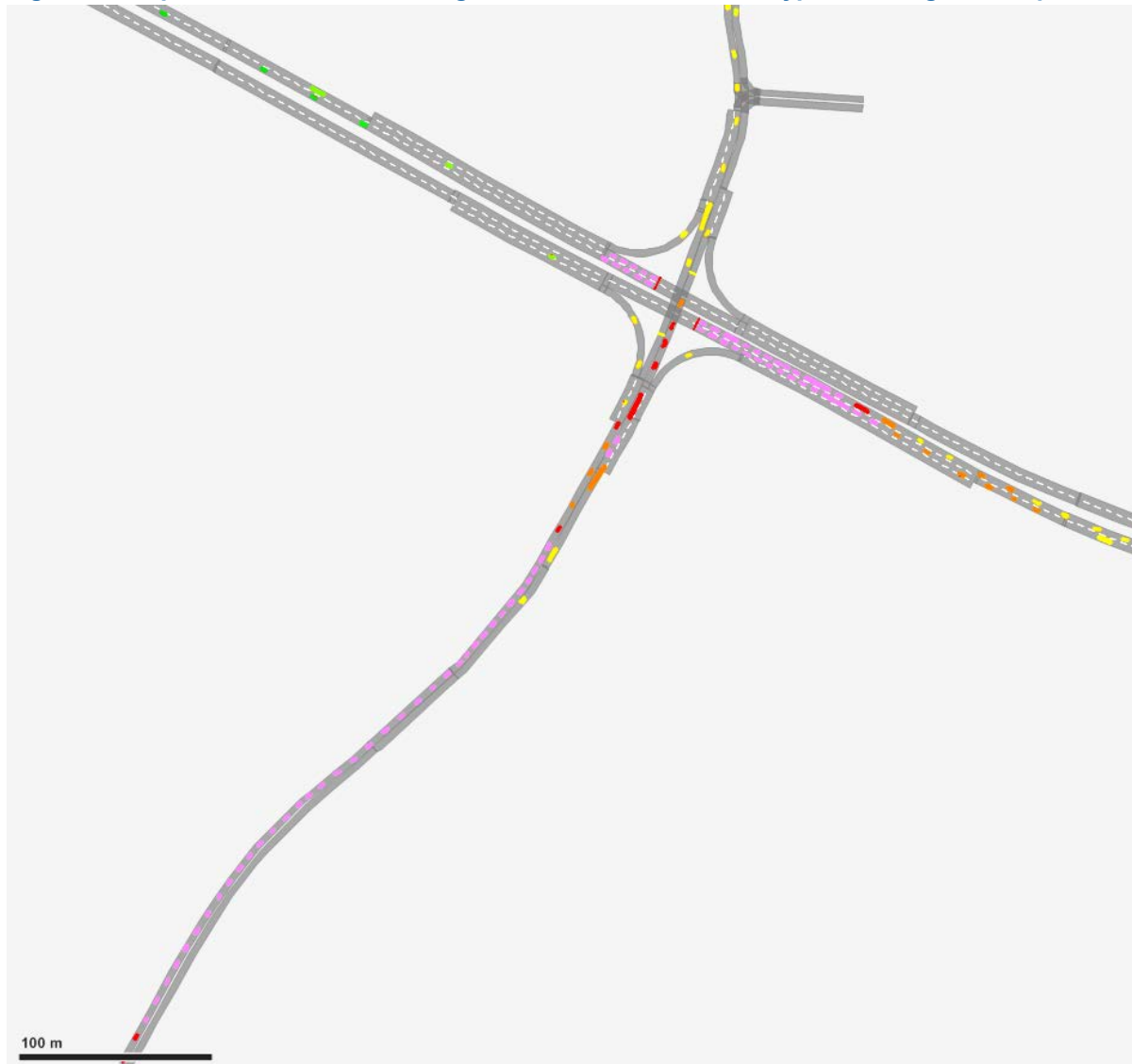
Figure 6.2: Option 1 – A259 Cathedral Way / Fishbourne Road East during the AM peak



6.1.2.2. A286 Stockbridge Road / A27 Chichester Bypass

Queuing is predicted by the VISSIM model primarily in the northbound direction of the A286 Stockbridge Road in the AM peak as shown in Figure 6.3. Provision of two lanes in the northbound direction could reduce or eliminate queuing, but due to the tight space constraints in this location this is unlikely to be feasible without demolition.

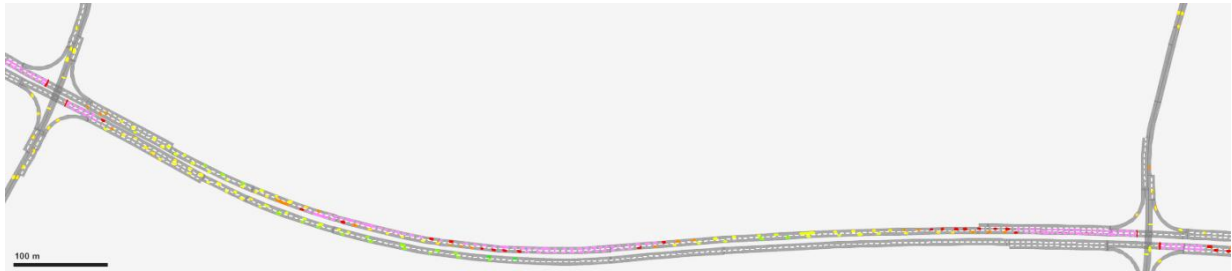
Figure 6.3: Option 1 – A286 Stockbridge Road / A27 Chichester Bypass during the AM peak



6.1.2.3. B2145 Whyke Road / A27 Chichester Bypass

In 2035 the Whyke Road junction has exceeded capacity, and so queues form on the eastbound carriageway during the PM peak as shown in Figure 6.4. Adding lanes / widening in east-west and/or north-south directions (both ways) is one solution that could help resolve the issue, although is restricted by space constraints to the north of the junction.

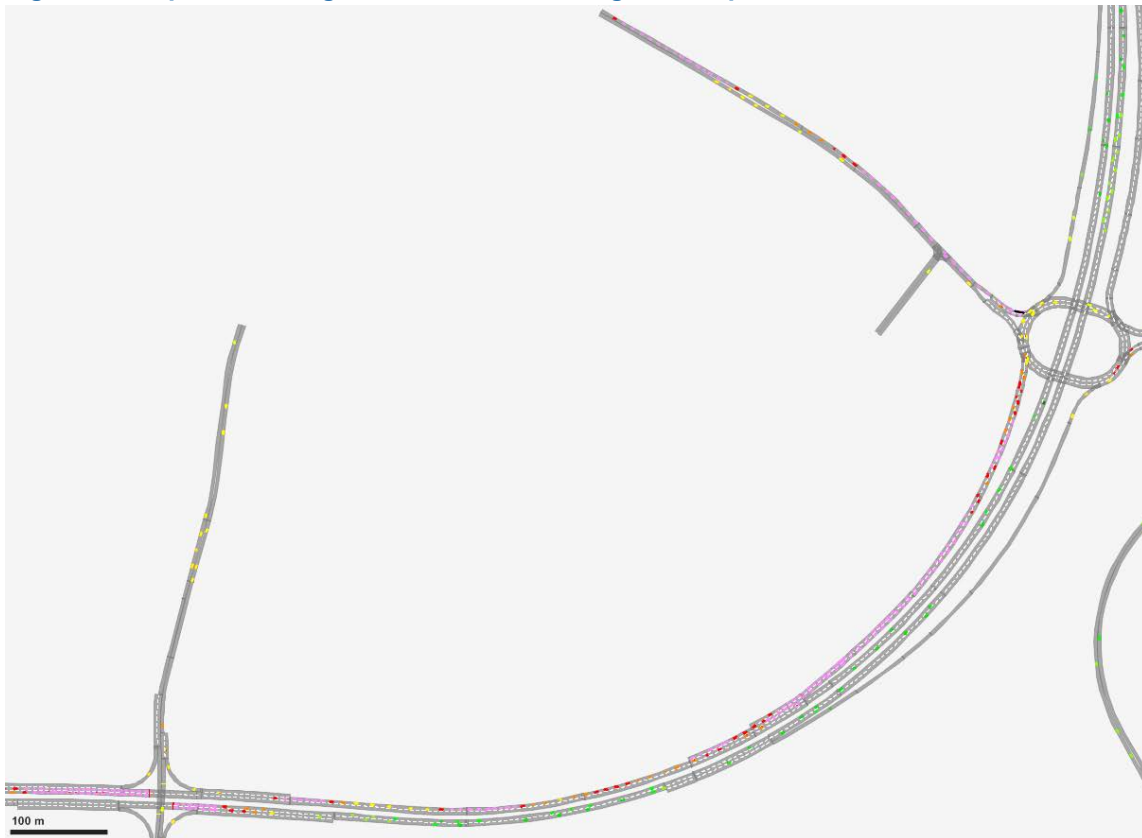
Figure 6.4: Option 1 – B2145 Whyke Road / A27 Chichester Bypass during the PM peak



6.1.2.4. Bognor Roundabout

Enlargement of the Bognor Roundabout and provision of the flyover have significantly improved junction operation. However, there is residual PM peak queuing on the northbound off-slip and on the eastbound approach as shown in Figure 6.5. A relatively minor improvement such as provision of additional lanes and signalisation of the roundabout could reduce or eliminate queuing.

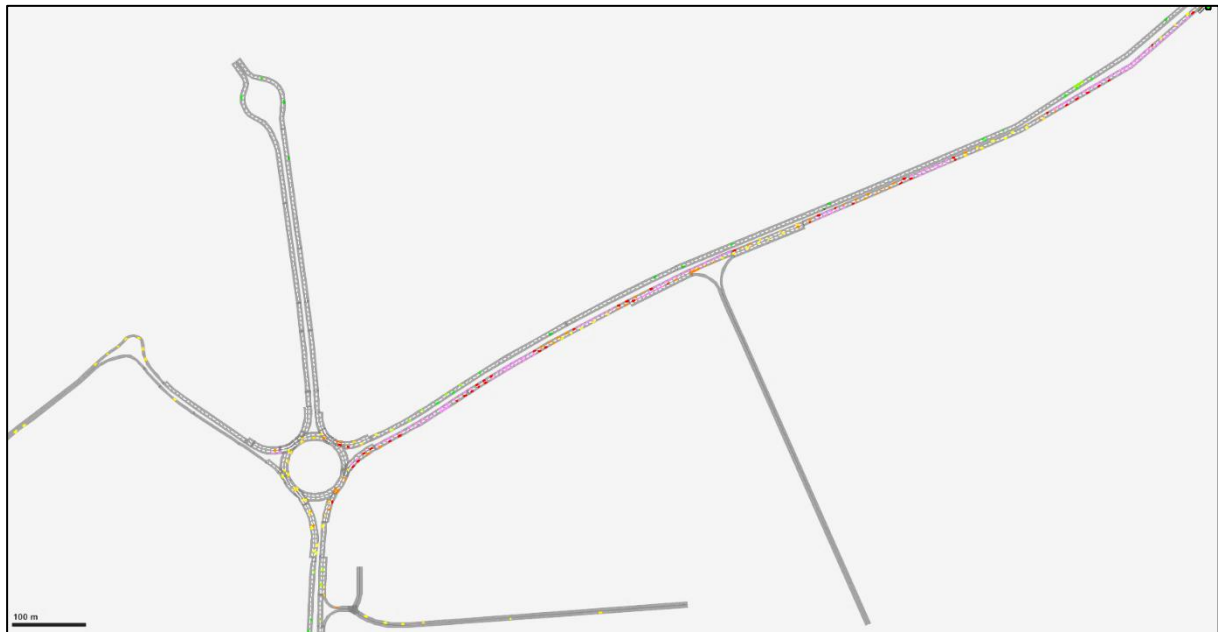
Figure 6.5: Option 1 – Bognor roundabout during the PM peak



6.1.2.5. Portfield Roundabout

Moderate queuing in the AM peak and heavy queuing in the PM peak is predicted on the westbound approach to the Portfield roundabout in 2035, as shown in Figure 6.6. Improvements to this roundabout design such as widening and a more efficient configuration are strongly recommended should this option be selected to be progressed to the next stage. The proximity of the slip roads for the Shopwhyke Lake housing development does limit the available options at this junction.

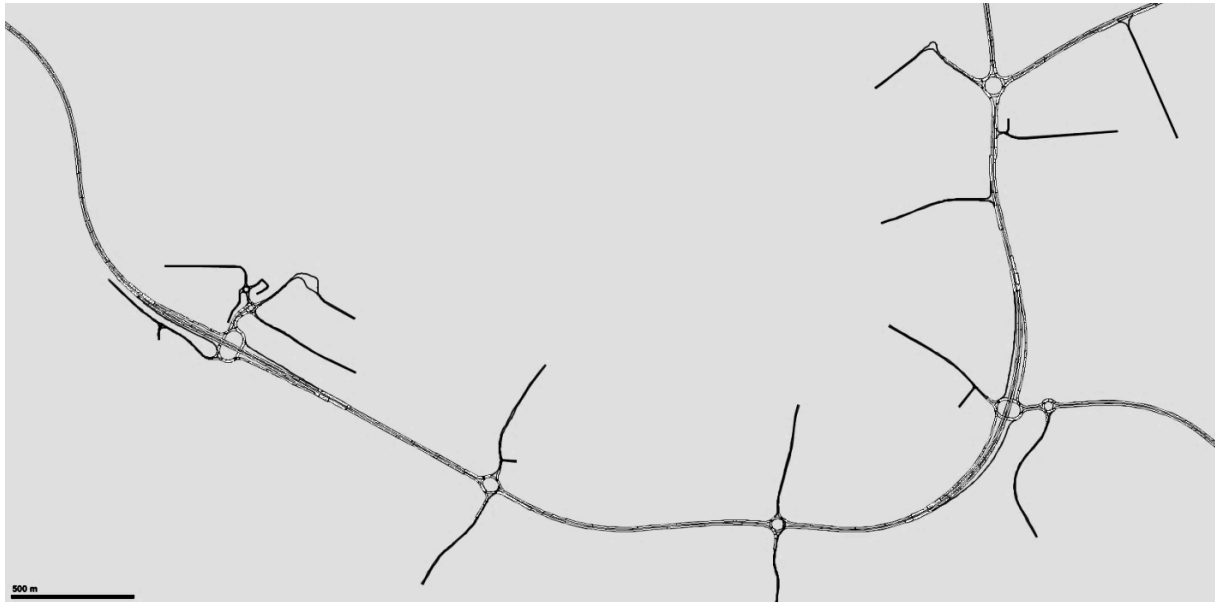
Figure 6.6: Option 1 - Portfield Roundabout during the PM peak



6.1.3. Option 1A

The extent of this option model is shown below in Figure 6.7. The junction improvements are explained in detail in Sections 4.

Figure 6.7: Option 1A – Extent



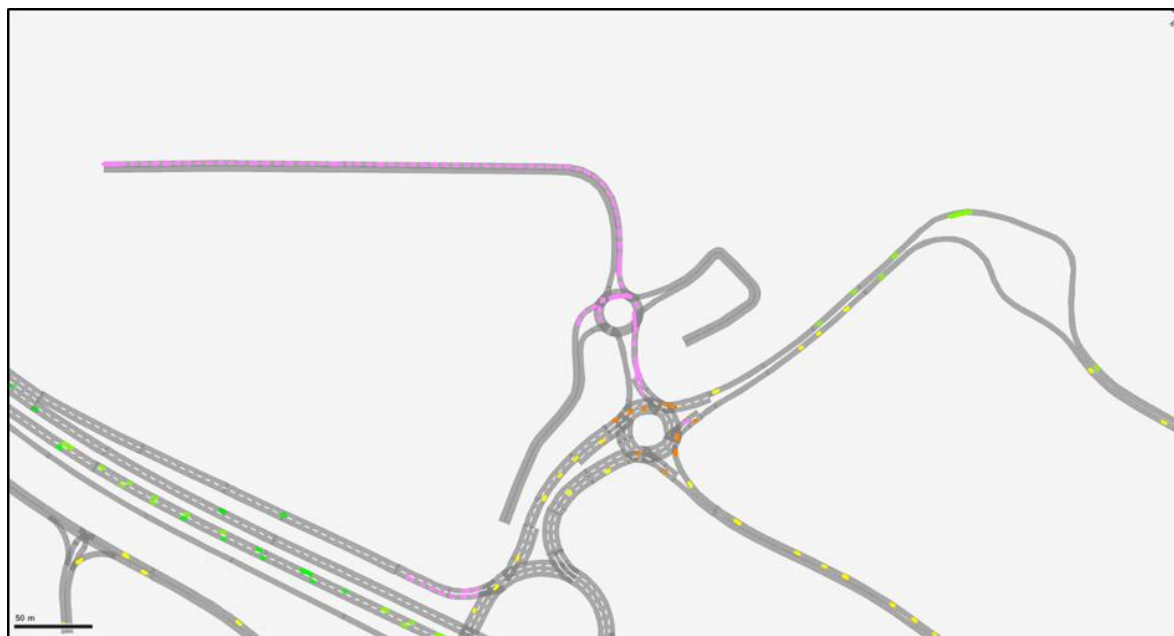
6.1.3.1. A259 Cathedral Way / Fishbourne Road East Roundabout

As in Option 1, it is proposed to convert this priority junction with restricted movements into a 3 lane roundabout with all movements possible. In addition, Terminus Road is proposed to be connected into this roundabout. With this configuration, vehicles arriving from Fishbourne Road East are unable to find sufficient gaps in traffic to enter the junction, and a long queue builds up in the AM peak as shown in Figure 6.8

Figure 6.8.

Therefore, a different type of junction should be considered instead of the roundabout in order to increase the junction capacity. The signal controlled cross-roads proposed in Option 3A appears to address the problem and so could be applied here as well.

Figure 6.8: Option 1A – A259 Cathedral Way / Fishbourne Road East during the AM peak



6.1.3.2. A286 Stockbridge Road / A27 Chichester Bypass

Queuing is predicted by the VISSIM model in the northbound direction of the A286 Stockbridge Road in the 2035 AM peak (although less than in Option 1) as shown in Figure 6.9. Widening or signalisation of the roundabout could increase the capacity of the junction. Widening may be limited by the proximity of houses to the junction, so signalisation may be the only viable solution.

Figure 6.9: Option 1A - Stockbridge Road / A27 Chichester Bypass during the AM peak



6.1.3.3. B2145 Whyke Road / A27 Chichester Bypass

Due to insufficient capacity of the Whyke Road roundabout, queues form on the southbound approach during the 2035 PM peak as shown in Figure 6.10. Increasing the number of lanes and/or signalisation of the roundabout could improve the junction capacity and performance. Due to the tight space constraints to the north of the junction, signalisation may be the only viable option.

