

A Route Strategy and Action Plan for the A27

Final Report (D8)

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Plan Design Enable

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Executive Summary

Executive summary

Introduction

Atkins was commissioned by West Sussex County Council (WSCC) to develop a Route Strategy and Action Plan for the A27, drawing on current and previous work relating to 14 key junctions on the A27 identified as bottlenecks at Worthing, Arundel and Chichester in order to recommend and drive forward options that can be delivered in the short term and will reduce congestion and improve journey times hence unlocking the economic potential of the areas.

Specific objectives for the schemes were defined that reflected challenges and opportunities in the study area:

- Improve journey times and journey time reliability for strategic (longer distance traffic) on the A27, whilst ensuring the dual function of the A27 as a longer distance strategic route and a local access route is maintained;
- Improve access by private and public transport to key employment and regeneration areas within Coastal West Sussex;
- Enable proposed housing, employment and retail growth to take place within Coastal West Sussex without undue congestion;
- Improve connectivity to/from the Manhood Peninsula (including Selsey and the Witterings).

These were to be achieved within a set of guiding principles defining interventions to be affordable and achievable in the short term with an indicative package cost in the order of £150m to £250m. Proposals were not to prejudice longer term aspirations for the route but more expensive full bypass options were excluded. Wider impacts on local traffic were to be considered alongside improvements for strategic traffic on the A27 itself and complementary local transport strategies for Chichester, Arundel, and Worthing were required to lock in the benefits of the identified strategy, and address residual problems on the network.

Preferred Package

After initial testing and assessment of options a preferred package has been subject to feasibility design and costs, traffic and economic modelling and detailed appraisal under WebTAG principles.

Table 1 below describes the preferred package and costs of schemes for the A27 which total £59.6m, plus maintenance of these schemes, estimated to cost approximately £35,000 per year.

Chichester		Arundel		Worthing	
Fishbourne - £5.8m	'Through About' Signalised Roundabout A27 straight ahead two lanes through signalised roundabout Left signalised filter lanes.	Crossbush - £8.0m	A27 carriageway extended under bridge to signalised junction with A284. A284 northbound diverted to west of bridge and southbound over bridge	Offington - £3.6m	'Through About' Signalised Roundabout A27 - Two straight ahead lanes Left signalised filter lanes Goodwood Road closed
Stockbridge - £5.6m	Signalised Junction A27 widened to three straight ahead lanes Left filter lanes. All right turn movements prohibited	Causeway - £3.6m	Three-leg signalised junction A27 widened to two straight ahead lanes Left filter lanes provided	Grove Lodge - £4.5m	'Through About' Signalised Roundabout A27 - Two straight ahead lanes Left signalised filter lanes
Whyke - £5.3m	Signalised Junction A27 widened to three straight ahead lanes Left filter lanes. All right turn movements prohibited	Ford - £3.8m	'Through About' Signalised Roundabout A27 – Two straight ahead lanes Left signalised filter lanes	Lyons Farm - £1.0m	A27 westbound improve merge A27 westbound widening in south verge Woodlands Ave and Hadley Ave closed. A27 lay-by closed. Signal optimisation
Bognor - £10.5m	Signalised reconfigured roundabout A27 widened to three straight ahead lanes A259 Bognor Road widened to			Busticle Lane - £0.2m	No changes to highway alignment and signal optimisation By use of MOVA or SCOOT control system, alterations to

Chichester		Arundel		Worthing	
	three lanes Vinnetrow Road diversion to signalised junction with A259				the phase / stage arrangements
Oving - £0.2m	Signalised junction A27 - Two lanes straight ahead and left turn only			North Lancing - £3.3m	Signalised Junction with flares A27 widened to two straight ahead Left filter lanes
Portfield - £4.2m	A27 New dedicated lanes westbound and revised roundabout layout and geometry A27 revised Portfield Roundabout layout and geometry New left in left out junctions with A27 to south and east of Portfield Roundabout New footbridges				
Area Cost	£31.6m	5.4m		£12.6m	
Total Cost	£59.6m				

Note: 2012 prices

Appraisal

Testing indicated that significant benefits could be achieved. In the majority of cases current delays on the A27 were reduced or removed. Similarly whilst there are occasions where delay increases on some adjacent arms these are not significant and most major delays on these arms are also reduced or removed.

However, whilst the benefit to traffic travelling across Worthing and Chichester is clear with significant improvements in average speed and reductions in travel time as a result of less delay the benefits to traffic across Arundel are less clear. By 2026 the network is forecast to be operating a better condition with the scheme than it is forecast to be operating at the time of construction in Chichester and Worthing, but not Arundel. The proposals do improve junction performance and allow for the forecast increase in traffic to be accommodated yet the wider benefits in improved average speed and reduced delays across the Arundel A27 corridor as experience elsewhere are not realised.

The value of including the schemes around Arundel warrant further investigation and there are some elements of the designs which will need further attention as the implementation process progresses but in general the scheme is a worthwhile one. Projected economic benefits of £309m over 60 years provide a very confident benefit to cost ratio of 5.0 which far exceeds the DfT guidance of 2 for progressing worthwhile schemes and allows for a certain amount of uncertainty which will can be addressed in future development of the schemes. In addition there are forecast to be further benefits to the wider economy through the potential for additional housing and employment opportunities:

- between 5,770 and 9,265 housing units could currently be considered dependant on improving these junctions on the A27;
- such improvements would release employment and mixed use development land that would have the potential to create 1000 to 2000 jobs; and
- generate a further £30.9m to £61.7m to the wider economy over 60 years.

An appraisal framework was defined early in the study which would ensure proposals were assessed against the strategic objectives and challenges and was based on the DfT and HA 5 business cases of Strategic Fit, Value for Money, Financial, Management and Commercial elements. At an aggregated qualitative level 3 of the 5 elements can be considered to provide Moderate Benefits. Financially whilst costs are lower than guided they are still considerable and there is limited funding available so is only considered to be slightly beneficial and commercially a slightly adverse impact is considered as a funding/financing package is one of the key uncertainties for future implementation of the scheme. Overall at this stage the scheme is considered to deliver Moderate Benefits.

The package provides sufficient improvement to accommodate currently planned growth to 2026 with conditions improving at Chichester and Worthing. The longevity of these benefits beyond 2026 will depend

on the actual rate of traffic growth and the effect of providing additional capacity on travel behaviour which may include attracting trips to the A27 which are currently made at different times of day or on different routes to avoid peak hour congestion on the A27

Recommendations

There are number of unresolved issues and elements of the process that hold risk if not considered or addressed as part of future refinement (section 8.2). These largely relate to the scale and use of the modelling and the value and design of some elements of the schemes against others.

Based on the range of findings key actions have been suggested for future development and to support delivery (section 8.3). Full application of the strategic model (and evening peak assessment) should be considered to shed further light on the operation of scheme. To clarify the performance of the scheme in Arundel a model review and more detailed refinements are recommended (section 6.1). In relation to this project the key uncertainty is considered to be funding and financing. Recommendations highlight the need for WSCC to begin engagement with the Finance department to agree the source of funding and define a plan for future financing, establish the longer term project management structure with the HA and begin engagement with the District Councils regarding setting up Community Infrastructure Levies (CILs) as a potential significant source of financing and how agreements for contributions to the A27 scheme could work. With the desire for short term implementation imminent action is desirable.

A27 Route Strategy Final Report

The background of the page is a solid teal color. In the lower half, there is a large, abstract graphic composed of several overlapping, semi-transparent geometric shapes in various shades of teal and light blue. These shapes create a sense of depth and movement, resembling a stylized architectural or landscape element.

1. Introduction

Atkins was commissioned by West Sussex County Council (WSSCC) to develop a Route Strategy and Action Plan for the A27, drawing on current and previous work relating to key junctions on the A27 at Worthing, Arundel and Chichester in order to recommend and drive forward options that can be delivered in the short term and will reduce congestion and improve journey times hence unlocking the economic potential of the areas.

This report documents the key elements of the strategy resulting from the development and testing work undertaken through the six month study from January to June 2013. It includes:

- A background to the study approach, area and issues in **Chapter 2**;
- The Route Strategy consisting of identified objectives and guiding principles, a brief summary of the option development and the description of the preferred schemes in **Chapter 3**;
- The scheme designs and cost at this feasibility level in **Chapter 4**;
- The potential for complementary local transport for the A27 Route Strategy, introduced in **Chapter 5**;
- The appraisal of the preferred schemes in relation to traffic and economic impacts, cost benefit analysis and a summary of the overall WebTAG based appraisal in **Chapter 6**;
- A plan of action is considered to help ensure implementation of the scheme can be pursued, particularly in relation to funding and financing is in **Chapter 7**; and
- An overall conclusion and set of key actions is included in **Chapter 8**.