Figure 6.10: Option 1A – B2145 Whyke Road / A27 Chichester Bypass during the PM peak

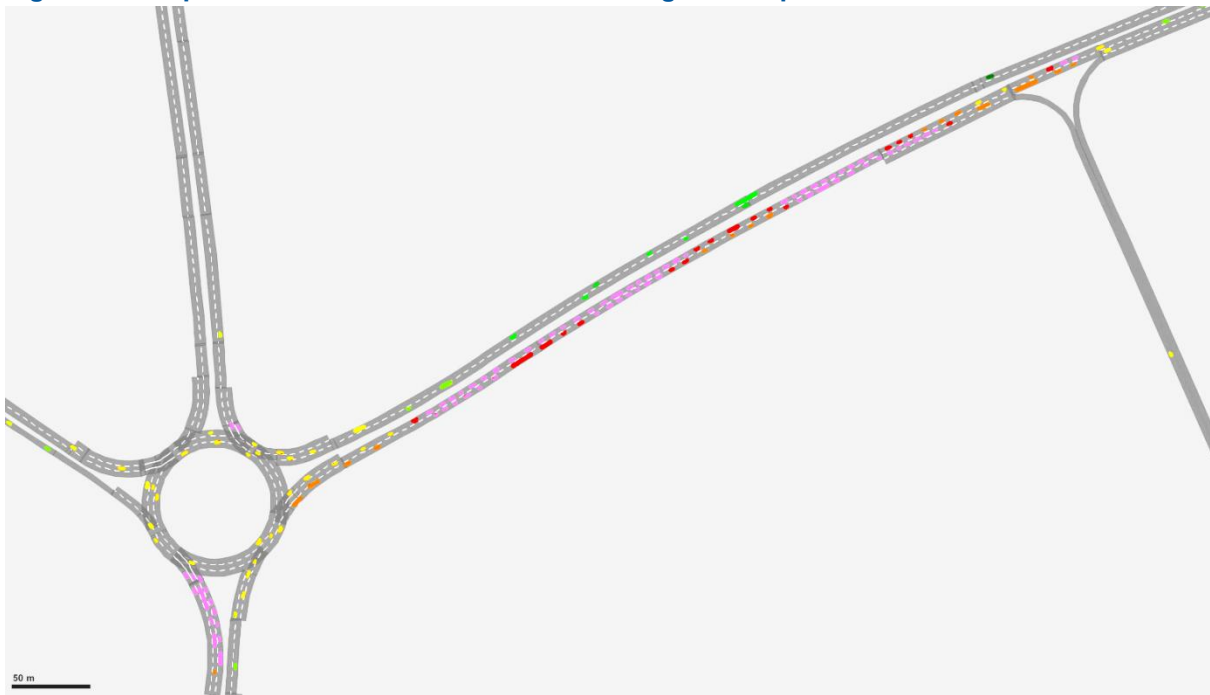


6.1.3.4. Portfield Roundabout

Moderate queuing is predicted in the 2035 AM peak on the westbound approach to the Portfield roundabout as shown in Figure 6.11. The PM queuing is much shorter than in Option 1, possibly due to a lower demand across the model.

As in Option 1, improvements to this roundabout design such as widening and a more efficient configuration are strongly recommended should this option be selected to be progressed to the next stage.

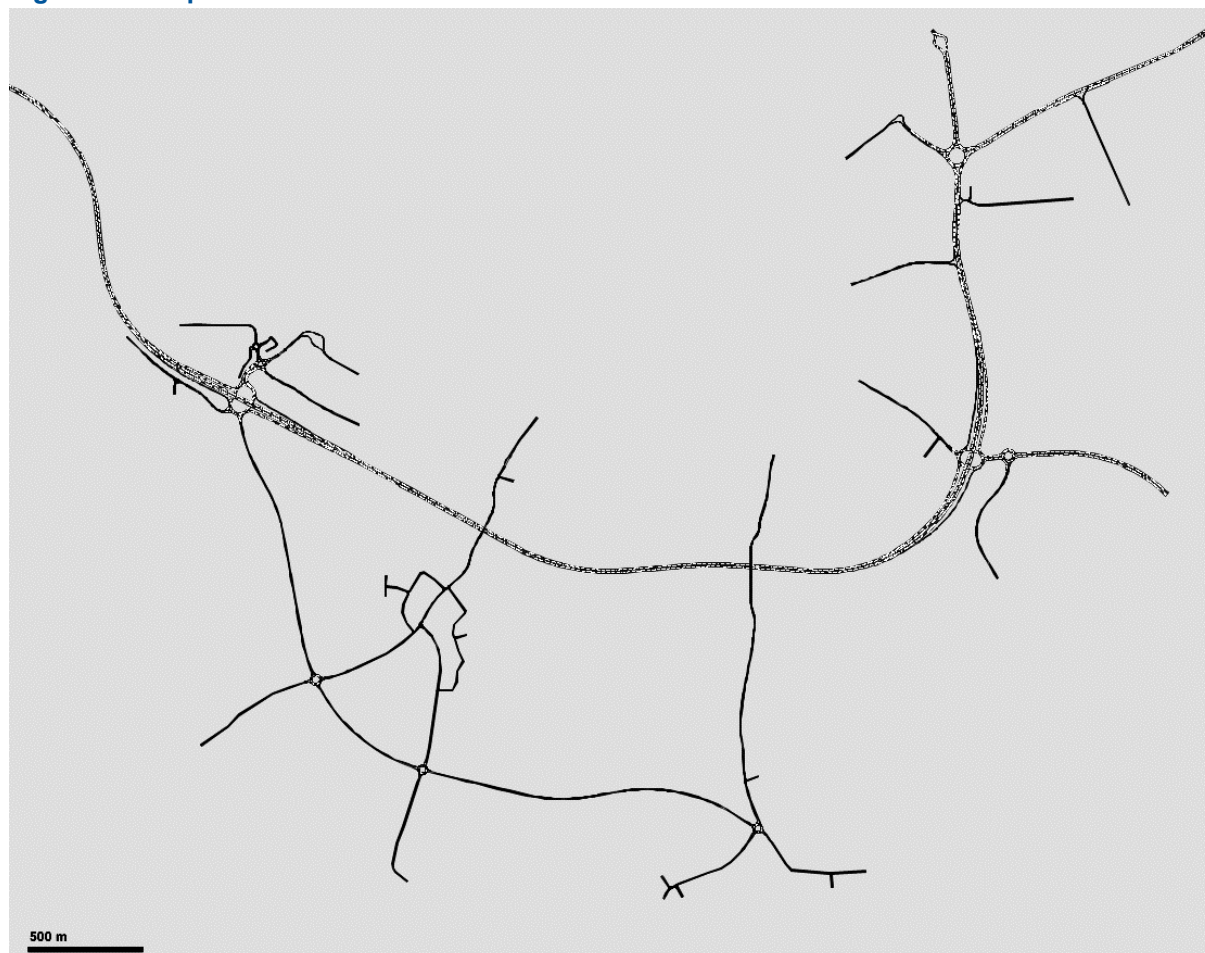
Figure 6.11: Option 1A - Portfield Roundabout during the AM peak



6.1.4. Option 2

The extent of this option model is shown below in Figure 6.12. The junction improvements are explained in detail in Sections 4.

Figure 6.12: Option 2 – Extent



6.1.4.1. A259 Cathedral Way / Fishbourne Road East Roundabout

As in Option 1 and 1A, it is proposed to convert this priority junction with restricted movements into a 3 lane roundabout with all movements possible. In addition, Terminus Road is proposed to be connected into this roundabout. With this configuration, vehicles arriving from Fishbourne Road East are unable to find sufficient gaps in traffic to enter the junction, and a long queue builds up in the AM peak as shown in Figure 6.13.

A different type of junction should be considered instead of the roundabout. The signal controlled cross-roads proposed in Option 3A appears to address the problem and so could be applied here as well.

Figure 6.13: Option 2 – A259 Cathedral Way / Fishbourne Road East during the AM peak



6.1.4.2. New Stockbridge Link Road / A286 Birdham Road Roundabout

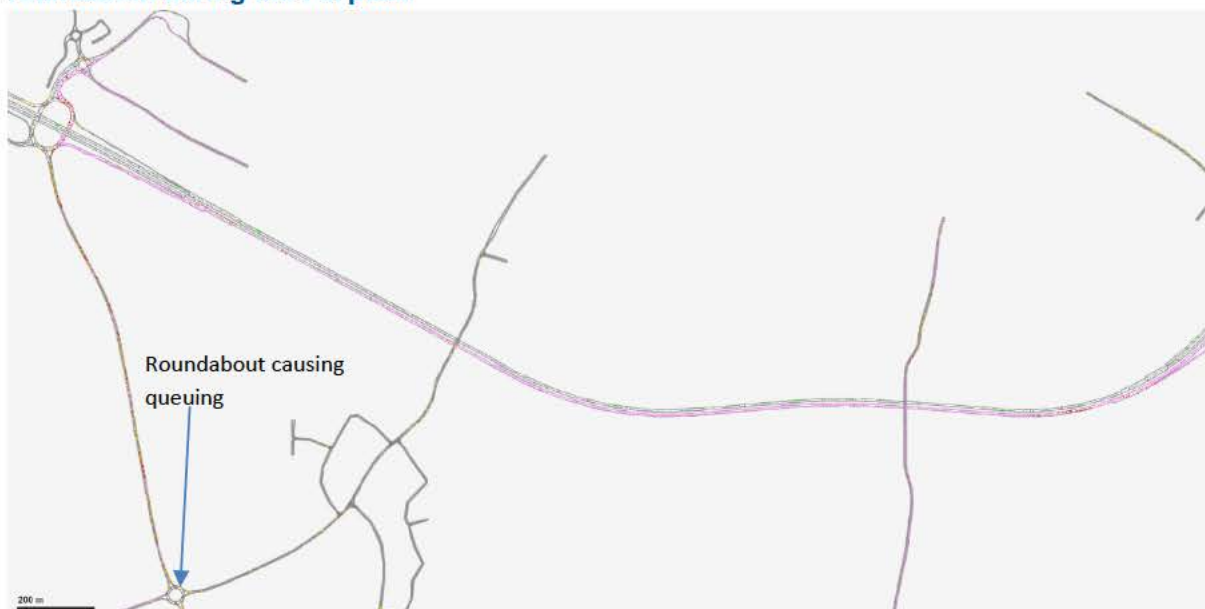
This newly proposed roundabout in relation to SLR has not yet been optimised in design for the traffic flows and so causes long queues and delays on its approaches in 2035 during both AM and PM peaks, as shown in Figure 6.14. In the PM peak, the queues heading south along the link road cause queueing along the A27 westbound carriageway as shown in Figure 6.15.

The roundabout geometry would need to be improved in the next stage so it can cope with the expected demand. An initial sensitivity test has been carried out that appears to show the situation can be improved with flaring of roundabout entry lanes or additional entry lanes.

Figure 6.14: Option 2 - New link / A286 Birdham Rd roundabout during the AM peak



Figure 6.15: Option 2 – A27 westbound congestion caused by the new link / A286 Birdham Rd roundabout during the PM peak



6.1.4.3. New Stockbridge Link Road / B2145 / B2166 Roundabout

This roundabout has not yet been optimised in design for the traffic flows and during the 2035 PM peak queues build up on the southbound approach as shown in Figure 6.16. The roundabout geometry would need to be improved in the next stage so it can cope with the expected demand.

Figure 6.16: Option 2 - New link road / B2145 / B2166 roundabout during the PM peak



6.1.4.4. Portfield Roundabout

Queuing occurs at this roundabout, the same as in Option 1 and 1A, as shown in Figure 6.17. In this option, queuing is predicted on the westbound approach in 2035 during both the AM and PM peaks.

As in Option 1 and 1A, improvements to this roundabout design such as widening and a more efficient configuration are strongly recommended should this option be selected to be progressed to the next stage.

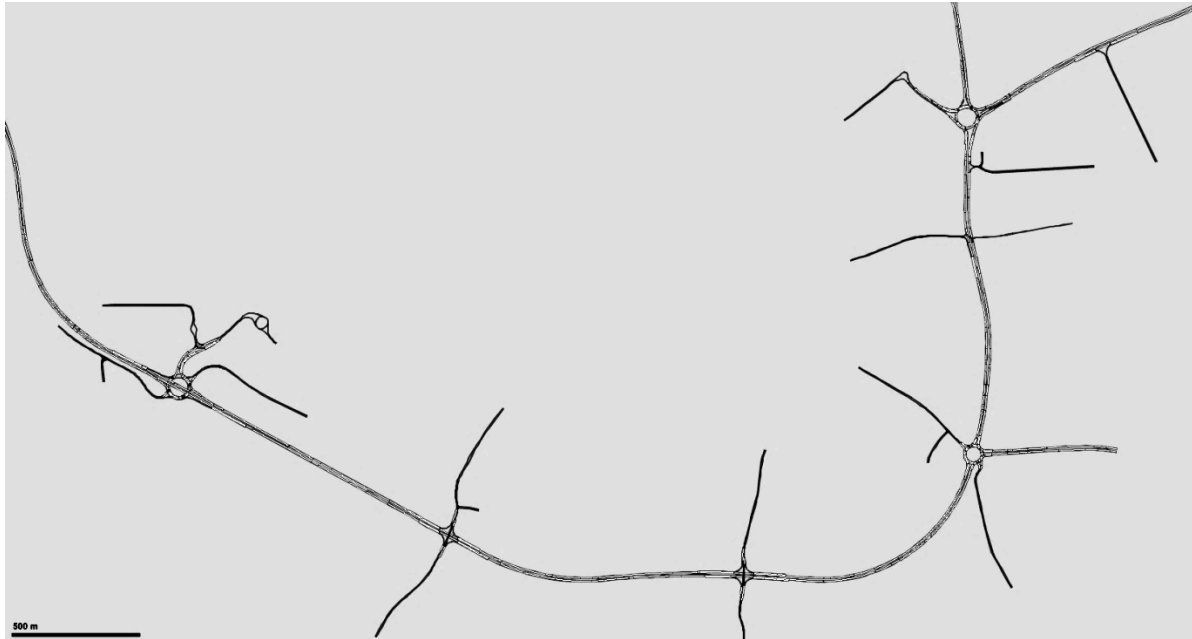
Figure 6.17: Option 2 - Portfield roundabout during the AM peak



6.1.5. Option 3

The extent of this option model is shown below in Figure 6.18. The junction improvements are explained in detail in Sections 4.

Figure 6.18: Option 3 – Extent



Fishbourne Roundabout

In this option, the Fishbourne roundabout is adapted to a through-about / 'hamburger' layout with the movement along the A27 cutting through the circulatory carriageway. A large number of arms and short distances between stop lines make signal optimisation of the junction challenging. During the AM peak, almost no traffic is able to arrive from Fishbourne Road West as the circulatory carriageway is usually blocked during the Fishbourne Road West green stage as shown in Figure 6.19.

There are various measures that could be applied in order to improve the performance such as:

- relocation Fishbourne Road West approach further east;
- adding further lane flaring;
- removal of the signals on the A27 on-slips so vehicles could freely exit the junction. This could lead to reduced blocking of the circulatory carriageway; and,
- increase of the number of lanes on the A27 within the junction.

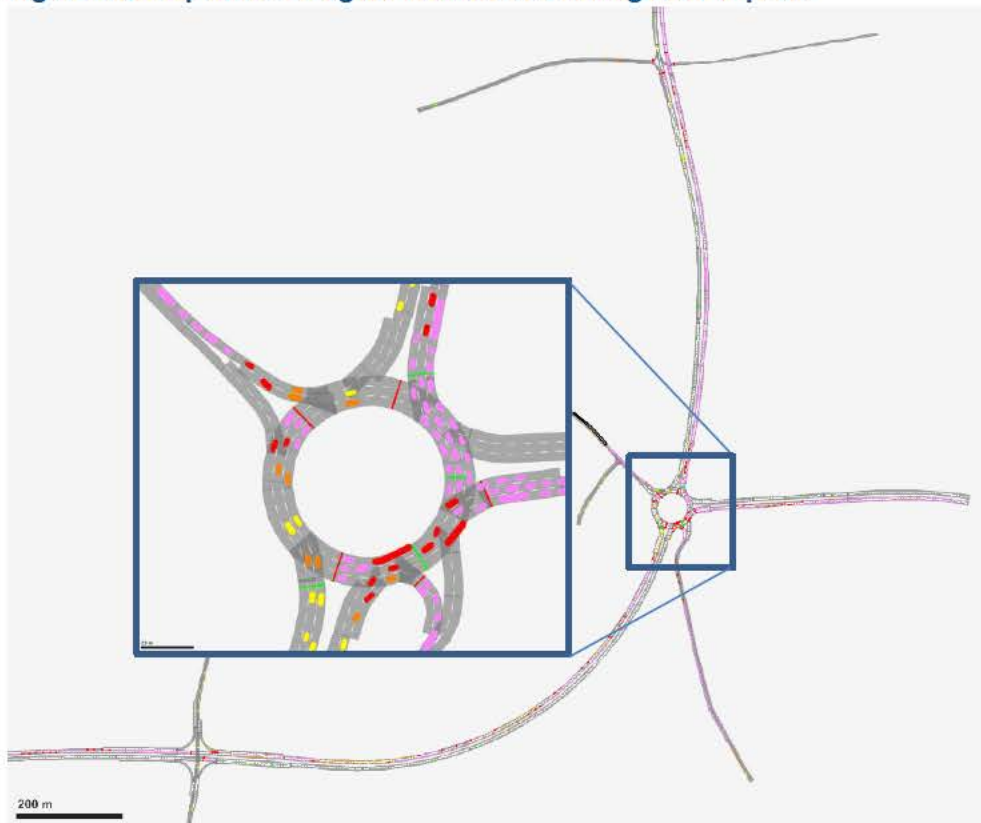
Figure 6.19: Option 3 – Fishbourne Roundabout during the AM peak



6.1.5.1. Bognor Roundabout

The signalised Bognor roundabout performs extremely poorly in both the AM and PM peaks in Option 3. The junction size becomes inadequate for the volume of traffic it carries and the number of arms. In 2035 long queues are predicted which block adjacent junctions, as shown in Figure 6.20.

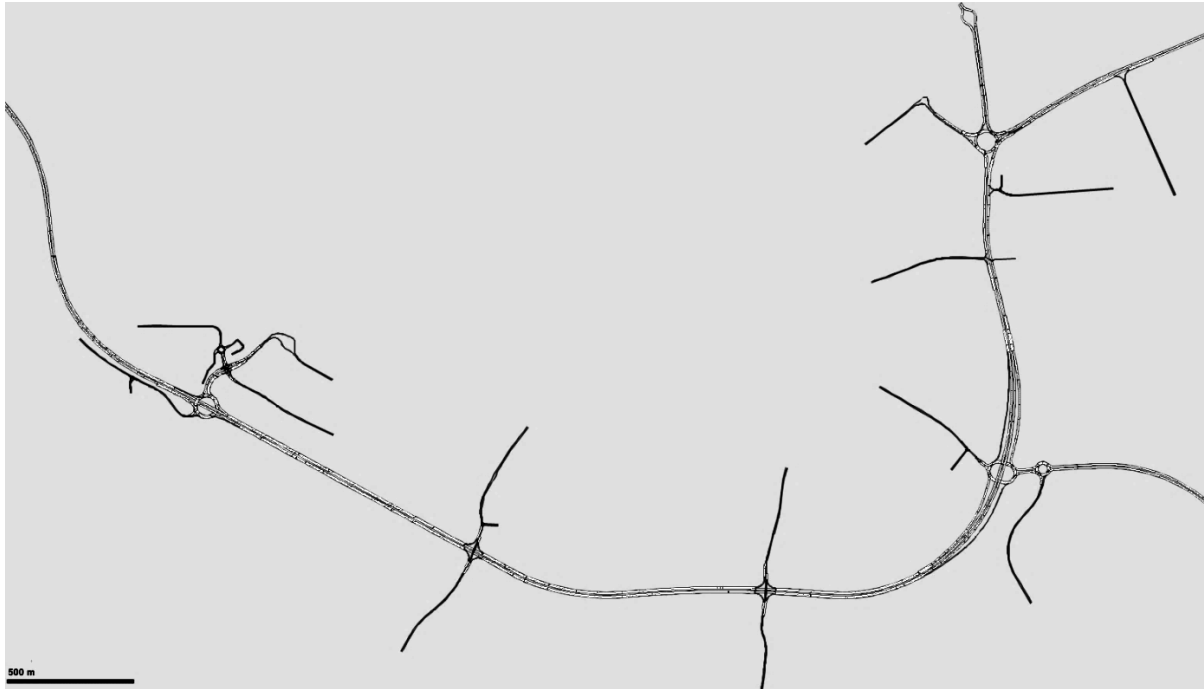
Figure 6.20: Option 3 – Bognor roundabout during the PM peak



6.1.6. Option 3A

The extent of this option model is shown below in Figure 6.21. The junction improvements are explained in detail in Sections 2 and 4.