Whilst providing a standalone document reporting on the study outcomes more detail on each of the stages can be found in the previous deliverables:

- Deliverable D1 - Route Strategy v1.2 (March 2013);
- Deliverable D2 - Option Identification and Sifting Report v1.1 (March 2013);
- Deliverable AD1 - Scenarios for Testing v1.5 (March 2013);
- Deliverable D6 - Complementary Local Transport Strategy v1.3 (April 2013);
- Scenarios Appraisal Report AD2 v1.4 (May 2013);
- Preferred Package Appraisal Report D5 v1.1 (June 2013);
- Action Plan D7 v1.0 (June 2013);
- AD3 Modelling Note v2 (June 2013).

2. Study Background

The approach to developing a Route Strategy for the A27 has been shaped by the Proportionate appraisal guidance (TAG Unit 2.1.2C), DfT's Early Assessment and Sifting Tool (EAST), and The Transport Business Case Guidance (DfT, April 2011). This identifies the need for an evidence-base identifying issues and a 'need' for intervention in order to allow for a clear rationale for the measures proposed.

To identify the problems and objectives for the area a large body of evidence was identified and reviewed which related to current transport-related problems; future transport-related problems; and underlying causes – framed within national and local priorities and taking account of future land-use policies.

Through this review and consultation with a WSCC steering group issues affecting the corridor as a whole between Chichester and Worthing were identified and the nature of the 'problem' at each of the 14 junctions.

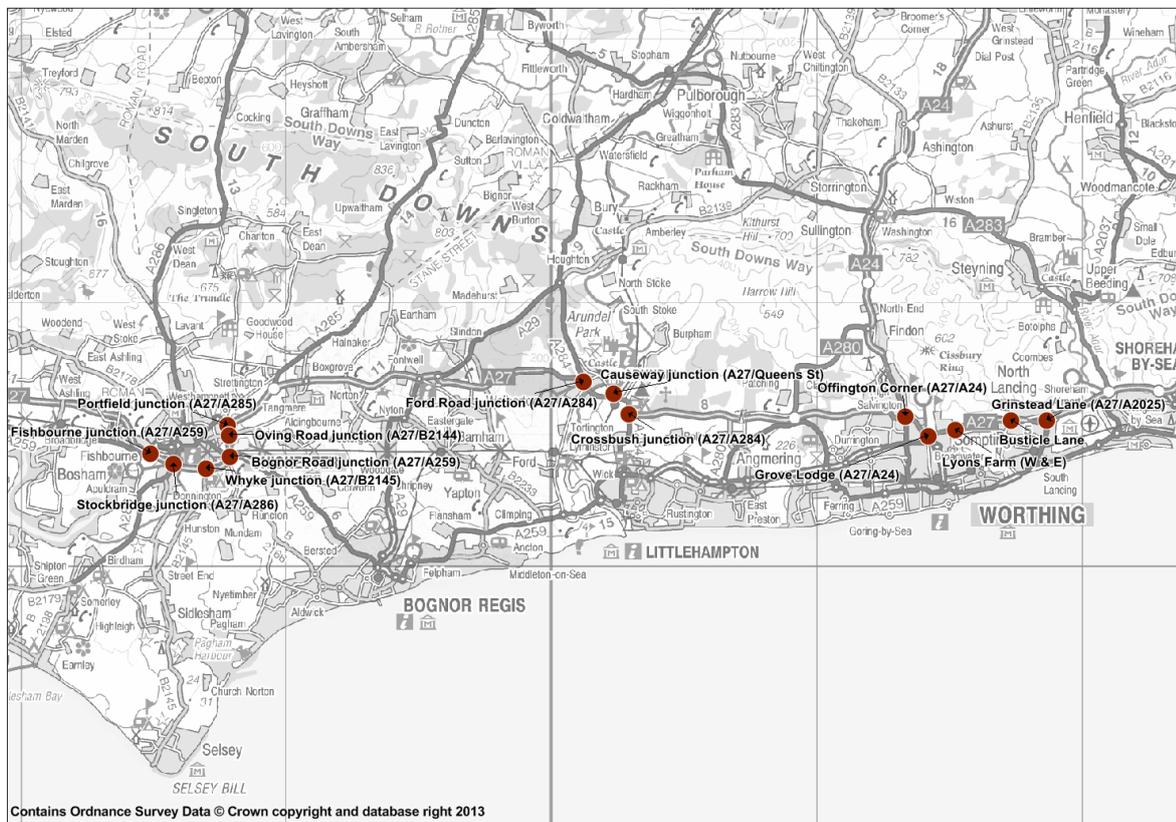
Options for improvement emerged from the review and suggestions by Atkins experts and the steering group. These were sifted and refined through a staged appraisal framework in order to reach the final preferred package of schemes. This process is described in more detail in Chapter 3.

Consultation with the steering group and Highways Agency Local Area Manager was undertaken throughout the process.

2.1. Study Area

The study area was defined in the brief for the project by WSCC and their steering group and is located within Coastal West Sussex, which encompasses Bognor Regis, Arundel, Littlehampton, Worthing, Shoreham, and Chichester. It focuses on 14 key junctions across Chichester, Arundel and Worthing shown in Figure 2-1.

Figure 2-1 Junctions identified for improvements



The focus on these junctions emerged through a number of previous studies dating back to the 1990's, including the South Coast Multi Modal Study (SoCoMMS, 1998) and the more recent West Sussex Coast

Delivering a Sustainable Transport System (DaSTS 2010) which have highlighted the problems which exist on the A27. A summary of these studies is included in **Appendix A**.

2.2. Strategic Background

The West Sussex Transport Plan 2011-2016 prioritised improvements to the main bottlenecks on the A27 at Chichester, Arundel and Worthing which continue to cause congestion and unreliable journey times for residents and businesses in West Sussex. However, recent Spending Review statements have made it clear that there is little prospect of government progressing such improvements in anything other than the very long term.

Accordingly, the WSCC Cabinet has agreed that the County Council should work with the Highways Agency, Coast to Capital Local Economic Partnership and Districts and Borough Councils to prepare a short term strategy for the A27 in West Sussex that:

- Optimises route standard and performance in terms of reliability and consistency;
- Reduces congestion and carbon emissions;
- Is realistic in terms of affordability and achievability;
- Is capable of phased implementation in response to funding availability;
- Integrates well with local transport networks, the local environment and plans for future growth;
- Quantifies benefits to the economy of improvement schemes; and
- Provides clear mechanisms for enabling delivery.

For manageability and affordability reasons this study has been limited to the 14 junctions identified. However, it is acknowledged that there are other locations along the A27 which are strategically and economically important to the region which also suffer from delays and traffic congestion.

The Sussex Pad junction is specifically worth noting because of the large scale of development planned around Shoreham Airport which will likely impact on the operation of that junction, requiring improvement and its potential to influence traffic at the junction westbound of North Lancing / Grinstead Lane which is included as part of the study. This development is intended to bring forward new employment opportunities and its economic potential is recognised as it is considered an important hub of the Brighton City Region City Deal.

It is worth noting early on that the study area is environmentally sensitive and includes sites of international, national and regional importance:

- The South Downs National Park borders or crosses the A27 at various locations, particularly around Arundel, west of Worthing and Sompting;
- The corridor also contains several watercourses and woodland areas of nature conservation importance, which will need to be considered;
- There is a need to minimise the risk of increased flooding in the corridor, particular in relation to the ground aquifer at Fishbourne, the River Lavant (which crosses the A27 between Fishbourne and Stockbridge Roundabout), and the River Arun at Arundel;
- Other issues to be considered include the historic character of Arundel, the setting and views of Arundel Castle and Cathedral from Causeway and Ford Road Junctions, and the settings and views of Chichester Cathedral in relation to Fishbourne Junction (in terms of view from the Harbour) and Bognor Junctions.

As a result of one or more of these issues a number of schemes have already been rejected due to, or significantly affected by, environmental factors, including proposals for Chichester Bypass (South Coast Multi-Modal Study 2002), Arundel By-Pass and Worthing By-Pass.