Figure 6.21: Option 3A – Extent



Fishbourne Roundabout

As in Option 3, the Fishbourne roundabout is adapted to a 'hamburger' layout with the movement along the A27 cutting through the circulatory carriageway. A large number of arms and short distances between stop lines make signal optimisation of the junction challenging. During both the AM and PM 2035 peaks almost no traffic is able to arrive from Fishbourne Road West as the circulatory carriageway is usually blocked during the Fishbourne Road West green stage as shown in Figure 6.22.

Various measures could be applied in order to improve the performance such as:

- relocating the Fishbourne Road West approach further east;
- adding further lane flaring;
- removal of the signals on the A27 onslips so vehicles could freely leave the junction. This could lead to reduced blocking of the circulatory carriageway; and,
- increasing the number of lanes on the A27 within the junction.

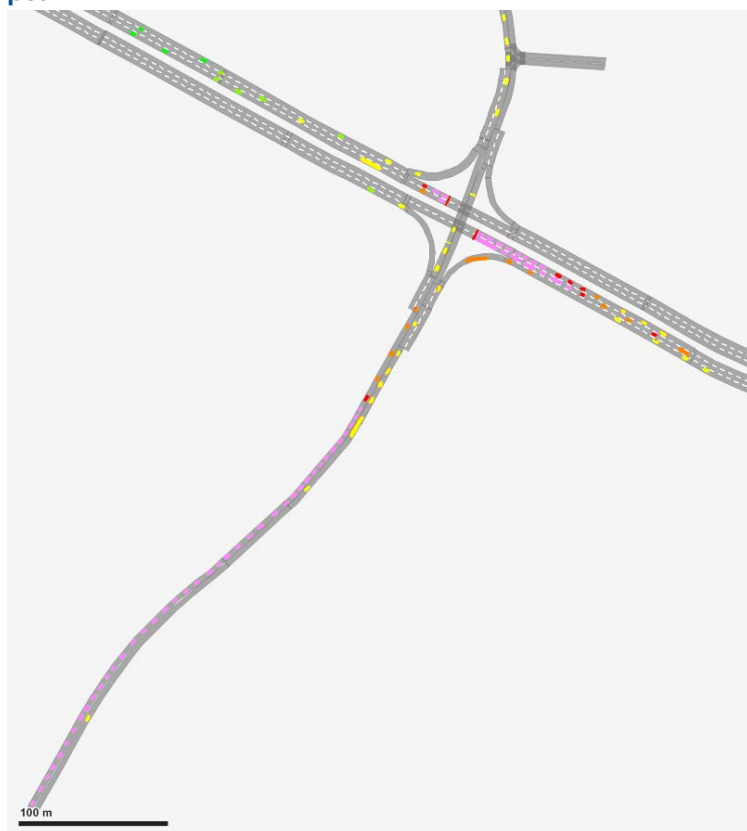
Figure 6.22: Option 3A – Fishbourne Roundabout during the AM peak



6.1.6.1. A286 Stockbridge Road / A27 Chichester Bypass junction

As in Option 1 and 1A, queuing is predicted by the VISSIM model in the northbound direction particularly in the AM peak as shown in Figure 6.23. Provision of two lanes in the northbound direction could reduce or eliminate queuing but due to the tight space constraints in this location this is unlikely to be feasible.

Figure 6.23: Option 3A – A286 Stockbridge Rd / A27 Chichester Bypass junction during the AM peak

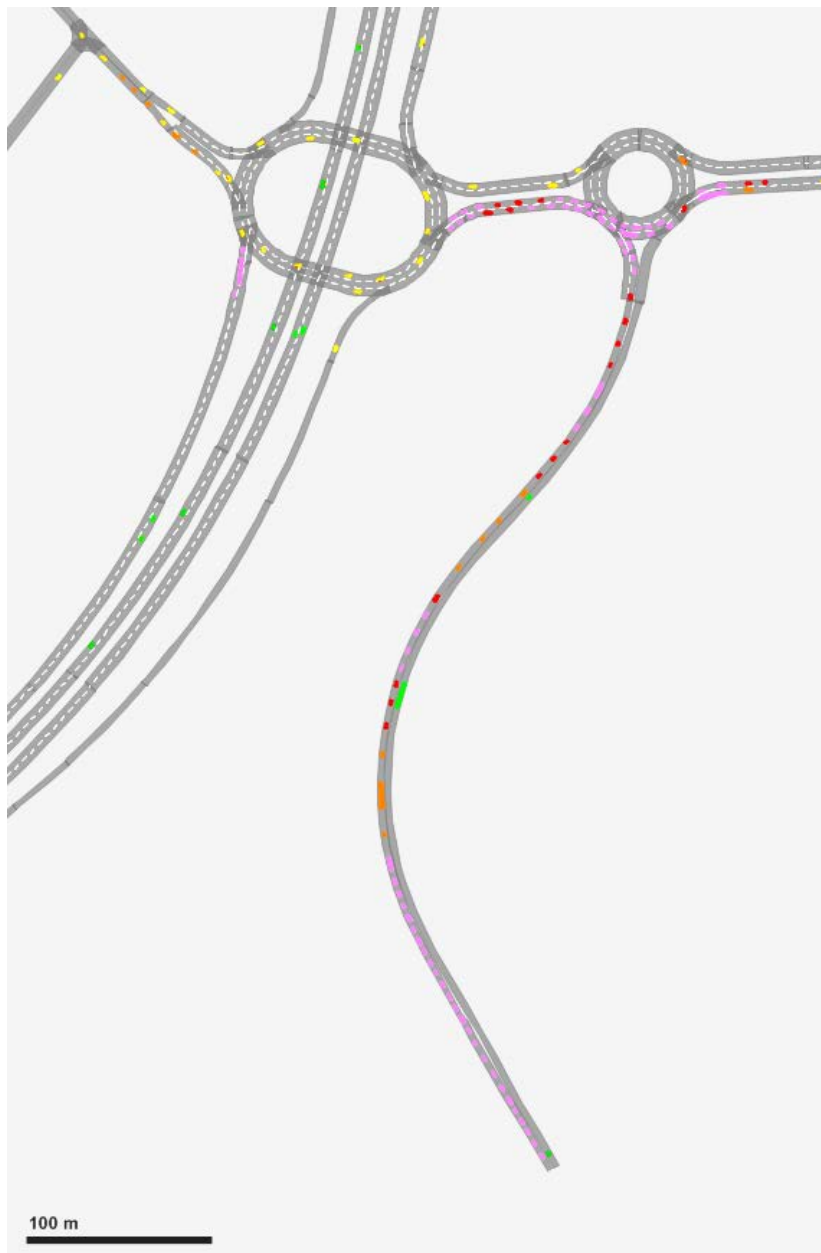


6.1.6.2. Bognor Roundabout

Enlargement of the Bognor Roundabout and provision of the flyover significantly improves junction operation. However, residual AM peak queuing on the on the westbound approach remains in this option, which extends to Vinnetrow Road, as shown in Figure 6.24. In the PM peak, queues develop on the northbound approach (from the off-slip) to the junction.

Relatively minor improvements such as provision of additional lanes and/or signalisation of the roundabout or repositioning of the Vinnetrow Roundabout further east on Bognor Road could reduce or eliminate queuing.

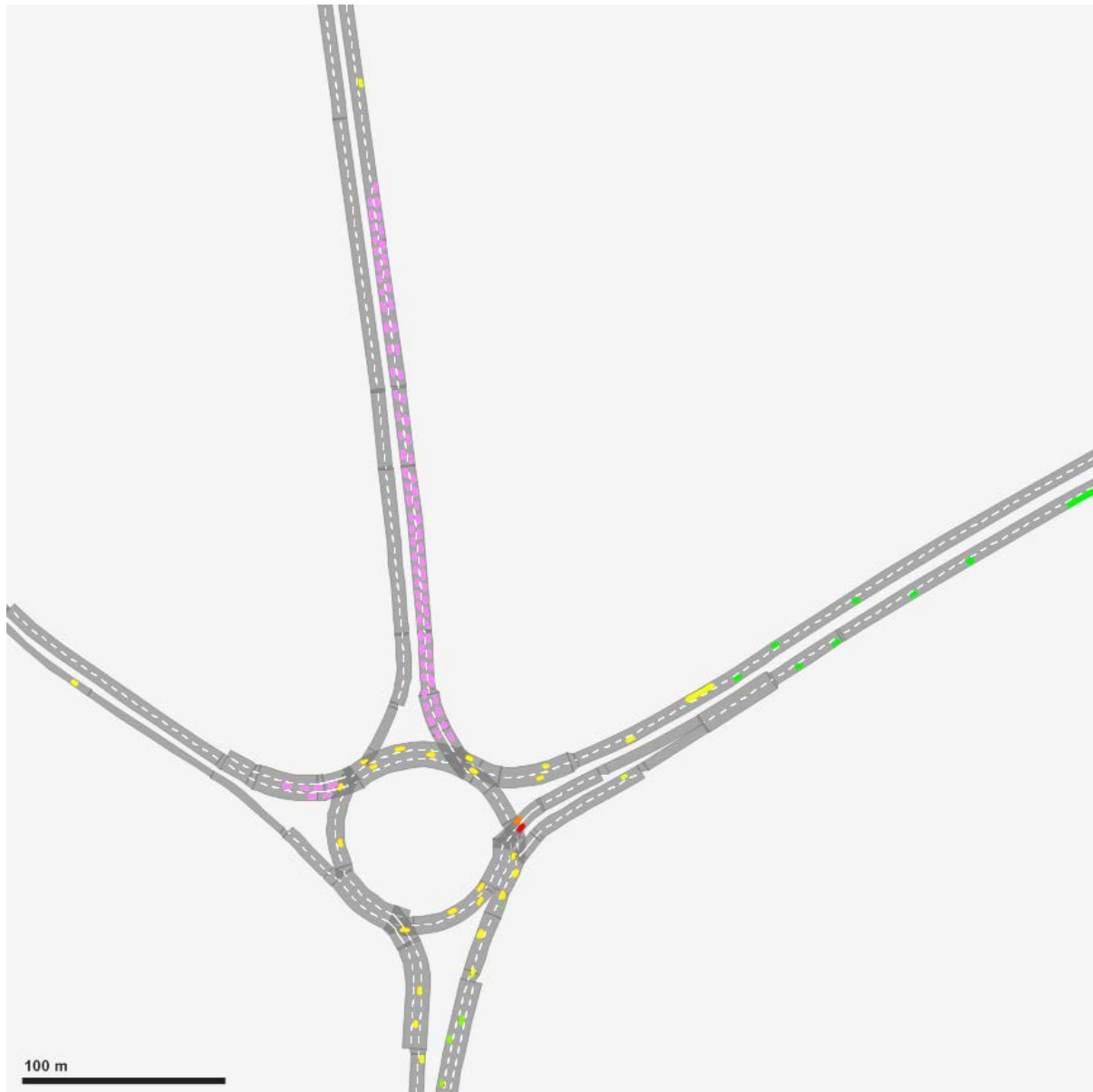
Figure 6.24: Option 3A – Bognor Roundabout during the AM peak



6.1.6.3. Portfield Roundabout

In Option 3A, some queuing is predicted on the southbound approach during the 2035 PM peak as shown in Figure 6.25. This queue could be reduced or eliminated by the roundabout widening or signalisation.

Figure 6.25: Option 3A - Portfield Roundabout during the PM peak



6.1.7. Options Performance Summary

The summary of junctions exceeding their design capacity in 2035, and so causing queuing in each option, is shown in Table 6.2. The peak period where capacity is exceeded is identified within the table.

Table 6.2: Junctions exceeding capacity in 2035

Junction	Option 1	Option 1A	Option 2	Option 3	Option 3A
A259 Cathedral Way / Fishbourne Rd E	AM	AM	AM		
Fishbourne Roundabout				AM	AM
A286 Stockbridge Road / A27	AM	AM			AM
B2145 / A27	PM	PM			
Bognor Road Roundabout	PM			AM + PM	AM + PM
Portfield Roundabout	AM + PM	AM + PM	AM + PM		PM
Link Road / A286 Birdham Roundabout			AM + PM		
New Link / B2145 / B2166 Roundabout			PM		

Table 6.2 shows that at this stage in the process all of the options have some problems with capacity at junctions and the selection of the Preferred Route needs to recognise those. Many options have commonalities in junction design so often the same problem occurs across various options. It should be noted that at this stage the junction designs assessed have not been optimised for the traffic flows, so could improve in the following stages as the Preferred Route is further developed.

It may be beneficial to combine the best improved features of the individual options into one which performs well across all of the junctions. For example, the Option 3A design at A259 Cathedral Way / Fishbourne Road E junction could be applied in Option 1, 1A and 2 in order to improve their performance.

6.2. Road Safety Audit

A Road Safety Audit (report no. 264223IW/ITD/ITQ/213) was conducted for each of the options in accordance with the CIHT Road Safety Audit Guidelines and the principles outlined in Highways England departmental standard HD 19/15 (as RSA Stage 0 is not a requirement under Highways England standards at this stage in design). A number of safety concerns were raised in this audit, which will require further development in Stage 3.

6.2.1. Non Motorised Users (NMU's)

The RSA also covered aspects related to Non Motorised Users including cyclists, pedestrians and equestrians. This element of the audit was informed by an NMUs Survey carried out in Autumn 2014. The findings listed in the RSA pertinent to the NMUs provisions and functionality should also be considered further for the Preferred Option in Stage 3.

A summary of the key road safety implications is provided in **Error! Not a valid bookmark self-reference.** below.

Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Table 6.3: Summary of potential safety implications for proposed options

Issue	Description	Option Impacted				
		1	1A	2	3	3A
NMU Provision	No continuous segregated NMU route is provided along the proposed scheme. This means that cyclists on the A27 main carriageway are more susceptible to conflict with merging/diverging traffic at Stockbridge and Whyke junctions where segregated left-turn lanes are provided.	X			X	X
Banned right turns	Traffic from the south will be unable to connect with the A27 eastbound at Stockbridge and Whyke junctions due to right turns not being permitted. This is likely to result in an increase in traffic finding alternative eastbound routes on the local road network. These routes may not be appropriate for increased levels of traffic.	X			X	X
Stockbridge and Whyke overbridges	Proposed overbridges at Stockbridge and Whyke junctions will have crest curves which are 'one step below desirable minimum'. These curves are likely to result in an inadequate Stopping Sight Distance between vehicles travelling over the crest, and those stopping for, or pulling out from, side road junctions. This may result in an increase of shunt type collisions and/or late braking accidents. Grade separation of these junctions is also likely to result in higher traffic speeds.			X		
At grade signalised junctions	Where at-grade signalised junctions are proposed at Stockbridge and Whyke there is the potential for collisions relating to higher approach speeds.	X			X	X
Increase in A27 vehicle speeds	Grade separation of traffic over the A27 at Stockbridge and Whyke junctions is likely to result in higher traffic speeds along the A27 and Stockbridge Road and Whyke Road respectively. The alignment of the A27 to the west of these junctions is not suitable for increased traffic speeds. Therefore, there may be an increase in loss of control or vehicle run off (leaving the carriageway) accidents.			X		
At grade signalised Bognor junction	It is expected that the internal stop lines on the signalised Bognor roundabout circulatory carriageway are unlikely to provide adequate vehicle stacking / storage capacity, resulting in traffic blocking back across the adjacent entry arms. This may increase the risk of collisions on the roundabout.				X	
Grade separated junctions	The introduction of a grade separated junction at the Fishbourne will mean Stockbridge junction will be the first junction where eastbound traffic will be required to stop. It is anticipated that traffic speeds on this eastbound approach will be higher, and therefore there is an increased risk of sudden braking / nose to tail, shunt type accidents.	X	X			
Access to properties	Segregated left-turn lanes and on all arms of the Stockbridge and Whyke junctions is expected to result in a significant collision risk between vehicles accessing properties and free flowing traffic using the segregated left turn lanes.	X			X	X
Through-about / 'Hamburger' junction	Traffic signals in the 'hamburger' arrangement at Fishbourne junction, have the potential to result in nose-to-tail (shunt) type accidents. This is of particular concern on the A27 eastbound approach because this junction is the first encountered by vehicles from the Emsworth junction, therefore vehicles will be approaching at high speeds.				X	X
Through-about / 'Hamburger' junction	Depending on traffic signal phasing at Fishbourne junction, there is potential for circulatory traffic to block Lane 1 of the Eastbound A27. This may result in collisions between stationary/queuing traffic, and those approaching at high speed.				X	X

7. Technology and Maintenance Assessment

7.1. Technology Assessment

At present there are no technology assets identified on Chichester Bypass apart from traffic counting loops.

In general, all the options have similar implications on the requirement for additional road side technology as provision of systems such as Variable Message Signs (VMS) on an All Purpose Truck Roads such as the A27 and would require Highways England's approval. Also not all options considered in the Stage 2 may be suitable for an upgrade to such technology systems.

While as indicated by Area 4 Maintaining Agent Contractor, VMS would improve the Bypass adaptability under traffic management conditions and ease of conveying messages to road users from a remote location, reducing the risk to road workers and road users, a comprehensive review of the costs related to implementing this technology would be required. This should also include the viability of installing a National Roads Telecommunications Service (NRTS) network on the Bypass connected to existing similar regional facilities, with the A3M being the nearest NRTS connectivity at present.

The role of technology on the Bypass should therefore form part of a review in Stage 3 for the Preferred Option taken forward.

7.2. Maintenance Assessment

Through consultation with the Area 4 Managing Agent Contractor, the current maintenance issues within the existing scheme extent were identified and discussed in relation to the proposed options. The main aspect identified was flooding of main carriageway. These are outlined below:

- limited formal maintenance laybys for operatives use only;
- limited opportunities for safe access to roadside features such as lighting equipment, signs and traffic signals;
- reduced resilience in the network, including adjacent side roads for appropriate diversion routes during planned maintenance interventions or emergency responses;
- extensive soft estate alongside carriageway requiring frequent maintenance with exposure to live traffic hazards;
- difficult access to drainage systems, primarily in central reserve. This is key for maintaining recent flooding remediation drainage works;

- limited temporary traffic management solutions with impact on road users and residents.

Key to improving the maintainability of the route is addressing the concerns raised by the Area 4 representatives in the next stage of design for the Preferred Option, as well as ensuring that features in the design do not create any further maintenance issues.

In summary, the maintenance implications of all the options are largely similar. Because the options are essentially online upgrades along the existing Bypass corridor, the improvements that can be made to the maintainability of the road are constrained. However, larger improvements can be made in Option 2 due to the new offline Stockbridge Link Road section. In all options the maintainability of the A27 can initially be improved by:

- better access to roadside features;
- providing maintenance laybys at suitable locations throughout the scheme, ideally on each link;
- setting up cross-over points for contraflow operation to aid in temporary traffic management;
- in the long-term, investigating the possibility of installing permanent VMS subject to a comprehensive technology review of the A27 corridor and associated costs. Acceptability of such technology on a Trunk Road would also need to be investigated and its suitability for the selected Preferred Route. These would reduce the risk to operatives in setting up any traffic management, or to warn users of incidents ahead. These can also be used to inform road users of any seasonal changes in traffic due to touristic activities or local events.

Additionally, as part of the improvement works, the vegetation could be cut back, providing a wider verge for operatives to work in, minimising the risk of vegetation impacting the performance of the safety barrier and improving sight lines along the route and to features such as sign faces.

Although many of the maintenance implications are common for all options, the more significant impacts have been summarised in Table 7.1. It must be noted that this table is for comparison purposes only, and as such any implications which are relevant to all options have been omitted. For a full assessment of how maintenance will be impacted by each option, please refer to the Maintenance and Repair Strategy Statement (343538-90-100-RE-003 Revision 01).

Table 7.1 Summary of potential maintenance implications for proposed options

Asset	Description of Implication	Option Impacted				
		1	1A	2	3	3A
Structures	Large new flyover structures at grade separated junctions will introduce a significant additional maintainable asset.	X	X	X		X
Structures	The railway bridge will be renewed as part of the Bognor junction grade separation. This will extend its life far beyond its current approximately 44 year residual life.	X	X	X		X

Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Asset	Description of Implication	Option Impacted				
		1	1A	2	3	3A
New Link Road	The new link road introduces additional network length which will require maintenance.			X		
New Link Road	The new offline link road provides the ability to design the carriageway to a modern standard and offers far more scope to improve maintainability of this link.			X		
Traffic Signals	Traffic signals will be introduced at Stockbridge and Whyke junctions. This will increase maintenance requirements.	X			X	X
Traffic Signals	Traffic signals will be introduced to control Bognor junction. This will add additional maintenance requirements.				X	
Traffic Signals	Fishbourne roundabout will become signal controlled, with the A27 passing through the centre. The introduction of traffic signals will increase the maintenance requirements.				X	X
Traffic Management	Grade separated junction designs offer the ability to close the mainline with relative ease. Traffic can be diverted around the roundabout below.	X	X	X		X
Traffic Management	The Stockbridge Link Road offers a diversion route for the A27 from Fishbourne to Bognor, or the alternate direction, permitting the road to be closed without diverting traffic through Chichester.			X		
Traffic Management	There is no alternative route other than through the centre of Chichester during maintenance.	X	X		X	X
Traffic Management	Banning right turns at Stockbridge and Whyke may increase the length of diversion routes.	X			X	X
Winter Maintenance	Gritting routes will be impacted by removing the ability to turn right or turn around at Stockbridge or Whyke junctions.	X			X	X
Winter Maintenance	Removing access to the A27 at Stockbridge and Whyke will impact winter maintenance routes.			X		
Winter Maintenance	New structures may introduce vertical barriers which cause snow to stack against them, making it difficult to clear heavy snow. Equally, the grade separated junctions may pose a concern during snow clearance on bridges.	X	X	X		X
Winter Maintenance	A footpath runs alongside the westbound carriageway between Stockbridge and Whyke verge which may be covered during the clearance of snow, especially in Option 3A where widening of the carriageway is proposed presenting a potential hazard for injuries.					X
Winter Maintenance	Off slips and on-slips will be introduced at grade separated junctions. This will increase the length and complexity of gritting routes.	X	X	X		X
Winter Maintenance	Dedicated left turn lanes at the signalised Stockbridge and Whyke junctions will increase the length and complexity of gritting routes.	X			X	X

8. Environmental Assessment and Environmental Design

This section summarises the results of the environmental assessment of the options considering their performance when in operation. More detail can be found in the Environmental Study Report.

8.1. Air Quality

During operation for Option 1, Option 3 and Option 3A, there is one receptor where the annual NO₂ objective is currently exceeded which would experience a deterioration in air quality, although there would be other properties which currently exceed the NO₂ objective where there would be an improvement in air quality. There would be several receptors in St Pancras AQMA which would experience an improvement in air quality, although Options 1, 3 and 3A would not bring the St Pancras AQMA within the air quality objective limits. During operation for Option 1A, there would be several receptors in the Stockbridge AQMA which would experience a deterioration in air quality as a result of this option, and where the annual NO₂ objective would be exceeded. However, this would be limited to receptors adjacent to Stockbridge Roundabout, and a single receptor immediately adjacent to the A27. There would be several receptors in St Pancras AQMA which would experience a benefit in air quality although Option 1A would not bring the St Pancras AQMA within the air quality objective limits.

During operation for Option 2, air quality effects would be beneficial overall. There would be no receptors which experience a deterioration in air quality where the annual NO₂ objective is exceeded, and there would be one receptor within the Stockbridge AQMA that currently exceeds the annual NO₂ objective, that would be brought within the NO₂ objective. There are likely to be several receptors in St Pancras AQMA which would experience an improvement in air quality where the annual NO₂ objective is exceeded, although Option 2 would not bring the St Pancras AQMA within the air quality objective limits.

Air quality effects would therefore be beneficial overall for all but Option 1A, which would have an overall adverse effect, but all effects are unlikely to be considered significant due to the small numbers of receptors affected. Air quality effects would be beneficial overall for all options at St Pancras AQMA.

A summary of air quality effects for all options is presented in **Error! Reference source not found.**

Table 8.1: Air Quality Effects of the Options

Receptor	Change in NO ₂ (DM to DS) (µg/m ³)				
	Option 1	Option 1A	Option 2	Option 3	Option 3A
R2 (St Pancras AQMA)	-3.6	-1.9	-4.6	-2.6	-3.3
R17	*	1.6	*	*	*
R18 (Stockbridge AQMA)	-8.4	1.0	-14.3	-10.0	-7.9
R19 (Stockbridge AQMA)	3.6	4.6	**	-0.9	3.7

* No exceedance of NO₂ objective, therefore not reported.

** Receptor would be demolished under Option 2, therefore not reported.

8.2. Cultural Heritage

All of the options, with the exception of Option 3, have the potential to result in significant adverse effects upon historic environment receptors during construction, with adverse effects anticipated on the setting of designated assets, buried archaeological remains within the construction area, and the historic setting of the local area.

During operation for Option 1, there would be a moderate adverse effect on Fishbourne and Chichester Conservation Areas, and the setting of five Grade II Listed buildings. For Option 1A, there would be a moderate adverse effect on Fishbourne and Chichester Conservation Areas, and the setting of four Grade II Listed buildings during operation. For Option 2, there would be a major adverse effect on a Grade II Listed building, as the realignment of Stockbridge Road under Option 2 would require the demolition of this designated asset. There would also be a moderate adverse effect on Fishbourne and Chichester Conservation Areas, and the setting of five Grade II Listed buildings during operation of Option 2. For Option 3, there would be no significant effects on cultural heritage assets during operation, due to the scale of the works proposed. For 3A, there would be a moderate adverse effect on Chichester Conservation Area during operation.

8.3. Landscape

Construction of all options would see new elements within the landscape/townscape. The presence of machinery, plant, earthworks and general construction activity would be at odds with the existing environment to varying degrees, however intervening vegetation may help to enclose areas of the work from the wider area. This would be more notable within the more rural agricultural scene to the south of the A27 where the Stockbridge Link Road (a component of Option 2) would be located, as this landscape has little development in comparison with the urban fringe of Chichester. Construction within, and immediately adjacent to, the existing A27 corridor would bring new elements to the townscape, including areas in close proximity to Fishbourne and Chichester Conservation Areas and Chichester Harbour AONB. The change would be set within the context of the heavily trafficked A27 and associated highway infrastructure, but there would still be temporary significant adverse effects during construction for all options.

**A27 Chichester Bypass
Scheme Assessment Report**

During the operational phase of the Scheme, effects where at-grade junctions are proposed would be minimal during operation, so for Option 3 the landscape/townscape would essentially remain unchanged and a neutral effect is anticipated. However, all other options would have potentially significant effects, from grade-separated junctions at Bognor and particularly at Fishbourne Junction, due to the proximity of the grade-separated junction as part of Options 1, 1A and 2 to the Fishbourne Conservation Area and Chichester Harbour Conservancy AONB. There would also be potentially significant effects from the widening of the existing A27 to three lanes between Fishbourne and Bognor proposed for Option 3A.

8.4. Nature Conservation

It is anticipated that following the implementation of recommended mitigation measures, there would not be a direct or indirect effect during construction or operation on the majority of designated sites within the study area, namely Solent Maritime SAC, Chichester and Langstone Harbours SPA and Ramsar, Chichester Harbour SSSI, River Lavant SNCI, River Lavant Marsh SNCI, River Lavant SNCI, Chichester Canal SNCI, Hunston Copse SNCI or Fishbourne Conservation Area. However, Options 1 and 2 are anticipated to have a slight adverse effect on Chichester Gravel Pits and Leythorne Meadow SNCI due to the effect on potential protected species associated with the designation. Options 1, 1A and 2 would also have a slight adverse effect on the Fishbourne Meadows SNCI, as the relocation of the A259 at Fishbourne junction would slightly encroach into the designated site.

All Scheme options would result in temporary and permanent loss and severance of Priority Habitats, including hedgerows, lowland mixed deciduous woodland and ponds. Furthermore, there would be temporary habitat loss in order to facilitate works, although mitigation in the form of replacement planting would be undertaken in accordance with the National Planning Policy Statement (NPPF) to compensate for the loss of priority habitat. Although habitat loss accounts for a small proportion of each designation within Chichester Gravel Pits and Leythorne Meadow SNCI, Fishbourne SNCI and Fishbourne Conservation Area, the presence and density of potential protected species associated with the designations is unknown.

8.5. Geology and Soils

During construction, all options have the potential to result in significant adverse effects upon geology and soils, resulting from potentially contaminated land and construction processes. There could be large adverse effects on groundwater from the mobilisation of previously unidentified contaminated material, and moderate adverse effects could result from physical removal and degradation of soils. However, the operational Scheme is not expected to result in any adverse effects for geology and soils, as the drainage design for the preferred option would keep all surface water runoff, and therefore potential sources of pollution, away from the groundwater and soils.

8.6. Materials

Effects are anticipated for all options due to waste arisings, such as quantities of spoil from piling, timber shuttering, and removal of existing steel safety barriers. Cut and fill material may also result in a significant effect for all options. Effects associated with materials during

the operation of any of the proposed options are not anticipated. Materials, waste arisings and transportation during construction all produce carbon dioxide either directly, as in the case of transportation, or indirectly as embodied carbon of the materials used.

All the scheme options have the potential to require significant quantities of materials for use, as well as the potential to generate significant quantities of waste. This would be particularly the case for options that introduce grade-separated junctions, namely Options 1, 1A, 2 and 3A where significant quantity of materials would need to be imported, especially for the proposed elevated sections. The new SLR in Option 2 would also fall in the same category. Option 3, due to its nature, would not present same challenges as all the junctions are retained at the ground level at all locations. However, use of artificial materials for the elevated sections, such as polystyrene blocks and other lightweight materials, should be investigated in Stage 3 for the Preferred Option if required.

8.7. Noise and Vibration

There is potential for construction activities to generate significant effects, and mitigation would be a necessity at some locations. With suitable mitigation, the likelihood of significant effects due to construction will be reduced; however, this cannot be fully determined until a construction method statement becomes available in Stage 3 of the scheme's development. Mitigation measures during construction may comprise shielding of noisy items of plant, appropriate siting of haul routes, enclosures, screening and monitoring.

During operation, the likelihood and occurrence of significant effects will depend on the balance between changing traffic flows on existing roads, new traffic noise sources on new or improved sections of road, and the level of mitigation designed into the preferred option. Based on preliminary mitigation assumptions, and comparing Do Minimum and Do Scheme traffic flows in the Year of Opening, there would be an overall reduction in significant effects with Options 1, 1A, 2, and 3A, and an overall negligible change in significant effects with Option 3. Improvements for all options may be possible as the design progresses through the implementation of mitigation measures such as noise barriers or thin course road surfacing.

The South Downs National Park would remain unaffected by all Scheme options. The nearest parts of the Chichester Harbour Conservancy AONB would potentially be affected by small increases in noise with Option 2.

8.8. Effects on All Travellers

During construction, a high level of driver stress is anticipated for vehicle travellers throughout the duration of works as well as Non-Motorised Users, due to the presence of traffic management. This is likely to be less significant for Option 3 due to its reduced duration of around 15 months and more intense for longer construction times such as in Options 2, estimated at a duration of 3 ½ years. However, this would be mitigated by measures such as appropriate phasing of works which should reduce traffic restrictions to minimum durations while working on each junction at the time. While requiring a longer duration to build, Option 2 can also be phased to reduce effects on travellers on the mainline. The SLR would also offer an alternative to traffic to be used as diversion route in Option 2,

minimising disruptions and increasing route choice during construction. In addition, the implementation of a Construction Environmental Management Plan (CEMP) would be employed for all options, therefore construction effects on vehicle travellers are considered to be not significant adverse.

During operation, effects on vehicle travellers are predicted to vary between the options, in accordance with predicted traffic flows. For all options, there would be a slight decrease in driver stress on the A27 with the scheme in place, although traffic on roads within 250m of the A27 (e.g. A286, Selsey Road and the B2166) would experience a larger decrease in driver stress under Option 2, which would reduce from high to moderate.

8.9. Community and Private Assets

During construction, effects on development land are anticipated as it is likely that there would be increased traffic during construction, particularly since the construction period for the A27 Chichester Bypass and the Shopwhyke and Tangmere developments overlap. This would be a slight adverse effect for all options. There would also be community severance effects due to temporary reduction in access to community facilities, although mitigation would be provided in the form of alternative access arrangements where appropriate. This would be a slight adverse effect for all options.

During operation, there would be effects due to the demolition and land acquisition of residential and business properties. Option 1 and 1A would cause the loss of five properties (three greenhouses, one barn and a disused warehouse) and Option 2 the loss of twenty properties (thirteen residential, three greenhouses, one barn, a disused warehouse and a garage). No properties would be lost as a result of Option 3 or Option 3A. There would be additional effects due to demolition and land acquisition during construction, but as the exact extent of construction works and compounds is not known at this stage, it has not been possible to assess this.

There would be an overall slight beneficial effect on development land during operation for all options, as the Scheme has the potential to reduce journey times to the proposed strategic developments sites. The effect on agricultural land would be moderate adverse Options 1, 1A, 2 and 3A due to the classification and area of land that would be lost. Option 3 would be no change due to the much smaller agricultural land take required.

8.10. Road Drainage and the Water Environment

With the inclusion of standard mitigation measures, through the CEMP, and the use of Sustainable Drainage Systems (SUDS) to attenuate surface water run-off and provide treatment, there are no significant effects anticipated on water quality as a result of the construction or operation of all the proposed options. However, the proposed grade-separation of Bognor junction as part of Options 1, 1A, 2 and 3A would result in the loss of an area of Leythorne Lake, which would be a moderate adverse effect.

An initial flood risk appraisal showed that fluvial and groundwater flooding are considered the greatest risks to the Chichester area. The majority of the options would maintain existing flood flow paths and therefore the risk of affecting flood risk would be low. However even

minor changes to ground levels have the potential to affect flood risk, and therefore the Preferred Option would be investigated through detailed hydraulic modelling using final design dimensions. The Stockbridge Link Road, part of Option 2, could also affect the flood extent and flood levels, although this could be mitigated using an open span bridge for the main river channel, with additional culvert(s) to maintain the existing flood flow paths to ensure flood risk is not increased, in the event that this becomes the Preferred Option.

The assessment of groundwater flood risk shows that Fishbourne and Stockbridge junctions are located in a Groundwater Emergence Zone and therefore are at risk of groundwater flooding. All options would require some degree of excavation and therefore there is potential to affect sub-surface flow paths, which could result in ground water emergence upstream of the carriageway. Surface flow paths would be maintained to minimise effects on ground water flows, should they emerge.

A preliminary Water Framework Directive (WFD) assessment concluded that there is the potential for all the options to affect the waterbody status, through the inclusion of culverts and potential channel realignment. In addition, the underlying Chichester Chalk groundwater could be affected by a number of the scheme elements.

8.11. Combined and Cumulative Effects

During construction, the combined effects would, on balance, be significant adverse for Options 2, and 3A, largely due to significant adverse effects predicted for landscape character and historic setting, cultural features, the water environment and ecological receptors as a result of works outside existing footprint for SLR in Option 2 or the third lane along the mainline between Fishbourne and Bognor in Option 3A. However, a combined non-significant adverse effect is anticipated for Options 1, 1A and 3, as these do not introduce new components such as the SLR or an extra lane on the mainline, outside the existing highways boundary.

Once operational, Options 1, 1A and 3 would have, on balance, non-significant adverse effects as vast majority of proposed amendments would be contained to the existing highways boundary with appropriate mitigations, albeit containing intrusive elements at the elevated sections, with the exception of Option 3. However, a significant adverse effect would be anticipated for Option 2 and 3A, largely as a result of significant adverse effects predicted for landscape, cultural features and ecology introduced as a result of the new SLR in option 2 or the additional lane along the Bypass in Option 3A.

During construction, the potential temporary cumulative effects would, on balance, be non-significant adverse for Options 1, 1A and 3, whilst a cumulative significant adverse effect would, on balance, be anticipated as a result of Options 2 and 3A. These cumulative adverse effects for Options 2 and 3A are due to the predicted adverse effects on ecology associated with these two options in conjunction with the proposed major developments, caused by effects to the Fishbourne Meadows SNCI and the Chichester Gravel Pits and Leythorne Meadow SNCI.

Permanent cumulative effects once operational would, on balance, be neutral for Options 1, 1A and 3, as beneficial effects associated with some of the proposed elements, in

conjunction with the proposed major developments combine with any adverse effects and lead to an overall cumulative neutral effect. Options 2 and 3A would be anticipated to have a cumulative non-significant adverse effect on balance during operation, due to the more adverse effects anticipated for landscape and ecology.

The overall significance of effect for each option during construction and operation is summarised in Appendix E.

8.12. Carbon Assessment

A High Level Carbon Assessment has been undertaken for each of the five options taken forward to Public Consultation using Mott MacDonald's Carbon Calculation Tool. The quantities and types of materials used in the calculation were extracted from the latest Stage 2 designs drawings. In the absence of specific information at this stage, assumptions were made based on the experience of previous similar projects.

The calculation of Green House Gas (GHG) emissions is primarily focussed on construction work only and does not include those emitted through the future operation of the scheme. Emissions generated through energy use such as fuel, electricity and transportation were also excluded at this stage due to the absence of information, as is normal for Stage 2.

A summary of the results obtained from the carbon calculation process is shown in Table 8.2 Table 8.2: Carbon Emission Summary below.

Table 8.2: Carbon Emission Summary

Options	Total Carbon Emission (tCO ₂ e)	Highest Carbon Emission by works	Highest Carbon Emission by Scope	Highest Carbon Emission by Material
Option 1	10,889.6	Pavement (50.2%)	Construction material (86.7%)	Aggregate (47%)
Option 1A	9814.2	Pavement (44.8%)	Construction material (85.9%)	Aggregate (42.4%)
Option 2	12887.2	Pavement (48.9%)	Construction material (87.6%)	Aggregate (45.9%)
Option 3	1863.9	Pavement (85.5%)	Construction material (94.7%)	Aggregate (74.7%)
Option 3A	7573.8	Pavement (60.5%)	Construction material (88.4%)	Aggregate (55.7%)

Further information can be found in the Carbon Calculation Report (343538-90-100-RE-005).

9. Public Consultation

The Public Consultation period ran from the 14th July 2016 to the 22nd September 2016 for a period of 10 weeks. During this time 16 public events were held across the Chichester area in addition to 3 events for Members and Officers of Local Authorities, Parishes and Key Stakeholders. Public events were held in the north, south, east, west and the centre of Chichester to provide all local communities with an opportunity to visit a suitable public exhibition from each side of the city and the surroundings. An additional event was held in Bognor Regis due to high levels of interest in the scheme from the area.

To publicise the consultation Highways England engaged a number of channels of communication. A letter of invitation to the exhibitions was sent to 55,500 households and businesses within the local and wider Chichester community, as well as updates to the Highways England, West Sussex County Council and Government websites. An early warning press release and a scheme media pack was also issued to the local print and radio media, and a full colour half page right hand side advert was placed in the Chichester Observer local newspaper. A poster campaign was used, displayed at 100 community hotspots identified by Chichester District Council's Community Engagement Officer. Throughout the consultation monthly newsletters were published that provided an update on the progress. These newsletters were distributed to key stakeholders as well as being published on the Highways England's A27 Chichester Bypass Improvement Scheme website.