2.3. Issues and Need for Intervention

Some of the area-wide headlines that emerged from the document review identified issues that can be addressed to some extent through transport improvements include:

- **Poor economic performance relative to the rest of West Sussex** – Coastal West Sussex and the economy is now forecast to grow less in the area than the South East average. Economic performance is of most concern in the districts of Arun (which includes Arundel) and Adur (which includes Lancing, Sompting, Shoreham and Southwick);

- **Pockets of deprivation** – In Coastal West Sussex (in 2007), 8 wards fall within the 20 percent most deprived wards nationally, including locations in Bognor Regis, Littlehampton, Worthing and the district of Adur;
- **Planned development** – There is considerable development planned for across the area. Whilst providing the opportunity to expand the local economies it will create increased traffic and is also widely accepted to perpetuate any traffic issues unless mitigations are put in place in the form of traffic schemes as well as wide ranging complementary transport measures;
- **Only strategic route** – The A27 is the only major east/west road along the South Coast linking areas such as Brighton, Worthing, Chichester Portsmouth, Southampton and beyond.
- **Dual functions for local and strategic traffic** – Particularly at sections around Chichester, Arundel and Worthing the A27 has a dual function as a strategic route and bypass and a local access road.
- **Poor local transport options:** Current rail services between Brighton and Chichester are perceived as slow and have been reaching capacity during peak periods of travel. There is also a limited supply of modern trains and carriages available to provide extra capacity along the West Coastway. The bus network is viewed as unreliable, infrequent, expensive and inconvenient, particularly in rural areas where some key destinations are not served. ;
- **Poor connectivity inhibits economic growth** – The current transport infrastructure deficit causes poor connectivity within Coastal West Sussex, and to the wider region, which inhibits economic growth. In particular, the current transport deficit is widely considered by local businesses to contribute to poor economic performance in Arun;
- **Number and proximity of major junctions on the A27** – A number of major junctions bisect the A27, causing delay for east-west traffic. These junctions are in close proximity to each other, typically between 0.4 and 0.7 miles apart. Any engineering solutions will therefore need to work collectively across each set of junctions, and recognise capacity constraints on adjoining links, to prevent passing the problem from one junction to another;
- **High car dependency** – Travel patterns within the corridor are dominated by the private car and low usage of sustainable modes of transport. The current provision of pedestrian, cycle and public transport facilities in each of the three areas are unable to support and maintain sustainable travel.

At a more localised level additional considerations were identified:

- Around Chichester:
 - **Dual function of Chichester Bypass** – there are a large number of commuters driving into the City in the morning and local traffic accounts for the majority of A27 traffic on this section;
 - **Congestion** - None of six junctions on the bypass cope with the present peak levels of traffic. Congestion is made worse in the summer when tourist traffic adds to the problem;
 - **Fishbourne Junction** - Noted as having important views of the Chichester Cathedral from this junction. There are potential issues relating to the groundwater aquifer at Fishbourne and water quality of the River Lavant;
 - **Stockbridge Junction** - A residential location and an AQMA with noise quality issues. Particular severance issues where there is a significant amount of residential development, immediately south of the A27. Significant congestion at the A286 Stockbridge Road and A259 Bognor Road roundabouts makes access from the Manhood Peninsula very unreliable due to the conflict between north-south and east-west A27 traffic. ;
 - **Whyke Junction** – A residential location. The level crossing nearby limits the attractiveness of this route in terms of providing good access into Chichester. Identified as a priority location in DEFRA Noise Action Plan;
 - **Bognor Road Junction** - Noted for important views of the Chichester Cathedral from this junction. Significant congestion at the A286 Stockbridge Road and A259 Bognor Road roundabouts makes access from the Manhood Peninsula very unreliable due to the conflict between north-south and east-west A27 traffic;
 - **Oving Road Junction** – A residential location. Narrowness and on street parking limits the attractiveness of this route in terms of providing good access into Chichester;
 - **Portfield Road Junction** - Supports traffic to the nearby retail park.
- Around Arundel:
 - **Congestion** - occurs on this section of the A27 at peak times on weekdays and at weekends, particularly in the summer. The Highways Agency Regional Network Report (2008) indicated that the predicted 'stress factor' performance indicator on the Arundel bypass will be over 150% by 2026;
 - **Secondary impacts on the Arundel area** – The LTP asserts that issues associated with the A27 around Arundel contribute to poor connectivity to/from Littlehampton, Bognor Regis and the coastal area;