The consultation material consisted of a consultation brochure and questionnaire, exhibition boards available to view at the events, and a number of technical reports available at exhibitions, with key documents being available on the Government consultation website. A 3D visual representation of what each option could look like in 2035 was also displayed at the exhibitions, as well as being available online.

9.1. Effectiveness of the Public Consultation

The public consultation process received a large number of responses. In total 5,388 visitors attended the public consultations and 4,869 respondents completed a questionnaire or provided a response via letter or email. This rate of response demonstrates the high level of local interest in the scheme. The Highways England A27 Chichester Bypass Improvement website recorded 20,740 unique page views, and the Government's A27 Chichester Bypass Improvement Scheme website recorded 16,908 unique page views.

9.2. Questionnaire Response Analysis

The questionnaire response indicated that 93% of respondents, considered that congestion was a problem on the A27 Chichester Bypass, with 2% not think it to be an issue and 5% not providing a response. 87% noted that they were concerned or very concerned about congestion on the bypass.

The most common comment received on the options presented was over accessibility, with over 1,900 comments received on the subject. These comments mainly focused on the

restriction of right turns at the Stockbridge and Whyke junctions, and the proposed modifications to the Oving Junction at the Shopwhyke Lakes development, which would close access from Oving East and remove traffic signals on the Oving Road. The only option to achieve positive comments on accessibility was Option 1A, where the existing Stockbridge and Whyke roundabouts are retained.

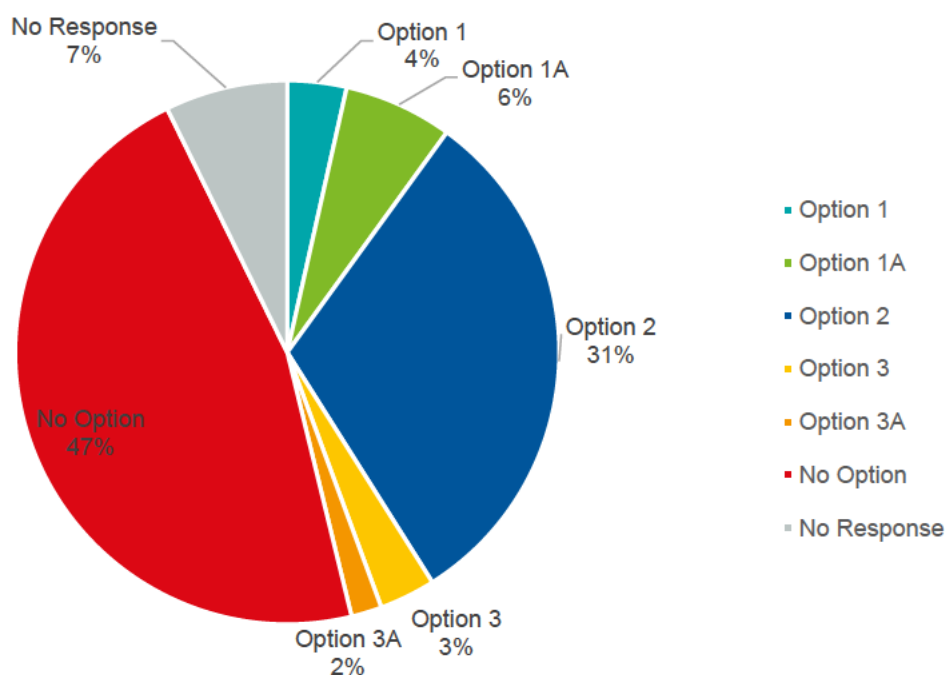
Another common topic for comments was on traffic lights. The majority of which were concerned with the operational aspects of the traffic lights, although a few recognised the benefits of traffic light controlled movement. These comments were mostly on Options 1, 3 and 3A, which convert the Stockbridge and Whyke junctions into traffic signal controlled cross-roads.

Option 2, includes the construction of a new link road and concerns were raised about the impacts on the environment, cultural heritage and landscape, although its overall benefits for traffic on the Bypass were recognised by a proportion of the responses.

When the responses were broken down by junction for all options, there was a significant number of concerns related to access at the Stockbridge and Whyke junctions, for options where these are presented with restricted movements or closed.

When asked to choose a Preferred Option, 47% of respondents chose not to select one of the five options and instead selected “No Option”. The next largest response was Option 2 with 31% of respondents selecting this option as their preferred option as shown in Figure 9.1 below.

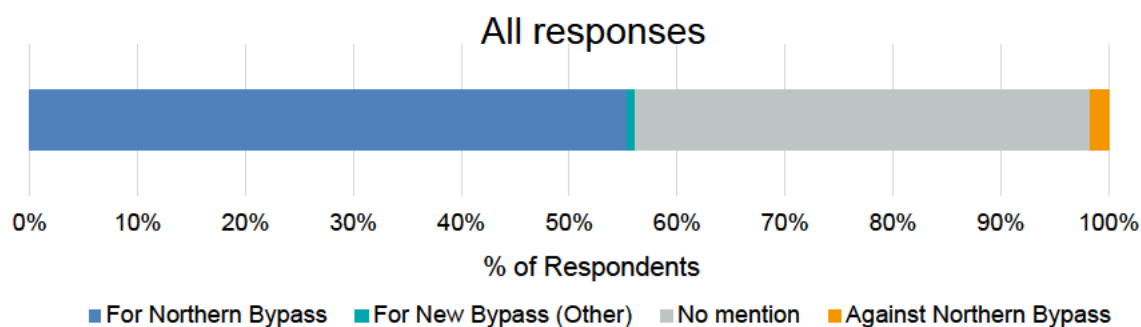
Figure 9.1: Public Consultation Response – Preferred Option



There was also a section for respondents to suggest alternative improvements, in which 56% of comments requested a completely new bypass to be implemented with a common

reference being made to the two options to the north of Chichester that had previously been discounted, while conversely 1.7% of respondents indicated that they will not favour a new bypass. This is illustrated in Figure 9.2 below

Figure 9.2: % of respondents that refer to a new bypass



Other alternative improvements indicated in responses were:

No's	Comments
141 Respondents	improvements should be made to public transport and cycle facilities
56 Respondents	indicate objection to restricting right turns at junctions
26 Respondents	there should be additional traffic lights
19 Respondents	there should be fewer traffic lights
213 Respondents	improvements should be made the Portfield Roundabout
42 respondents	introduction of speed limits
Other suggestions (less than 10 Respondents)	<ul style="list-style-type: none"> - consideration of holiday traffic - provision of acoustic barriers - suggestion of a toll to increase funding - concerns about congestion caused by level crossings

9.3. Summary of Responses from Local Organisations

50% of the Local Authorities and Parishes opted for 'No Option' or requested the reinstatement of the Northern Bypass options, while 33% were in favour of Option 2 with one indicating support for Option 1A. The remainder were not able to commit to one of the presented options at this stage.

56% of local businesses or business groups consulted were in favour of Option 2, while 19% were in favour of Option 3. The remainder requested the reinstatement of the Northern Bypass options or said that their preference was for "No Option".

9.4. Other factors concerning the Public Consultation

In the lead up to the Public Consultation and during it, there were five notable campaign groups established. "Chichester Deserves Better" ran a campaign against a Northern Bypass, Options 4 and 5, in conjunction with the local media. In response to this, there were

**A27 Chichester Bypass
Scheme Assessment Report**

two groups set up, “Best4Chichester” and “Chi Needs New Bypass” which both campaigned for a Northern Bypass route. “No Option is an Option” was established during the Public Consultation and was against all the proposed options, with some within the group for a Northern Bypass, and some for an alternative improvement or more integrated measures. “Chichester Moves On” also opposes all the options presented at the consultation, as well as a new bypass, instead wanting an integrated transport system.

Two petition groups emerged from the campaign groups which had conflicting objectives. The first was against the introduction of a Northern Bypass. The second group were asking for a Northern Bypass to be introduced. Each opposing group had about 4,000 signatories.

Please see the A27 Chichester Bypass Report on Public Consultation Ref: 343538-90-120-LF-003 for further details.

10. Appraisal Summary Table (AST)

The AST is a one page summary of the main economic, environmental and social impacts associated with each of the Stage 2 options and is presented in Appendix F.

11. Comparison of Options

Conclusion of Stage 2 of the development of a scheme is selection of a Preferred Option. This section sets out the process of comparison that has been undertaken during Stage 2 to support the decision making process.

Stage 1 concluded with the selection of 6 options to take forward for development and more detailed assessment in Stage 2. These options are described in Section 4 of this report. In addition to these options three further sub-options were developed to test the impact / features of the online options taken through. These sub-options (Options 1A, 2A and 3A) are also described in Section 4.

11.1. Intermediate Assessment

Highways England's Investment Decision Committee (IDC) undertook an intermediate assessment of the viability of the options in early 2016. This assessment considered the options on affordability grounds against the budget set for the scheme in the Road Investment Strategy of between £100M and £250M. The cost estimates provided by Benchmark at the time of the review are shown below:

Option	Option 1	Option 2	Option 2A	Option 3	Option 4	Option 5	Option 6
Cost Estimate	£167M	£251M	£242M	£41M	£332M	£307M	£583M

From this analysis, IDC concluded that Options 4, 5 and 6 were unaffordable and should not be continued to be developed and assessed.

At the same time the analysis of Option 2A compared to Option 2 showed that Option 2A performed less well than Option 2. It was therefore decided not to pursue Option 2A further.

Option	Option 2	Option 2A
BCR	2.66	1.7

IDC also asked for two additional options to be developed to provide a more detailed understanding of where the benefits in the scheme were accrued. From this, Option 1A was developed to determine whether the signalisation of Stockbridge and Whyke and the limited movements significantly contributed to the benefits of Option 1 and similarly whether the closure of these junctions and the SLR contributed to the benefits of Option 2. This would also help to understand whether an option that retained these movements would be more popular than one that closed them. For Option 3 the traffic analysis showed that the Bognor Road junction would be over-capacity in the Design Year and so Option 3A was developed to determine whether a resolution of this issue would significantly contribute to the benefits of Option 3. This would also allow the acceptability of these larger junctions on the urban fringe of Chichester to be tested in the public consultation by comparing the responses to Option 3 and Option 3A.

Therefore Options 1, 1A, 2, 3A and 3A were developed further with cost estimates updated as they evolved, taken to public consultation and form part of this final appraisal of the options.

11.2. Appraisal Methodology

The Design Manual for Roads and Bridges sets out the approach to be used in appraising options (DMRB, Volume 5, Part 4, TA30/82 'Choice Between Options For Trunk Road Schemes'). The approach in TA 30/82 adopts an Appraisal Framework that focuses on the differences in economic, social, and environmental factors of each route / option. Since this Advice Note was issued the Department for Transport introduced the Appraisal Summary Tables (AST's) through the Transport Analysis Guidance (TAG) to summarise the effects of transport options. As such, the AST's have been used as the Appraisal Framework to compare the five options.

The process for assessing the relative merits of the options is undertaken as a series of pairwise comparisons of the options with each comparison eliminating the poorer performing option. The process is repeated until one option remains.

The comparison exercise for each option as per this methodology is presented in Appendix G in the form of a Red, Amber, Green (RAG) Analysis for all five options. This table is however merely a summary of the impacts in the AST's for ease of reference and does not replace the original AST's included in Appendix F to which full reference was made throughout this exercise.

The comparisons are summarised in the following sections. The Options are described on Section 4.5 of this report.

11.2.1. Comparison 1: Option 1 with Option 1A

The key advantages of each are presented in Table 11.1.

Table 11.1: Advantages of Option 1 and Option 1A Advantages

Key Advantages of Option 1	Key Advantages of Option 1A
Increased benefits due to better journey time reliability for business users and transport providers in the study area.	Reduced Green House Gases (GHG) emissions due to either shorter distances travelled or changes in speed profiles.
Greater benefits in Air Quality with no exceedance of the NO ₂ or PM ₁₀ air quality limit values.	Improved safety benefits due to a decrease of -0.4% in accidents across the study area.
Improved journey time reliability for commuting and other users.	Reduced construction duration (23 months)
Marginally greater Benefit to Cost Ratio (BCR).	Reduced capital cost at approx. £140M towards the lower range of the RIS budget.

11.2.2. Summary of Comparison

Option 1 provides around one and half minute additional savings in journey times than Option 1A on the A27 in average between AM and PM peak and an average of 20 seconds

**A27 Chichester Bypass
Scheme Assessment Report**

across other key routes⁹ in the study area. The journey time saving and journey reliability benefit of Option 1 are due to the increased scope of works at Stockbridge and Whyke which do not feature in Option 1A. The reduction in journey time does however, result in overall longer journey distances and higher Vehicle Operating Costs (VOC). The increased scope of works in Option 1 also increases the construction and future maintenance delays.

Environmental benefits tend to be similar amongst both options, Option 1 adds more benefit to air quality improvements, while Option 1A adds more benefit to noise reductions. Option 1A also has more reduction in GHG emissions due to the smaller changes in speed profile. Both options require the demolition of five properties.

In terms of safety, Option 1A provides a greater reduction in accidents with an overall decrease of 0.4% across the study area over the 60-year appraisal period. Option 1 increases accidents by 2% with an associated cost of £8.5M.

The result of the Public Consultation shows that Option 1A was marginally favoured with 6% of supportive responses compared to 4% for Option 1. The construction cost of Option 1 is approximately £40.0M greater than Option 1A. However, the Benefit to Cost Ratios are very similar with a small margin in favour of Option 1 at 2.55 compared to 2.49. In terms of DfT's Value for Money assessment, both options represent 'high value for money'.

11.2.3. Comparison 1 Result

The balance of economic benefits appears to lie in favour of Option 1. However, these benefits are offset by the predicted increase in accidents across the study area by 2%. For this reason, Option 1A is considered marginally preferred to Option 1 and is taken forward in the appraisal. Refer to Appendix G for a visual comparison between these two options.

11.2.4. Comparison 2: Option 1A with Option 2

The key advantages of each are presented in Table 11.2.

⁹ key route: journey times between fixed points on the existing A27 and other five routes that pass through Chichester via junctions on the Bypass, are reported on in the Traffic Forecast Report, Section 6.13 between the 2035 Design Year do Minimum and do Something scenarios.

Table 11.2: Advantages of Option 1A and Option 2

Key Advantages of Option 1A	Key Advantages of Option 2
Reduced GHG emissions due to the shorter distances travelled.	Significant benefits for business users from the improvement of the junctions through reduced travel time and vehicle operating cost.
Less impact on townscape due to less elevated structures.	Further benefits also due to reduced delays in future maintenance.
Less impact on the historic environment.	Journey time reliability is expected to improve noticeably for all users.
Less demolition required due to reduced footprint.	Improved Air Quality within the study area overall with no exceedance of the NO2 or PM10 air quality standards or limit values.
Less impact on water environment as unlikely to affect water resources.	Significantly increased benefits for commuting and other users from improved junctions through reduced travel time and vehicle operating costs.
Reduced construction duration (23 months).	Improved safety benefits due to a decrease of -2.0% in accidents across the study area.
Reduced capital cost at approx. £140M towards the lower range of the RIS budget.	Greater Benefit to Cost Ratio (BCR).

11.2.5. Summary of Comparison 2

Option 2 performs very well in reducing peak journey times on the A27 with an average saving of over two and a half minutes between AM and PM peak times, compared to Option 1A and an average of approximately one minute savings on the other key routes. It also generates cost benefits amounting to +£551.3 M (total PVB – present value benefits) through improvements in journey time and journey reliability, while Option 1A generates +279.1M PVB.

The reduced scope of works in Option 1A and retention of the all movements at Stockbridge and Whyke has benefits in VOC due to the reduction in overall distance travelled. For the same reason, Option 1A also promotes significantly less costs due to construction and future maintenance delays.

Option 2 has good overall air quality and noise benefits. During operation, there would be no receptors which experience a deterioration in air quality where the annual NO2 objective is exceeded at present, and there would be one receptor within the Stockbridge AQMA that currently exceeds the annual NO2 objective, that would be brought within the NO2 objective. Option 1A generates less GHG emissions. Option 1A also requires substantially less properties to be demolished (five compared to 20 for Option 2).

Option 1A has less impact on the historic environment as opposed to Option 2, which would demolish Stockbridge House – a grade II listed building to accommodate realignment of Stockbridge Road flyover.

Option 2 has the greatest reduction in accidents with an overall decrease of 2.0% across the study area over the 60-year appraisal period. Option 1A also reduces accidents but to a far lesser extent (0.4%).

Option 1A sits within the RIS range at approx. £140M. Option 2 has the largest construction cost at approx. £280M which is over the upper limit of the RIS budget. Option 2 has a greater benefit to cost ratio at 2.66 compared to 2.49 for Option 1A and in terms of DfT's 'Value for Money' assessment both offer 'high value'.

The result of the Public Consultation shows that Option 2 was significantly favoured with 31% of respondents noting it to be their preferred choice compared to 6% for Option 1A.

11.2.6. Comparison 2 Result

The reduced construction cost and associated delays are the main advantages of Option 1A together with less impact on buildings and townscape, historic environment, water environment and less GHG emissions. However, the economic benefits are much greater in Option 2 supplemented by better overall noise and air quality benefits which outweigh its other environmental effects. For this reason, Option 2 is taken forward in the assessment. Refer to Appendix G for a visual comparison between these two options.

11.2.7. Comparison 3: Option 2 with Option 3

The key advantages of each are presented in Table 11.3.

Table 11.3: Advantages of Option 2 and Option 3

Key Advantages of Option 2	Key Advantages of Option 3
Significant benefits for business users from the improvement of the junctions through reduced travel time and vehicle operating cost.	Less impact on townscape due to no elevated structures.
Further benefits also due to reduced delays in future maintenance.	Requires no demolition.
Less GHG emissions due to the shorter distances travelled.	There is no impact on designated sites with no direct impact on Chichester Harbour Conservancy AONB.
Journey time reliability is expected to improve noticeably for all users.	Less impact on water environment as unlikely to affect water resources.
Significantly increased benefits for commuting and other users from improved junctions through reduced travel time and vehicle operating costs.	Reduced construction duration (15 month)
Greater benefits in accidents savings.	Reduced capital cost at approx. £47M which is below the lower range of the RIS budget.
Slightly greater benefits in Air Quality.	Superior Benefit Cost Ratio (BCR).

11.2.8. Summary of Comparison 3

Option 2 performs very well in reducing peak journey times compared to Option 3 with an average saving of over 2 and a half minutes more than Option 3 on A27 and around 2 minutes on the other key routes. Its PVB also amount to over £366.4M greater than Option 3.

The reduced scope of work in Option 3 has significant benefits in VOC due to the reduction in overall distance travelled. For this reason, Option 3 also has significantly less costs due to construction and future maintenance delays.

**A27 Chichester Bypass
Scheme Assessment Report**

Both options reduce accidents and are favourable in terms of safety. Option 2 offers a greater reduction in accidents with an overall decrease of 2.0% across the study area, compared to 1.0% in Option 3.

The increased scope of work in Option 2 requires substantially more properties to be demolished including the grade II listed building Stockbridge House due to the realignment of Stockbridge Road. There would also be a moderate adverse effect on Fishbourne and Chichester Conservation Areas, and the setting of five Grade II Listed buildings during operation. In comparison, there is no demolition of buildings with Option 3 and there would be no significant effects on cultural heritage assets during its operation.

Option 2 has the largest construction cost at approx. £280M which is over the upper limit of the RIS budget range. The estimated cost of Option 3 is substantially less and sits well below the RIS budget range at £47M. The BCR of Option 3 at 4.13 is also considerably higher than Option 2 which is at 2.66. However this is due to the considerable lower cost of Option 3 and it does not generate the same level of user benefits at £184.9M PVB. In terms of DfT's Value for Money assessment Option 2 represents 'high value for money' and Option 3 'very high value for money'.

Option 2 has more benefits for air quality and GHG emissions while Option 3 has less impacts on townscape, historic environment and water environment due to its reduced footprint and limited nature of improvements proposed.

The result of the Public Consultation shows that Option 2 was significantly favoured with 31% of respondents selecting it as their preferred option compared to 3% for Option 3.

11.2.9. Comparison 3 Result

Option 3 provides 'very high' value for money when compared to Option 2, which falls in the 'high' category as defined by the DfT terminology. This monetary advantage is dictated by a relative better relation between the benefits provided by Option 3 for a reduced overall cost and is not normally an indication of the performance of the scheme in other areas. In contrast however, despite the significant construction cost and duration, Option 2 provides considerably larger benefits, far surpassing those of Option 3, primarily in journey times and therefore Option 2 is taken forward in the assessment. Refer to Appendix G for a visual comparison between these two options.

11.2.10. Comparison 4: Option 2 with Option 3A

The key advantages of each option are presented in Table 11.4.

Table 11.4 Advantages of Option 2 and Option 3A

Key Advantages of Option 2	Key Advantages of Option 3A
Significant benefits for business users from the improvement of the junctions through reduced travel time and vehicle operating cost.	Less impact on townscape due to reduced elevated structures.
Less impact and dis-benefits in noise.	Less impact in historic environment due to reduced footprint.
Greater benefits in Air Quality.	Increased security due to an extra lane between Stockbridge and Bognor Junction in each direction.
Significantly increased benefits for commuting and other users from improved junctions through reduced travel time and vehicle operating costs.	Reduced construction duration (27 months).
Journey time reliability is expected to improve noticeably for users.	Less properties require demolition.
Improved safety benefits due to a decrease of -2.0% in accidents across the study area.	Less land required to construct.
Greater Benefit to Cost Ratio (BCR).	

11.2.11. Summary of Comparison 4

Option 2 performs very well in reducing peak journey time when compared to Option 3A with an average saving of over 1 and a half minute at peak times more than Option 3A for the A27 and around 1 minute for the other key routes. Its PVB also amount to over £243.3M more than Option 3A.

In terms of safety, Option 2 provides a reduction in accidents with an overall decrease of 2.0% across the study area over the 60-year appraisal period. Option 3A, in turn increases accidents by 5% with an associated cost of £24.1M.

Option 2 has less impact on the environment including noise, air quality and GHG emissions due to a more consistent speed profile.

The increased scope of work in Option 2 requires the demolition of 20 buildings, including a grade II listed, while Option 3A requires less properties to be demolished (2 building units) and requires less land to construct.. The land required to construct Option 2 is also significantly greater than Option 3A.

The result of the Public Consultation shows that Option 2 was favoured with 31% of respondents selecting it as their preferred option compared to 2% for Option 3A. Option 2 has the largest construction cost at approx. £280M which is over the upper limit of the RIS budget range of £120-£250M. The cost of Option 3A is substantially less and sits within the RIS budget range at approx. £172M. Option 2 has a greater BCR at 2.66 compared to Option 3A at 2.27, with both offering 'high value for money'.

11.2.12. Comparison 4 Result

Both options represent 'high value for money' in terms of economic assessment. Despite the significant construction cost and duration, the advantages of Option 2 surpass those of Option 3A primarily as Option 3A is predicted to cause an increase in accidents across the study area by 5%. Therefore, Option 2 is taken forward. Refer to Appendix G for a visual comparison between these two options.

11.2.13. Project Objectives Analysis

The project objectives agreed at inception stage with the Key Stakeholders and as evolved throughout Stages 1 and 2, have also been used to compare the options performance. In the similar manner as in the sifting process carried out in Stage 1, the objectives were used to confirm the assessment undertaken above based on TA30/82.

The options assessment against project objectives is shown in the Table 11.5 below.

Table 11.5: Project objectives analysis

	Option 1		Option 1A		Option 2		Option 3		Option 3A	
Objectives	Score	Qualifier	Score	Qualifier	Score	Qualifier	Score	Qualifier	Score	Qualifier
Transport										
Improve capacity on the A27 and local road network	6.34	PVB £349.4m	5.06	PVB £279.1m	10	PVB £551.3m	3.35	PVB £184.9m	5.59	PVB £308.0m
Improve journey time reliability	9.12	JTR B £227.7m	3.43	JTR B £85.9m	10	JTR B £249.8m	6.63	JTR B £165.5m	8.33	JTR B £208.2m
Safety										
Improve road safety during construction, operation and maintenance for all	-10	AB £-8.5m	2.26	AB £1.9m	10	AB £8.4m	6.9	AB £5.8m	-10	AB £-24.1m
Community and environment										
Address existing AQMAs and ensure no further are created	3	Not significant beneficial	-3	Not significant adverse	3	Not significant beneficial	3	Not significant beneficial	3	Not significant beneficial
Address existing noise important areas and ensure no further are created	5	Beneficial	5	Beneficial	5	Beneficial	0	Neutral	0	Neutral
Economic										

Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

	Option 1		Option 1A		Option 2		Option 3		Option 3A	
Objectives	Score	Qualifier	Score	Qualifier	Score	Qualifier	Score	Qualifier	Score	Qualifier
Improve capacity and support the growth of the regional economy by:										
facilitating timely delivery of the scheme to enable provision of housing	6	2023	10	2021	6	2023	10	2021	8	2022
improving connectivity with local roads, including for non-motorised users	-5	Banned Turns	0	Allowed Turns	5	Link Road	-5	Banned Turns	-5	Banned Turns
improving accessibility to tourist attractions	-5	Banned Turns	0	Allowed Turns	5	Link Road	-5	Banned Turns	-5	Banned Turns
Total	9.46		22.75		54		19.88		4.92	

The analysis was carried out as a comparison between each option by attributing a qualifier in the table above to each project objective. The qualifier relates to values from the economic assessment or environmental assessment detailed in the previous sections. Some objectives' qualifiers have been condensed in a qualitative text definition where a quantifiable value was not applicable.

A score was then attributed to each option, based on a +10 to -10 scale, where the highest benefits were given a score of 10 and the others given a score based on a % of this. The colours shown are related to the scores providing a RAG type analysis for ease of reference.

From the analysis, it is evident that Option 2 contributes the most to meeting all the project objectives, in comparison to all the other options. For the transport objectives, related to improving capacity and journey time reliability, it achieves the highest scores as it delivers the greatest benefit values for these in the economic assessment. It provides the same level of performance for the safety objective providing the highest accident savings over the study area.

For community and environmental objectives, Option 2 again gets the highest scores, addressing the existing AQMA to a similar extent as three other options, namely Option 1, 3 and 3A, while addressing the existing noise important areas to a similar extent as Option 1 and 1A.

**A27 Chichester Bypass
Scheme Assessment Report**

In terms of its economic performance, Option 2 takes longer to build than the rest of the options and for this reason would not provide the 'timely delivery' required to enable the provision for housing in line with the CLP ambitions, hence attracting the lowest score alongside Option 1.

However, for the remainder of the objectives, related to improving connectivity and accessibility, Option 2 attracts the highest scores, due to featuring the new Stockbridge Link Road which adds to the travel choices available for communities to the south.

The analysis against the project objectives therefore also demonstrates that Option 2 is the better performing option, based on its ability to meet the project objectives to a greater extent when compared to the other four options.

12. Conclusion and Recommended Route

All the five options considered give a 'high' or 'very high' return in economic terms as defined by DfT Value for Money terminology. They vary in level and magnitude of intervention as well as impacts and benefits, therefore contributing to meeting the project objectives in various degrees and requiring different mitigations to the effects introduced.

Taking into consideration the factors presented throughout this report, Option 2 is considered to perform better when compared against the competing options. Option 2 has also emerged as the better performing option when assessed against the project objectives in a comparison exercise against the other options. It has also garnered the largest proportion of support in the Public Consultation by a significant margin at 31% (the next most favoured having 6% support).

Therefore, it is for these reasons that Option 2 is recommended as the Preferred Option.

To provide consistency and confidence in the recommendation of Option 2 as the Preferred Route a further analysis of the feedback given in the Public Consultation is provided in the next sub-section.

12.1.1. Public Consultation Feedback

The written feedback from the residents and stakeholders indicate preference or support in various degrees for the five options considered. As detailed in Section 9 of this report, there is also a 'no option' response emerging from the feedback that features strongly in the responses received. A summary of the responses is included in Table 12.1 below.

Table 12.1 Summary of Public Consultation responses

Option	% preference	Comments
Option 1	4%	Removal of right-turn movements at Stockbridge and Whyke seen as unfavourable to local communities south of Chichester due to longer distance journeys.
Option 1A	6%	Attracted some positive feedback in spite of the fact that by retaining Stockbridge and Whyke roundabouts to eliminate re-routing, journey times marginally deteriorate for communities south of Chichester.
Option 2	31%	Seen as most substantial option to address the problems. However also seen as intrusive on communities, mostly south of Chichester, with impacts on residential buildings (incl. one grade II listed building), flood plains, noise, landscape, and visual envelope. Construction impact also seen as a major concern.
Option 3	3%	Seen as limited intervention with minimal potential for a positive outcome. Removal of right-turn movements at Stockbridge and Whyke seen unfavourably by local communities to the south.

Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Option	% preference	Comments
Option 3A	2%	Similar Option 3 mainly due to removal of right-turn movements at Stockbridge and Whyke.
No Option	47%	85 % of the people returning this response commented that would prefer to see a northern route re-assessed.
No Response	7%	

While it can be noted that the 'no option' response appears to be the leading preference expressed in the consultation, this is in apparent contradiction with the response to the first question asked in the consultation materials '*Do you think there is a problem with congestion on the A27 Chichester bypass?*' to which question, 93% of participants responded 'Yes', which confirms that an intervention is required.

From the consultation it can be concluded that, Option 2 is the favoured option by the local communities out of the five options presented, which confirms the conclusion of the options comparison analysis in Section 11.

12.1.2. Risks in Preferred Route Selection

Given the complexity of the scheme and as highlighted early in this report, all options have a series of risks pertinent to the improvements they introduce. The key risk in an overall decision is the diverse range of options available and the significant difference in the magnitude of the benefits and impacts of each option.

An overview of the key risks in relation to the selection of Option 2 as Preferred Option is given overleaf in a tabulated format. For comparison, the key risks for all other options have also been included.

Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Top 5 Risks	Option 1		Option 1A		Option 2		Option 3		Option 3A	
	Risk	Consequence	Risk	Consequence	Risk	Consequence	Risk	Consequence	Risk	Consequence
Construction cost estimated greater than Capital Planning limit of £140M	x	Capital Planning will need to be increased to £182M	N/A	Cost estimated at £139M	x	Capital Planning will need to be increased to £280M	N/A	Cost Estimated at £47M	x	Capital Planning will need to be increased to £172M
Construction Cost estimated outside the upper limit of RIS budget range of £120M – £250M	N/A		N/A		x	RIS budget will need to be increased to £280M	N/A		N/A	
No real support expressed from stakeholders or residents in Public Consultations	x	Potential for challenges based on better performing options not being progressed. Also Local Authorities funding contribution may be at risk.	x	Potential for challenges based on better performing options not being progressed. Also Local Authorities funding contribution may be at risk.	N/A	However, has greatest impact on residential properties due to demolition including a Grade II listed building. Also impacts on flood plains.	x	Potential for challenges based on better performing options not being progressed. Also Local Authorities funding contribution may be at risk.	x	Potential for challenges based on better performing options not being progressed. Also Local Authorities funding contribution may be at risk.
Impacts on land and settings from Chichester Harbour AONB and other sensitive areas and assets.	x	Potential for legal challenge. Chichester AONB already expressed dissatisfaction. Requires further mitigations on access to Manhood Peninsula.	X	Potential for legal challenge. Chichester AONB already expressed dissatisfaction. Requires further mitigations on access to Manhood Peninsula.	x	Potential for legal challenge. Chichester AONB already expressed dissatisfaction. Requires further mitigations on access and environment. SLR requires land for which National Trust has a covenant.	N/A		x	Potential for legal challenge. Chichester AONB already expressed dissatisfaction. Requires further mitigations on access to Manhood Peninsula.

Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Indicated to increase accidents in the study area not contributing to improving road safety	x	Potential for legal challenge on safety grounds. Also contradicts HE Health and Safety policies.	N/A		N/A		N/A		x	Potential for legal challenge on safety grounds. Also contradicts HE Health and Safety policies.
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13. Confidential Consultations

No confidential consultations were undertaken as part of the Stage 2 assessment.

Appendix A Stage 2 Option Plans

Appendix B 2035 AM/PM Peak Flows – Compared to Do Minimum

Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Option 1 – 2035 AM – Difference from Do Minimum



Option 1 – 2035 AM – Difference from Do Minimum



Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Option 1A – 2035 AM – Difference from Do Minimum

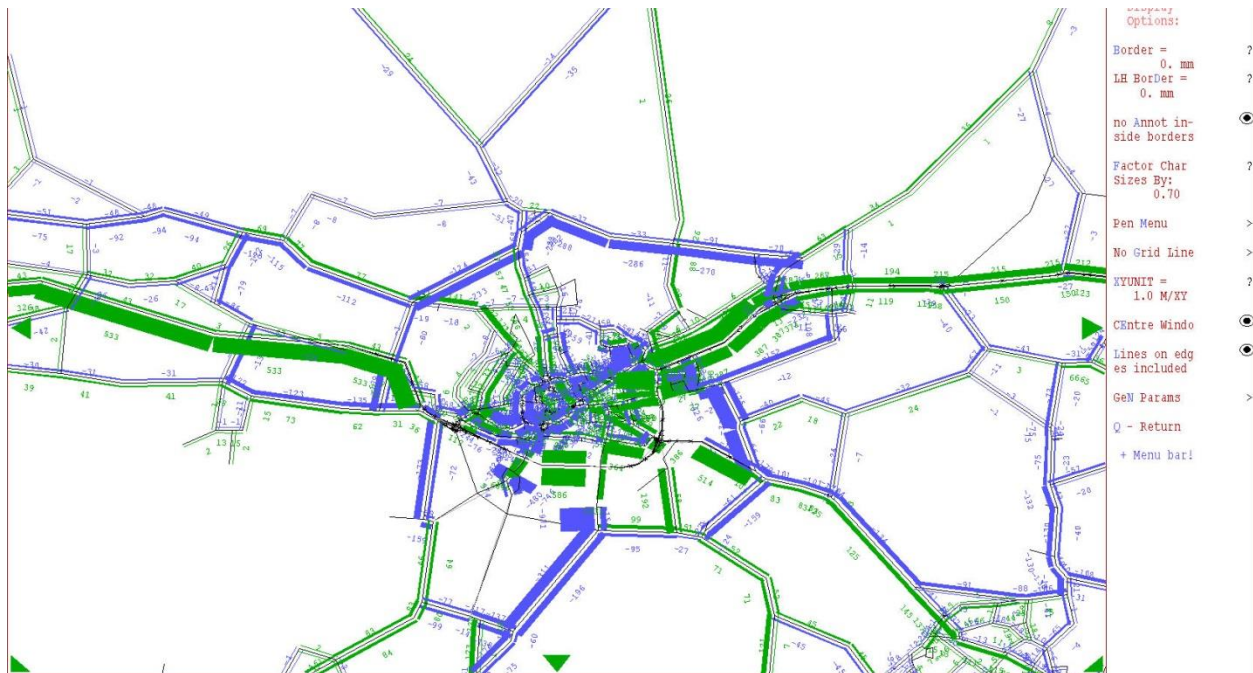


Option 1A – 2035 PM – Difference from Do Minimum

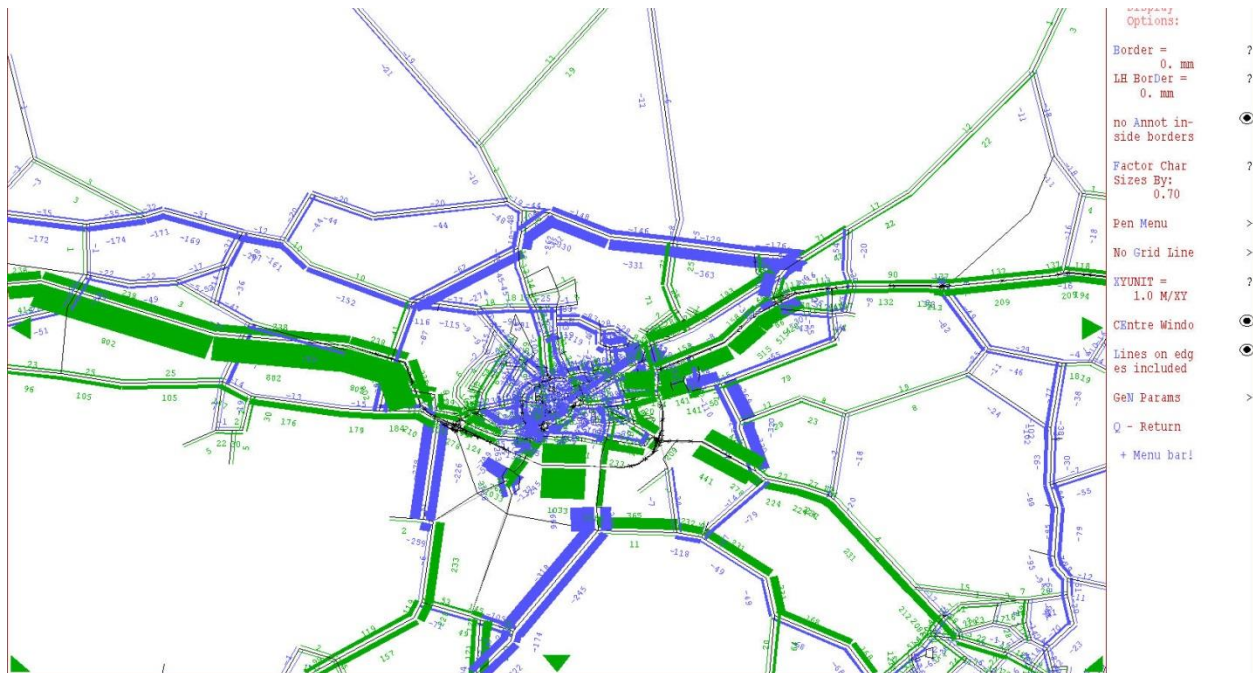


Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Option 2 – 2035 AM – Difference from Do Minimum



Option 2 – 2035 PM – Difference from Do Minimum



Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Option 3 – 2035 AM – Difference from Do Minimum



Option 3 – 2035 PM – Difference from Do Minimum



Option 3A – 2035 AM – Difference from Do Minimum



Option 3A – 2035 PM – Difference from Do Minimum



Appendix C Comparison of 2035 AM Peak Hour Journey Time

Project Support Framework (PSF) 2011-2016

A27 Chichester Bypass

Scheme Assessment Report

Comparison of Journey Time through Chichester for All Options 2035 AM Peak Hour

Average Journey Times (mins)																
Year 2035 CORE																
Peak Hour AM																
Option	Do Minimum															
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broyle					
Chichester	-	23.3	10.0	11.0	7.0	6.7	7.9	7.5	7.8	8.7	8.0					
Havant	24.7	-	33.9	30.5	30.7	29.6	27.9	26.9	21.4	22.3	28.9					
Fontwell	13.9	35.8	-	10.4	13.5	4.3	7.1	12.3	18.5	18.0	18.0					
Bognor Regis	18.5	36.3	11.3	-	21.8	11.6	8.0	8.1	20.7	17.7	25.5					
Lavant	8.4	31.3	12.1	17.9	-	8.9	11.8	15.8	11.0	14.5	8.8					
Tangmere	9.7	31.7	6.1	9.9	9.4	-	3.8	7.6	14.3	13.8	13.8					
Oving	12.1	32.5	7.1	7.1	14.1	3.9	-	5.9	17.0	14.7	18.2					
North Mundon	13.8	29.7	14.1	6.4	18.5	8.3	6.6	-	14.2	11.2	20.8					
Fishbourne	11.8	24.5	18.7	19.0	11.7	15.4	16.4	15.4	-	5.6	10.2					
Birham	11.8	25.9	19.5	16.2	14.6	15.3	13.6	11.4	5.0	-	13.7					
West Broyle	10.4	28.4	17.3	21.3	9.2	14.0	16.9	17.8	9.1	13.4	-					