- **Single Lane Carriageway sections operating near capacity** – The single lane sections between Ford and Causeway Roundabouts (Arundel By-pass) and Causeway Roundabout and Crossbush Junction (The Causeway) act as a constraint on the amount of traffic that can pass through the bottleneck;
- **Ford Roundabout** – The HA indicates that pinch point funding has been awarded to reduce congestion by providing two lanes at the westbound entry to the roundabout and providing new lane markings on the roundabout and associated roads. DEFRA has identified noise issues around Ford Road Junction;
- **Causeway** – This area is close to exceeding allowable air quality levels;
- **Crossbush** – Currently the focus of a separate study. Congestion occurs westbound where the A27 dual lane approach meets the A285 and becomes single lane.
- Around Worthing:
 - **Dual function of A27 through Worthing** – the Worthing Congestion Study indicates the majority of traffic using the A27 in Worthing and Lancing starts or ends its journey in Worthing or Lancing, with only around a quarter being through traffic;
 - **Congestion** - Significant peak time congestion causes long delays, and very unreliable journey times for local and through traffic at peak times in both directions (and on the A24 north and southbound directions);
 - **Offington Corner** - Both the A24 and A27 carry high volumes of traffic, with the approaches experiencing severe congestion during the peak hours, predominantly due to circulatory traffic creating few gaps for traffic to enter the roundabout;
 - **Single Lane Carriageway sections operating at capacity** – The single lane sections between Offington Roundabout and Grove Lodge (Warren Road) and between Grove Lodge and Sompting Road (Upper Brighton Road) act as a constraint on the amount of traffic that can pass through the bottleneck;
 - **Grove Lodge** - Signalised roundabout on SCOOT/UTC system has been declared an AQMA. The local Sixth Form College is being relocated to a site on the junction;
 - **Lyons Farm/Sompting Road** – These junctions are within close proximity and both signalised Junction on SCOOT/UTC and therefore considered linked providing access to the Lyons Farm retail park and Sompting Road. The two signalised junctions are the main reason for the delay. On the westbound carriageway congestion also originates from Grove Lodge and a substandard lane merge with traffic going from two lanes to one causing friction with many drivers not merging in turn;
 - **Busticle Lane** - Congestion at peak times can be an issue due to the large number of turning movements catered for and the heavy A27 through flow;
 - **North Lancing (Grinstead Lane)** - Experiences considerable queues in both directions during the peak hours predominantly due to high approach flows and circulatory traffic resulting in reduced gaps to enter.

3. A27 Route Strategy

The previous chapter summarises the challenges faced and the need for intervention, which will be perpetuated in the absence of any intervention. These challenges have shaped the objectives against which options are assessed to ensure that the recommended strategy delivers the expected benefits.

In addition, a set of guiding principles were identified to ensure that options included within the strategy are consistent with the expectations of West Sussex County Council (WSCC) and the Highways Agency (HA), in terms of strategic fit, value for money, affordability, deliverability, and commercial viability.

This chapter documents the A27 Route Strategy through the defining structure and processes which led to the definition of preferred package.

3.1. Objectives and Guiding Principles

3.1.1. A27 specific objectives

The following intervention objectives reflect the challenges and opportunities outlined in the previous chapter. Some will primarily be addressed through interventions to the A27 itself, while others will primarily be addressed through complementary measures as part of the wider strategy:

- Improve journey times and journey time reliability for strategic (longer distance traffic) on the A27, whilst ensuring the dual function of the A27 as a longer distance strategic route and a local access route is maintained;
- Improve access by private and public transport to key employment and regeneration areas within Coastal West Sussex, including Chichester, Worthing and key regeneration areas such as Bognor Regis and Littlehampton;
- Enable proposed housing, employment and retail growth to take place within Coastal West Sussex without undue congestion;
- Improve connectivity to/from the Manhood Peninsula (including Selsey and the Witterings).

Secondary and complementary objectives

- Reduce severance caused by the A27 and address safety concerns, particularly where the A27 passes through a residential area (e.g. in Worthing);
- Minimise the impact of strategic traffic on nearby residential and rural roads (i.e. minimise rat running);
- Reduce car dependency for trips within the study corridor and within the individual sub-corridors;
- Protect the high quality urban and rural environment, and seek solutions that deliver long term environmental benefits in terms of air quality, noise and carbon emissions.

3.1.2. Guiding Principles

The following guiding principles reflect the constraints outlined by WSCC and the HA in the study brief, and our wider understanding of the requirements for a successful business case. They have therefore been structured around the Treasury's 5 Cases Model for business cases, which also forms the basis for the assessment framework presented in Chapter 6.