Option	1															
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broyle	Chichester	Havant	Fontwell	Bognor Regis	Lavant
Chichester	-	23.5	10.1	10.4	7.0	6.7	7.6	7.0	6.9	7.8	8.0	0.0	0.1	0.1	-0.8	0.0
Havant	24.9	-	30.7	30.9	30.9	27.4	28.2	27.5	22.8	23.6	28.8	0.2	0.0	-3.1	0.4	0.2
Fontwell	12.2	31.8	-	10.3	13.3	4.3	7.1	11.5	15.3	14.3	17.5	-1.6	-4.1	0.0	0.0	-0.2
Bognor Regis	15.4	33.6	11.1	-	21.3	13.3	8.9	8.2	17.2	16.1	22.3	-3.2	-2.7	-0.3	0.0	-0.5
Lavant	7.5	30.6	12.0	15.8	-	8.7	11.9	12.4	10.7	14.9	8.8	-0.9	-0.8	-0.1	-2.1	0.0
Tangmere	8.0	27.6	6.1	9.7	9.1	-	3.8	7.3	11.1	10.1	13.3	-1.7	-4.1	0.0	-0.2	-0.3
Oving	9.3	27.5	7.1	7.4	13.7	3.8	-	5.9	11.1	10.1	16.2	-2.8	5.0	0.0	0.3	-0.4
North Mundon	9.9	27.3	14.0	6.2	15.9	8.6	7.0	-	10.8	9.8	16.9	-3.9	-2.5	-0.1	-0.2	-2.5
Fishbourne	10.8	24.4	17.9	19.3	11.1	14.6	16.6	15.9	-	7.3	9.6	-1.0	-0.1	-0.8	0.2	-0.7
Birham	11.3	25.6	18.9	18.0	14.0	15.6	16.5	12.7	5.0	-	12.5	-0.5	-0.4	-0.6	1.7	-0.6
West Broyle	10.2	28.2	17.2	20.4	9.1	13.8	17.7	17.1	9.0	14.8	-	-0.3	-0.2	-0.1	-0.9	-0.1

Option	1A															
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broyle	Chichester	Havant	Fontwell	Bognor Regis	Lavant
Chichester	-	23.2	9.9	10.2	7.0	6.6	7.5	7.0	7.0	7.9	8.0	0.0	-0.2	0.0	-0.8	0.0
Havant	24.4	-	32.0	32.4	30.1	28.7	29.6	27.1	21.6	22.5	28.8	-0.4	0.0	-1.9	1.9	-0.5
Fontwell	12.4	32.8	-	10.3	13.3	4.3	7.1	11.3	16.8	16.2	17.5	-1.4	-3.0	0.0	0.0	-0.2
Bognor Regis	15.5	34.7	11.1	-	21.4	13.1	8.8	7.5	18.7	16.6	22.4	-3.0	-1.6	-0.2	0.0	-0.4
Lavant	7.9	30.6	12.0	15.4	-	8.7	11.8	12.2	10.7	15.3	8.8	-0.5	-0.8	-0.1	-2.5	0.0
Tangmere	8.2	28.7	6.1	9.6	9.1	-	3.8	7.1	12.6	12.0	13.3	-1.5	-3.0	0.0	-0.3	-0.3
Oving	9.6	28.8	7.1	7.2	13.6	3.8	-	5.9	12.7	12.1	16.5	-2.5	-3.8	0.0	0.2	-0.5
North Mundon	10.9	29.9	14.5	6.2	16.9	8.8	7.2	-	13.9	10.4	17.9	-2.9	0.2	0.4	-0.2	-1.6
Fishbourne	10.1	24.3	17.6	18.9	10.8	14.3	16.0	13.6	-	7.9	9.5	-1.7	-0.2	-1.1	-0.1	-1.0
Birham	12.9	26.5	19.2	16.2	17.6	15.9	16.8	11.0	9.0	-	16.4	1.1	0.6	-0.3	0.0	3.0
West Broyle	9.7	28.0	17.1	19.9	9.1	13.8	17.2	16.6	8.9	14.5	-	-0.7	-0.4	-0.2	-1.5	-0.1

Option	2															
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broyle	Chichester	Havant	Fontwell	Bognor Regis	Lavant
Chichester	-	23.9	10.1	10.2	7.0	6.8	7.7	7.0	7.2	7.4	7.9	0.0	0.5	0.1	-0.8	0.0
Havant	26.0	-	30.0	31.2	32.0	26.7	27.6	27.6	24.1	24.0	29.0	1.3	0.0	-3.8	0.7	1.3
Fontwell	12.3	30.4	-	10.3	13.3	4.3	7.1	11.5	14.0	14.2	17.4	-1.6	5.5	0.0	0.0	-0.2
Bognor Regis	15.4	32.2	11.0	-	21.4	13.3	9.1	8.6	15.8	13.9	22.3	-3.2	-4.1	-0.3	0.0	-0.4
Lavant	7.6	31.1	12.1	15.6	-	8.7	11.9	12.4	10.7	14.6	8.8	-0.8	-0.3	-0.1	-2.3	0.0
Tangmere	8.1	26.2	6.1	9.6	9.1	-	3.8	7.3	11.1	10.0	13.2	-1.6	5.5	0.0	-0.3	-0.3
Oving	9.3	26.1	7.1	7.5	13.7	3.8	-	5.9	9.7	9.9	16.2	-2.8	6.4	-0.1	0.4	-0.5
North Mundon	9.7	26.1	13.4	6.3	15.7	8.5	6.9	-	9.4	6.6	16.6	-4.1	-3.6	-0.6	-0.1	-2.8
Fishbourne	11.8	24.7	18.6	19.2	11.8	15.3	18.2	14.0	-	7.0	10.1	0.0	0.1	-0.1	0.2	0.0
Birham	9.2	23.7	16.3	13.3	14.6	13.0	13.0	8.0	5.0	-	13.7	-2.5	-2.2	-3.2	-2.9	0.0
West Broyle	10.4	28.3	17.3	20.5	9.1	14.0	17.9	17.2	8.9	14.9	-	0.0	-0.1	0.0	-0.8	0.0

Option	3															
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broyle	Chichester	Havant	Fontwell	Bognor Regis	Lavant
Chichester	-	23.7	9.8	11.3	7.0	6.5	7.5	8.0	7.3	8.2	8.0	0.0	0.4	-0.2	0.3	0.0
Havant	24.6	-	31.4	29.3	30.5	28.1	26.7	26.0	22.3	23.1	28.8	-0.1	0.0	-2.5	-1.2	-0.2
Fontwell	13.5	33.7	-	10.4	13.4	4.3	7.1	12.2	17.5	16.5	17.6	-0.4	-2.2	0.0	0.0	-0.2
Bognor Regis	18.4	34.8	11.2	-	21.3	11.4	7.7	9.0	18.6	17.6	25.4	-0.1	-1.5	-0.2	0.0	-0.5
Lavant	8.1	31.4	12.0	17.6	-	8.7	11.5	14.3	10.8	15.9	8.8	-0.3	0.1	-0.1	-0.3	0.0
Tangmere	9.3	29.5	6.0	9.8	9.2	-	3.8	7.5	13.3	12.3	13.5	-0.4	-2.2	-0.1	-0.1	-0.2
Oving	11.6	30.3	7.1	6.7	13.8	3.9	-	5.8	14.1	13.1	17.9	-0.5	-2.2	0.0	-0.4	-0.3
North Mundon	10.9	27.3	14.0	6.4	16.8	8.1	6.4	-	11.1	10.2	17.8	-2.9	-2.4	0.0	0.0	-1.8
Fishbourne	11.1	24.5	18.1	17.7	11.3	14.8	15.1	14.4	-	10.9	9.7	-0.7	0.0	-0.6	-1.3	-0.5
Birham	11.8	24.6	19.7	17.2	14.1	16.4	14.5	12.0	5.0	-	12.6	0.0	-1.4	0.2	1.0	-0.5
West Broyle	10.3	28.2	17.2	21.6	9.1	13.9	16.7	18.2	8.9	16.0	-	-0.1	-0.2	-0.1	0.2	0.0

Option	3A															
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broyle	Chichester	Havant	Fontwell	Bognor Regis	Lavant
Chichester	-	24.2	10.2	10.4	7.0	6.9	7.7	7.1	7.3	8.2	8.0	0.0	0.9	0.3	-0.8	0.0
Havant	24.6	-	30.1	30.9	30.5	26.7	27.6	27.6	22.2	23.1	28.8	-0.1	0.0	-3.8	0.4	-0.1
Fontwell	12.9	32.0	-	10.4	13.3	4.3	7.1	12.4	15.2	14.3	17.5	-1.0	-3.8	0.0	0.0	-0.2
Bognor Regis	15.9	33.4	11.1	-	21.2	12.8	9.3	7.7	16.5	15.7	22.8	-2.7	-2.8	-0.3	0.0	-0.6
Lavant	7.5	31.1	12.0	16.2	-	8.7	12.3	12.9	10.7	15.1	8.8	-1.0	-0.2	-0.1	-1.7	0.0
Tangmere	8.7	27.9	5.8	9.7	9.1	-	3.8	7.6	11.0	10.2	13.3	-1.0	-3.8	-0.3	-0.3	0.0
Oving	9.3	26.8	7.1	7.2	13.5	3.8	-	6.0	10.0	9.2	16.2	-2.8	5.7	-0.1	0.1	-0.7
North Mundon	10.3	27.1	13.5	6.2	15.7	8.9	7.2	-	10.2	9.4	17.2	-3.5	-2.6	-0.6	-0.2	-2.8
Fishbourne	10.7	24.4	18.1	18.9	11.0	14.7	15.6	15.6	-	9.8	9.6	-1.1	-0.1	-0.6	-0.1	-0.7
Birham	12.3	25.5	19.0	18.2	13.9	15.7	16.5	13.0	5.1	-	12.5	0.5	-0.4	-0.5	2.0	-0.7
West Broyle	10.2	28.1	17.2	20.5	9.1	13.8	17.8	17.1	8.9	14.4	-	-0.2	-0.3	-0.1	-0.9	-0.1

Project Support Framework (PSF) 2011-2016

A27 Chichester Bypass

Scheme Assessment Report

Comparison of Journey Time through Chichester for All Options 2035 PM Peak Hour

Average Journey Times (mins)												
Year 2035 CORE												
Peak Hour PM												
Option	Do Minimum											
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broye	
Chichester	-	29.1	12.2	17.7	7.3	8.7	9.8	13.3	8.8	12.1	8.5	
Havant	24.0	-	34.2	34.4	29.6	30.8	30.2	28.9	21.5	22.5	29.0	
Fontwell	12.9	40.5	-	11.1	14.1	4.2	7.2	13.9	19.6	19.1	19.2	
Bognor Regis	15.5	36.3	10.7	-	20.8	10.0	6.7	6.7	18.4	14.9	22.9	
Lavant	6.8	35.0	12.4	20.6	-	8.9	12.9	18.1	11.5	14.7	8.9	
Tangmere	8.9	36.4	6.1	11.8	10.1	-	4.1	9.3	15.5	15.1	15.2	
Oving	11.4	35.0	7.1	8.8	14.5	4.0	-	7.4	17.1	13.6	18.5	
North Mundon	11.2	31.3	13.5	7.4	16.5	7.3	5.6	-	13.4	10.0	18.7	
Fishbourne	8.6	26.0	17.7	20.4	10.5	14.2	16.2	14.9	-	5.3	9.7	
Birham	12.5	27.5	18.1	18.3	14.9	14.7	14.1	12.8	6.4	-	14.0	
West Broye	8.1	29.9	17.2	25.8	8.9	13.8	17.8	21.3	9.0	13.0	-	

Option	1											
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broye	
Chichester	-	27.8	13.2	18.5	7.3	9.7	10.8	14.2	8.1	8.9	8.3	
Havant	24.0	-	31.4	32.8	29.6	27.9	28.6	28.3	21.7	22.5	29.1	
Fontwell	12.1	34.6	-	11.0	13.8	4.2	7.2	13.7	15.0	14.2	18.1	
Bognor Regis	12.2	33.3	10.6	-	18.5	10.3	6.9	6.5	13.7	12.9	19.5	
Lavant	6.7	33.2	12.7	20.9	-	9.2	13.4	17.8	10.7	14.3	8.8	
Tangmere	7.9	30.5	6.4	11.7	9.6	-	4.2	9.0	10.9	10.1	13.9	
Oving	9.3	30.4	7.0	9.6	14.1	3.9	-	6.9	10.7	9.9	16.5	
North Mundon	9.0	29.2	12.5	7.2	15.2	7.3	5.6	-	9.6	8.7	16.2	
Fishbourne	7.6	24.7	15.3	16.7	10.4	11.7	12.5	12.2	-	6.5	9.6	
Birham	9.3	26.4	17.0	18.4	14.1	13.4	14.2	13.9	5.8	-	13.3	
West Broye	7.9	29.9	17.4	23.7	8.8	13.9	18.7	19.2	9.0	13.3	-	

Option	1A											
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broye	
Chichester	-	27.1	11.9	17.2	7.2	8.5	9.5	12.6	8.3	9.2	8.3	
Havant	24.0	-	33.0	33.7	29.5	29.6	29.4	29.3	21.5	22.5	29.2	
Fontwell	11.8	35.8	-	11.0	13.9	4.2	7.1	14.0	17.2	16.6	18.5	
Bognor Regis	12.2	35.2	10.6	-	17.5	10.2	6.9	6.5	16.5	14.9	19.6	
Lavant	6.8	32.5	12.3	20.4	-	8.9	12.7	17.2	10.9	14.6	8.8	
Tangmere	7.7	31.7	6.2	11.7	9.8	-	4.0	9.3	13.1	12.5	14.4	
Oving	9.4	32.5	7.0	9.7	14.2	3.9	-	7.5	13.9	13.2	16.8	
North Mundon	9.1	29.9	11.5	7.2	14.3	7.2	5.6	-	11.3	9.8	16.4	
Fishbourne	7.7	23.8	17.0	17.7	10.4	13.6	13.4	13.3	-	5.9	9.6	
Birham	11.2	27.2	18.3	19.0	16.0	14.8	14.7	13.3	7.7	-	15.2	
West Broye	8.0	29.9	17.1	25.1	8.8	13.6	17.3	20.5	9.0	13.4	-	

Option	2											
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broye	
Chichester	-	28.7	11.6	15.6	7.2	8.1	8.9	10.5	8.9	9.2	8.2	
Havant	24.5	-	29.9	30.8	30.2	26.4	26.1	25.8	22.2	22.4	28.9	
Fontwell	11.7	33.3	-	11.0	13.7	4.2	7.1	12.8	13.8	14.2	18.0	
Bognor Regis	12.2	32.6	10.6	-	17.5	10.3	6.9	6.7	13.1	11.8	19.4	
Lavant	6.8	35.0	12.3	20.4	-	8.8	12.5	15.5	10.7	14.0	8.8	
Tangmere	7.6	29.2	6.1	11.9	9.6	-	3.9	8.2	9.7	10.0	13.8	
Oving	9.1	29.5	7.0	9.3	14.1	3.9	-	6.4	10.0	10.4	16.3	
North Mundon	9.1	28.2	11.9	7.7	14.4	7.3	5.6	-	8.3	6.8	15.9	
Fishbourne	8.5	26.4	16.9	17.7	10.4	13.4	13.0	12.3	-	5.4	9.6	
Birham	8.8	26.0	14.7	14.5	13.3	11.2	10.9	8.2	5.0	-	12.5	
West Broye	8.1	30.1	17.1	23.2	8.8	13.6	16.9	17.8	8.9	13.0	-	

Option	3											
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broye	
Chichester	-	27.4	11.6	17.0	7.2	8.1	9.1	12.5	8.4	9.2	8.4	
Havant	24.1	-	31.8	32.6	29.8	28.3	28.2	28.2	22.8	23.7	29.0	
Fontwell	12.5	36.9	-	11.1	14.0	4.2	7.1	12.8	17.9	16.9	18.6	
Bognor Regis	15.3	34.1	10.7	-	20.3	10.0	6.7	6.7	15.0	14.1	22.6	
Lavant	6.8	33.8	12.3	20.7	-	8.9	12.8	16.9	10.9	15.6	8.8	
Tangmere	8.4	32.8	6.3	11.9	9.9	-	4.0	8.1	13.8	12.8	14.5	
Oving	10.8	31.5	7.0	8.6	14.2	3.9	-	6.3	12.5	11.5	18.1	
North Mundon	10.1	28.8	12.9	7.4	15.7	7.3	5.6	-	9.8	8.8	17.5	
Fishbourne	8.5	26.2	17.9	18.8	10.5	14.5	14.4	14.4	-	9.8	9.7	
Birham	11.3	27.5	19.0	19.9	13.6	15.5	15.5	14.9	5.1	-	12.8	
West Broye	8.1	29.8	17.2	24.9	8.8	13.7	17.2	20.5	8.8	15.5	-	

Option	3A											
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broye	
Chichester	-	27.0	12.9	17.8	7.3	9.4	10.5	13.4	7.6	8.5	8.2	
Havant	24.2	-	31.9	33.6	30.1	28.4	29.6	29.3	22.2	23.1	28.9	
Fontwell	12.8	35.4	-	11.1	13.8	4.2	7.1	13.5	16.0	14.3	18.2	
Bognor Regis	12.3	33.2	10.6	-	18.6	10.4	6.9	6.5	13.8	12.1	19.6	
Lavant	6.7	33.4	12.6	20.6	-	9.1	13.2	16.8	10.8	14.8	8.8	
Tangmere	8.8	31.3	6.1	11.8	9.8	-	4.4	8.8	11.9	10.2	14.1	
Oving	9.3	30.2	7.0	9.4	14.2	3.9	-	6.6	10.8	9.1	16.6	
North Mundon	8.8	29.4	12.3	7.1	15.1	7.3	5.6	-	10.0	8.3	16.1	
Fishbourne	8.5	26.2	18.0	19.7	10.5	14.5	15.6	15.4	-	9.2	9.6	
Birham	11.5	28.0	19.3	21.0	13.8	15.8	16.9	15.2	5.4	-	12.9	
West Broye	8.1	29.8	17.4	25.5	8.8	13.9	18.5	21.1	8.8	14.9	-	

Option	4											
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broye	
Chichester	-	27.0	12.9	17.8	7.3	9.4	10.5	13.4	7.6	8.5	8.2	
Havant	24.2	-	31.9	33.6	30.1	28.4	29.6	29.3	22.2	23.1	28.9	
Fontwell	12.8	35.4	-	11.1	13.8	4.2	7.1	13.5	16.0	14.3	18.2	
Bognor Regis	12.3	33.2	10.6	-	18.6	10.4	6.9	6.5	13.8	12.1	19.6	
Lavant	6.7	33.4	12.6	20.6	-	9.1	13.2	16.8	10.8	14.8	8.8	
Tangmere	8.8	31.3	6.1	11.8	9.8	-	4.4	8.8	11.9	10.2	14.1	
Oving	9.3	30.2	7.0	9.4	14.2	3.9	-	6.6	10.8	9.1	16.6	
North Mundon	8.8	29.4	12.3	7.1	15.1	7.3	5.6	-	10.0	8.3	16.1	
Fishbourne	8.5	26.2	18.0	19.7	10.5	14.5	15.6	15.4	-	9.2	9.6	
Birham	11.5	28.0	19.3	21.0	13.8	15.8	16.9	15.2	5.4	-	12.9	
West Broye	8.1	29.8	17.4	25.5	8.8	13.9	18.5	21.1	8.8	14.9	-	

Option	5											
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broye	
Chichester	-	27.0	12.9	17.8	7.3	9.4	10.5	13.4	7.6	8.5	8.2	
Havant	24.2	-	31.9	33.6	30.1	28.4	29.6	29.3	22.2	23.1	28.9	
Fontwell	12.8	35.4	-	11.1	13.8	4.2	7.1	13.5	16.0	14.3	18.2	
Bognor Regis	12.3	33.2	10.6	-	18.6	10.4	6.9	6.5	13.8	12.1	19.6	
Lavant	6.7	33.4	12.6	20.6	-	9.1	13.2	16.8	10.8	14.8	8.8	
Tangmere	8.8	31.3	6.1	11.8	9.8	-	4.4	8.8	11.9	10.2	14.1	
Oving	9.3	30.2	7.0	9.4	14.2	3.9	-	6.6	10.8	9.1	16.6	
North Mundon	8.8	29.4	12.3	7.1	15.1	7.3	5.6	-	10.0	8.3	16.1	
Fishbourne	8.5	26.2	18.0	19.7	10.5	14.5	15.6	15.4	-	9.2	9.6	
Birham	11.5	28.0	19.3	21.0	13.8	15.8	16.9	15.2	5.4	-	12.9	
West Broye	8.1	29.8	17.4	25.5	8.8	13.9	18.5	21.1	8.8	14.9	-	

Option	6											
	Chichester	Havant	Fontwell	Bognor Regis	Lavant	Tangmere	Oving	North Mundon	Fishbourne	Birham	West Broye	
Chichester	-	27.0	12.9	17.8	7.3	9.4	10.5	13.4	7.6	8.5	8.2	
Havant	24.2	-	31.9	33.6	30.1	28.4	29.6	29.3	22.2	23.1	28.9	
Fontwell	12.8	35.4	-	11.1	13.8	4.2	7.1	13.5	16.0	14.3	18.2	
Bognor Regis	12.3	33.2	10.6	-	18.6	10.4	6.9	6.5	13.8	12.1	19.6	
Lavant	6.7	33.4	12.6	20.6	-	9.1	13.2	16.8	10.8	14.8	8.8	
Tangmere	8.8	31.3	6.1	11.8	9.8	-	4.4	8.8	11.9	10.2	14.1	
Oving	9.3	30.2	7.0	9.4	14.2	3.9	-	6.6	10.8	9.1	16.6	
North Mundon	8.8	29.4	12.3	7.1	15.1	7.3	5.6	-	10.0	8.3	16.1	
Fishbourne	8.5	26.2	18.0	19.7	10.5	14.5	15.6	15.4	-	9.2	9.6	
Birham	11.5	28.0	19.3	21.0	13.8	15.8	16.9	15.2	5.4	-	12.9	
West Broye	8.1	29.8	17.4	25.5	8.8	13.9	18.5	21.1	8.8	14.9	-	

Option	7											
	Chichester	Havant										

Appendix D Sector Distribution of Time and VOC Benefits

Option 1 Sector to Sector Benefits output from TUBA – Core Scenario, £m

Benefits per sector Core Scenario Option 1		Destination									Total
		1	2	3	4	5	6	7	8	9	
Origin	1	0.0	-7.0	-3.1	2.8	1.6	2.4	0.9	3.3	7.5	8.2
	2	1.3	-0.1	0.0	-0.9	-0.6	6.5	5.8	-0.6	2.5	14.0
	3	1.3	0.2	0.1	0.1	0.3	4.7	4.0	-0.1	2.9	13.5
	4	6.1	2.3	0.6	-0.6	5.6	22.4	29.2	4.4	23.8	93.9
	5	3.3	7.7	5.4	1.6	0.0	5.5	30.7	-0.2	9.8	63.9
	6	1.9	-0.1	1.4	2.4	0.5	2.5	8.5	-0.1	8.1	25.1
	7	0.3	-11.7	-6.9	4.5	11.5	4.3	0.2	18.7	5.1	26.0
	8	3.7	5.7	2.8	0.9	-2.7	2.1	36.8	0.8	3.2	53.4
	9	8.3	3.8	3.5	10.1	10.0	15.2	13.4	2.7	10.7	77.6
Total		26.3	0.9	3.8	20.8	26.2	65.7	129.4	29.0	73.6	375.7

Option 1A – Sector to Sector Benefits output from TUBA – Core Scenario, £m

Benefits per sector Core Scenario Option 1A		Destination									Total
		1	2	3	4	5	6	7	8	9	
Origin	1	0.0	-1.0	-0.1	2.0	1.4	3.5	3.0	2.1	11.0	21.8
	2	-1.5	0.0	-0.3	-0.9	0.8	0.6	1.3	1.3	-1.8	-0.4
	3	-0.7	-0.2	-0.1	-0.3	1.2	0.3	0.7	1.4	-1.3	1.0
	4	2.1	1.3	1.7	-0.6	5.4	20.6	12.3	4.8	23.1	70.8
	5	1.3	4.7	4.2	1.9	0.2	4.2	17.6	0.6	9.6	44.3
	6	1.5	4.0	2.5	3.5	1.4	1.8	9.4	0.4	7.2	31.7
	7	0.3	0.2	-0.3	-1.0	4.5	2.4	0.2	7.3	2.7	16.3
	8	1.2	3.1	2.2	1.2	-1.3	1.7	21.8	0.5	3.3	33.6
	9	7.4	5.9	3.4	12.3	11.9	12.3	16.7	3.4	8.9	82.3
Total		11.6	18.2	13.1	18.1	25.6	47.4	83.0	21.8	62.7	301.4

Option 2 - Sector to Sector Benefits output from TUBA – Core Scenario, £m

Benefits per sector Core Scenario Option 2		Destination									Total
		1	2	3	4	5	6	7	8	9	
Origin	1	0.0	-0.1	0.5	1.7	0.5	-0.5	-1.3	1.3	-2.9	-0.8
	2	2.7	-0.1	1.0	1.5	4.0	13.0	9.8	2.5	6.3	40.8
	3	2.5	0.9	0.4	-0.2	1.5	7.3	6.3	0.7	5.7	25.2
	4	8.1	5.0	1.7	-0.8	6.7	25.3	39.4	5.2	26.9	117.6
	5	4.2	6.6	3.5	2.3	0.3	6.9	38.0	0.1	11.2	73.0
	6	1.9	11.9	6.5	9.7	2.5	2.3	10.4	1.1	7.1	53.5
	7	0.2	7.5	5.4	12.1	17.3	3.7	0.6	27.7	0.6	75.2
	8	5.0	4.5	1.3	0.8	-2.2	3.2	47.9	0.9	3.9	65.3
	9	7.2	21.7	13.6	21.8	15.6	15.4	14.0	4.5	10.9	124.6
Total		31.9	57.9	34.0	49.0	46.2	76.6	165.1	44.0	69.7	574.3

Option 3 – Sector to Sector Benefits output from TUBA – Core Scenario, £m

Benefits per sector Core Scenario Option 3		Destination									Total
		1	2	3	4	5	6	7	8	9	
Origin	1	-0.1	-10.5	-5.3	1.0	0.2	0.4	-1.4	0.7	1.2	-13.8
	2	1.9	-0.1	-0.1	-1.2	-1.2	4.9	6.1	-1.3	1.2	10.3
	3	1.3	0.2	0.1	-0.2	0.1	3.4	4.2	-0.4	2.1	10.8
	4	4.8	1.2	-0.3	0.6	2.7	8.8	21.4	1.8	6.0	47.2
	5	1.4	2.5	1.4	0.3	0.1	1.6	16.3	-0.2	2.7	26.0
	6	1.1	-3.8	-0.2	4.8	1.4	0.9	5.1	0.6	3.8	13.6
	7	-0.3	-11.8	-7.5	6.4	9.7	2.9	0.1	16.6	3.1	19.2
	8	1.7	2.3	0.9	-0.6	-0.6	1.0	21.0	0.6	0.9	27.2
	9	5.1	-1.0	0.6	11.2	8.8	6.7	7.5	2.9	5.0	46.9
		17.1	-21.1	-10.4	22.3	21.1	30.7	80.3	21.3	26.0	187.3

Project Support Framework (PSF) 2011-2016
A27 Chichester Bypass
Scheme Assessment Report

Total										
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Option 3A – Sector to Sector Benefits output from TUBA – Core Scenario, £m

Benefits per sector Core Scenario Option 3A		Destination									Total
		1	2	3	4	5	6	7	8	9	
Origin	1	0.0	-9.2	-4.3	1.4	1.0	2.0	0.1	2.4	5.4	-1.1
	2	1.4	-0.1	-0.1	-1.2	-1.0	4.8	4.5	-0.8	1.4	9.2
	3	1.3	0.3	0.1	0.0	0.3	3.8	3.5	0.0	2.2	11.5
	4	6.6	3.0	0.8	-1.0	5.8	20.8	29.8	4.8	21.9	92.4
	5	3.2	7.9	5.0	1.1	0.3	3.5	27.8	-0.2	5.7	54.3
	6	1.8	1.1	1.9	2.5	0.9	2.6	7.4	-0.1	8.1	26.2
	7	0.1	-11.4	-6.7	3.3	12.4	3.7	0.2	20.0	3.4	25.0
	8	3.8	5.9	2.7	-0.1	-1.4	1.4	34.6	1.1	1.6	49.5
	9	7.3	7.0	4.8	12.0	12.2	16.1	12.3	3.4	10.9	85.9
Total		25.5	4.5	4.4	18.0	30.5	58.7	120.2	30.5	60.5	352.9

Appendix E Significance of Environmental Effects During Construction and Operation

Significance of Effects During Construction and Operation

	Option 1		Option 1A		Option 2		Option 2A		Option 3		Option 3A		Option 6	
	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Air Quality	Not Significant Adverse	Not Significant Beneficial	Not Significant Adverse	Not Significant Adverse	Not Significant Adverse	Not Significant Beneficial	Not Significant Adverse	Not Significant Beneficial	Not Significant Adverse	Not Significant Beneficial	Not Significant Adverse	Not Significant Beneficial	Not Significant Beneficial	Not Significant Beneficial
Cultural Heritage	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Major Adverse	Moderate Adverse	Major Adverse	Moderate Adverse	Neutral	Neutral	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse
Landscape	Significant Adverse	Significant Adverse	Significant Adverse	Significant Adverse	Significant Adverse	Significant Adverse	Significant Adverse	Significant Adverse	Significant Adverse	Neutral	Significant Adverse	Significant Adverse	Significant Adverse	Significant Adverse
Nature Conservation	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Slight Adverse	Slight Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse
Geology and Soils	Large Adverse	Neutral	Large Adverse	Neutral	Large Adverse	Neutral	Large Adverse	Neutral	Large Adverse	Neutral	Large Adverse	Neutral	Neutral	Neutral
Materials	Slight to Moderate Adverse	Neutral	Slight to Moderate Adverse	Neutral	Slight to Moderate Adverse	Neutral	Slight to Moderate Adverse	Neutral	Slight to Moderate Adverse	Neutral	Slight to Moderate Adverse	Neutral	Neutral	Neutral
Noise and Vibration	Not Significant Adverse	Beneficial	Not Significant Adverse	Beneficial	Not Significant Adverse	Beneficial	Not Significant Adverse	Not Significant Adverse	Not Significant Adverse	Neutral	Not Significant Adverse	Neutral	Not Significant Adverse	Not Significant Adverse
Effects on All Travellers	Not Significant Adverse	Not Significant Beneficial	Not Significant Adverse	Not Significant Beneficial	Not Significant Adverse	Not Significant Beneficial	Not Significant Adverse	Not Significant Beneficial	Not Significant Adverse	Not Significant Beneficial	Not Significant Adverse	Not Significant Beneficial	Not Significant Beneficial	Not Significant Beneficial
Communities and Private Assets	Slight Adverse	Moderate Adverse	Slight Adverse	Moderate Adverse	Slight Adverse	Moderate Adverse	Slight Adverse	Moderate Adverse	Slight Adverse	Moderate Adverse	Slight Adverse	Moderate Adverse	Not Significant Beneficial	Not Significant Beneficial
Road Drainage and Water Environment	Slight Adverse	Moderate Adverse	Slight Adverse	Moderate Adverse	Slight Adverse	Moderate Adverse	Slight Adverse	Moderate Adverse	Slight Adverse	Slight Adverse	Slight Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse
Combined effects	Not Significant Adverse	Not Significant Adverse	Not Significant Adverse	Not Significant Adverse	Significant Adverse	Significant Adverse	Significant Adverse	Significant Adverse	Not Significant Adverse	Not Significant Adverse	Significant Adverse	Significant Adverse	Significant Adverse	Significant Adverse
Cumulative effects	Not Significant Adverse	Neutral	Not Significant Adverse	Neutral	Significant Adverse	Not Significant Adverse	Significant Adverse	Not Significant Adverse	Not Significant Adverse	Neutral	Significant Adverse	Not Significant Adverse	Significant Adverse	Not Significant Adverse

All effects are assessed on the basis of the precautionary principle and are therefore worst case. Shading indicates effects that are significant (moderate or above).

Appendix F Appraisal Summary Tables

Appendix G Comparison of Appraisal Summary Tables

Comparison of Appraisal Summary Tables for all Options

		OPTION 1			OPTION 1A			OPTION 2			OPTION 3			OPTION 3A		
		Qualitative	Monetary £(NPV)	RAG Analysis	Qualitative	Monetary £(NPV)	RAG Analysis	Qualitative	Monetary £(NPV)	RAG Analysis	Qualitative	Monetary £(NPV)	RAG Analysis	Qualitative	Monetary £(NPV)	RAG Analysis
Economy	Business users & transport providers	Not applicable	+ £150.2M	Moderate Beneficial	Not applicable	+ £115.6M	Moderate Beneficial	Not applicable	+ £222.1M	Large Beneficial	Not applicable	+ £74.3M	Slight Beneficial	Not applicable	+ £142.4M	Moderate Beneficial
	Reliability impact on Business users	Not applicable	+ £149.7M	Moderate Beneficial	Not applicable	+ £59.8M	Slight Beneficial	Not applicable	+ £164.7M	Moderate Beneficial	Not applicable	+ £109.7M	Moderate Beneficial	Not applicable	+ £136.3M	Moderate Beneficial
	Regeneration	Not Assessed at this Stage	-	Neutral	Not applicable	-	Neutral	Not applicable	-	Neutral	Not applicable	-	Neutral	Not applicable	-	Neutral
	Wider Impacts	Not Assessed at this Stage	-	Neutral	Not applicable	-	Neutral	Not applicable	-	Neutral	Not applicable	-	Neutral	Not applicable	-	Neutral
Environmental	Noise (NPV)	Not applicable	- £5.7M	Slight Adverse.	Not applicable	- £5.3M	Slight Adverse.	Not applicable	- £4.02M	Slight Adverse.	Not applicable	- £3.29M	Slight Adverse.	Not applicable	- £9.53M	Moderate Adverse
	Air Quality (NPV)	Not applicable	+ £2.8M	Moderate Beneficial	Not applicable	+ £580K	Slight Beneficial	Not applicable	+ £2.18M	Moderate Beneficial	Not applicable	+ £2.72M	Moderate Beneficial	Not applicable	+ £1.07M	Slight Beneficial
	Greenhouse gases	Not applicable	- £1.18M	Moderate Adverse	Not applicable	+ £1.0M	Slight Beneficial	Not applicable	- £191K	Slight Adverse.	Not applicable	- £1.75M	Moderate Adverse	Not applicable	- £951K	Slight Adverse.
	Landscape	Not applicable	-	Neutral	Not applicable	-	Neutral	Not applicable	-	Neutral	Not applicable	-	Neutral	Not applicable	-	Neutral
	Townscape	Slight Adverse.	-	Slight Adverse.	Slight Adverse.	-	Slight Adverse.	Moderate Adverse	-	Moderate Adverse	Neutral	-	Neutral	Slight Adverse	-	Slight Adverse.
	Historic Environment	Moderate Adverse	-	Moderate Adverse	Moderate Adverse	-	Moderate Adverse	Major Adverse	-	Large Adverse	Neutral	-	Neutral	Moderate Adverse	-	Moderate Adverse
	Biodiversity	Slight Adverse	-	Slight Adverse	Slight Adverse	-	Slight Adverse	Slight Adverse	-	Slight Adverse	Neutral	-	Neutral	Slight Adverse	-	Slight Adverse
	Water Environment	Neutral	-	Neutral	Neutral	-	Neutral	Slight Adverse	-	Slight Adverse	Neutral	-	Neutral	Slight Adverse	-	Slight Adverse
Social	Commuting and Other users	Not applicable	+ £206.8M	Moderate Beneficial	Not applicable	+ £167.5M	Moderate Beneficial	Not applicable	+ £320.5M	Large Beneficial	Not applicable	+ £100.7M	Slight Beneficial	Not applicable	+ £194.8M	Moderate Beneficial
	Reliability impact on Commuting and Other users	Not applicable	+ £78.1M	Moderate Beneficial	Not applicable	+ £26.1M	Slight Beneficial	Not applicable	+ £85.0M	Large Beneficial	Not applicable	+ £55.9M	Slight Beneficial	Not applicable	+ £71.8M	Moderate Beneficial
	Physical activity	Neutral	-	Neutral	Neutral	-	Neutral	Neutral	-	Neutral	Neutral	-	Neutral	Neutral	-	Neutral
	Journey quality	Large Beneficial.	-	Large Beneficial	Large Beneficial.	-	Large Beneficial	Large Beneficial.	-	Large Beneficial	Large Beneficial.	-	Large Beneficial	Large Beneficial.	-	Large Beneficial
	Accidents	Not applicable	-£8.5M	Moderate Adverse	Not applicable	+ £1.9M	Slight Beneficial	Not applicable	+ £8.4M	Large Beneficial	Not applicable	+ £5.8M	Large Beneficial	Not applicable	- £24.1M	Large Adverse
	Security	Neutral	-	Neutral	Neutral	-	Neutral	Neutral	-	Neutral	Neutral	-	Neutral	Slight Beneficial	-	Slight Beneficial
	Access to services	Slight Beneficial	-	Slight Beneficial	Slight Beneficial	-	Slight Beneficial	Slight Beneficial	-	Slight Beneficial	Slight Beneficial	-	Slight Beneficial	Slight Beneficial	-	Slight Beneficial
	Affordability	Not Assessed at this Stage	-	Neutral	Not Assessed at this Stage	-	Neutral	Not Assessed at this Stage	-	Neutral	Not Assessed at this Stage	-	Neutral	Not Assessed at this Stage	-	Neutral
	Severance	Not Assessed at this Stage	-	Neutral	Not Assessed at this Stage	-	Neutral	Not Assessed at this Stage	-	Neutral	Not Assessed at this Stage	-	Neutral	Not Assessed at this Stage	-	Neutral
	Option and non-use values	Not applicable	-	Neutral	Not applicable	-	Neutral	Not applicable	-	Neutral	Not applicable	-	Neutral	Not applicable	-	Neutral
Public Accounts	Cost to Broad Transport Budget	Not applicable	+£137.2M	Moderate Beneficial	Not applicable	+ £112.2M	Moderate Beneficial	Not applicable	+ £207.3M	Large Beneficial	Not applicable	+ £44.8M	Slight Beneficial	Not applicable	+ £135.9M	Moderate Beneficial
	Indirect Tax Revenues	Not applicable	+£3.7M	Moderate Beneficial	Not applicable	- £1.1M	Slight Adverse	Not applicable	+ £2.0M	Moderate Beneficial	Not applicable	+ £4.6M	Moderate Beneficial	Not applicable	+ £3.5M	Moderate Beneficial

Large Beneficial
Moderate Beneficial
Slight Beneficial
Neutral
Slight Adverse
Moderate Adverse

Large Adverse