Strategic:

- Study objectives need to fit with wider transport and government objectives, including those of WSCC and the Highways Agency;
- Interventions should be affordable and achievable in the short term, but should not prejudice longer term aspirations for the route (considered at this stage to be the Chichester fly-overs, Arundel By-pass and Worthing by-pass);
- Complementary local transport strategies will be required for Chichester, Arundel, and Worthing / Lancing to lock in the benefits of the identified strategy, and address residual problems on the network;
- Wider impacts on local traffic will need to be considered alongside improvements for strategic traffic on the A27 itself. *E.g. Options such as closing of roundabouts or banning right turns, which benefit through movements on the A27, may have significant adverse impacts on access to urban areas or use of other local routes.*

Economic / Value for Money:

- Interventions need to represent good value for money in an economic, environmental and social context;
- The junctions within particular sub-corridors are in close proximity to each other, typically between 0.4 and 0.7 miles apart. Solutions will need to work collectively across each set of junctions, and recognise limitation in the adjoining link, so as to optimise route standard and performance in terms of reliability and consistency and to prevent passing the problem from one junction to another.

Financial:

- Interventions need to be affordable and financially sustainable in the short-term. An indicative package cost, in the order of £150m to £250m has been identified. Investigations of more expensive full bypass options are therefore excluded from this study, although remain as long term aspirations;
- Options which attract developer or other sources of third party funding will be assessed more favourably from a financial perspective;
- Scheme costs will need to consider wider impacts on utilities.

Management:

- The package must be acceptable and deliverable in the short-term;
- It must be capable of phased implementation in response to funding availability;
- Designs need to be consistent with the Design Manual for Roads and Bridges, with details of any known departures from standards clearly set out.

Commercial:

- The strategy must be based on clear mechanisms for enabling delivery;
- The Highways Agency (as the responsible authority for the A27 trunk road) needs to approve the overall strategy (and key deliverables) to enable scheme implementation to progress with minimal further work as funding opportunities arise.

3.2. Developing a Preferred Package

There were two key stages leading to the definition of the preferred package:

- An emerging list of options was derived from document reviews and consultation with the WSCC member steering group which underwent an initial sift to discard options that did not fit the objectives and guiding principles;
- Three scenarios of options for each centre were then defined and underwent traffic model testing, cost estimation and initial appraisal.

The preferred package was defined and subsequently refined from the best performing and complementary elements across the scenarios, rather than comprising wholly of any tested scenario.

3.2.1. Identification of Potential Options

The document review and initial consultations resulted in a list of 43 options across the 14 junctions. These included a range of options which sat within the following categories:

- At grade options such as:
 - Conversion of roundabouts to signalised junctions (or vice versa);
 - Signal optimisation (e.g. Assessment of timings or method of control);
 - Junction redesign within current carriageway (e.g. lane reorganisation);
 - Junction redesign with minor carriageway adjustments (e.g. lane widening, flaring on approaches);
 - Junction redesign with significant carriageway adjustments (e.g. hamburger junctions, slip roads, or relocation);
 - Traffic management (e.g. closure of entry/exits, banning right turns);
 - Intelligent transport solutions, such as Variable Message Signs;
- Low cost grade separation (e.g. flyovers) such as previously identified options for Fishbourne Roundabout, Bognor Road Roundabout (Jacobs) and Crossbush Signalised Junction (BBMM jv), which could be delivered within the indicative budget;
- Within, or adjacent to the existing land boundary, minimising use of land outside of the highways boundary or public authority ownership (Note: options to widen sections of the A27 at Arundel and elsewhere where intrusive land take would be required are considered out of scope); and
- Signals at junctions involving the use of signal control equipment, such as MOVA (Microprocessor Optimised Vehicle Actuation). MOVA offers a sophisticated dynamic method of control, which DMRB

recognises is ideal for coping with the widely changing volume of traffic and speed, commonly encountered at isolated junctions, and has been identified by the Highways Agency as the standard method of control for trunk road traffic signal sites. An extensive network of vehicle detectors on all approaches to the signalised junction enables all signal timings to vary in response to real time changes in traffic flow, maximising capacity during congested periods and avoiding unnecessary queuing during uncongested periods. MOVA can also result in a reduction in injury accidents, including lone vehicle incidents, by applying an 'All Red' phase during periods of low demand to constrain vehicle speed.

A summary of the initial types of options and those discarded in the initial sift is included in **Appendix B. Strategy for Developing A27 Packages**

To help define a preferred package a number of scenarios consisting of combinations of the emerging options were defined and tested. In order to help define these initial scenarios and resulting preferred package some overarching strategies emerged through review of documents and consultation with the WSCC steering group. These were:

- The strategy will seek to identify improvements at each of the three centres, rather than prioritising investment at any one of the three urban centres;
- It will aim to avoid significant increases in delay on other sections of the A27;
- The needs of both long distance through traffic and local movements will be considered;
- In Chichester Fishbourne, Bognor Road, and Portfield junctions will be prioritised as the three main approach routes into the City Centre. This is consistent with the approach identified within the emerging Local Plan Core Strategy;
- Options for related junctions will be treated as a combined package; and
- The strategy will consider the current noise and air quality issues and will seek to improve the existing situation where possible.

3.2.1.1. Access routes to Chichester

A consequence of promoting the three identified junctions as main approaches to Chichester would be limiting access at the others, or making them less attractive as an option. Through discussions with WSCC, the member's steering group and the HA options for testing were defined to include banning right turns and local straight over movements at Whyke, Stockbridge and Oving junctions. The access routes to Chichester from these junctions all involve crossing railway level crossings and are narrow streets with on-street parking so would benefit from reduced traffic levels. Following initial testing and further consultation the options at Whyke and Stockbridge were adjusted to allow local straight over movements retaining banned right turns. This was primarily to maintain access from the Manhood Peninsula to Chichester and the local schools. The proposals at Oving junction were not altered due to their current approved status by the HA as part of the Shopwhyke Lakes development.

3.2.2. Scenario Packages

A maximum of three options per centre were defined and tested which meant that not every permutation was possible. The scenarios chosen aimed to reflect the strategy and objectives described above.

As a result some scenarios represented themes in terms of solutions and managing residual impacts, others identified an 'alternative' option at one or more junction so that variations in impacts can be assessed. There were only a few options that did make the initial sift and were not selected for testing. These tend to be options that fitted less well within the overall A27 route strategy, offered the potential for fewer benefits or involved greater disbenefits to other users. The scenarios are presented in **Appendix C.**

3.2.3. Modelled Traffic Impacts

One of the most important elements required to assess the impact of the tested packages was the traffic impacts. The strategic and the local impacts of these options were modelled separately based on morning peak traffic flow in 2026.

The impact of the specific junction improvements at individual junctions have been modelled using LinSig (with traffic lights) and ARCADY (without traffic lights). This gives detailed information about junction performance, including delay for each traffic movement and traffic volume as a measure of capacity. The wider road network impact of the package of improvements has been modelled in SATURN. This estimates interaction of the package improvements with the wider assignment of traffic across the network and the impact on journey times along the A27 corridor. The development of the strategic model used in the testing is documented in more detail in **Appendix D.**

The different models produce slightly different results therefore the most appropriate indicators to consider when assessing the impact of the junction improvements were considered to be:

- From the Saturn model the average speed, total delay, vehicle kilometres and journey time across all junctions in each area. These reflect longer term performance by focussing on results forecast for 2026;
- The capacity at each junction and the delay experienced by vehicles on the strategic route and local road entry arms from the local junction modelling results using LinSig and Arcady.

The summary modelling results are presented in **Appendix E**. It was apparent from the results that whilst some scenarios performed better than others overall there were individual options in alternative scenarios that outperformed those in the overall better performing scenarios, highlighting the need for mixing and matching options for the final preferred package.

3.2.4. Outline Costs and Summary Appraisal

As well as the traffic impacts the outline costs and outcome of the WebTAG based appraisal featured in the decision making process for the preferred package composition. These are presented in **Appendix F and G** respectively.

3.3. Preferred Package

Following consideration of the scenario tests traffic model outputs, economic model outputs and appraisal of the 5 business cases and consultation with WSCC, HA and the WSCC member steering group a preferred package for final testing at this stage of development was identified.

As the preferred package comprises elements from across the range of scenarios tested they do not necessarily fall under any particular type or definition, but looking across the whole of the preferred package there are some generalities that can be picked out to define the improvements:

- Type of improvements - generally at-grade solutions, incorporating additional control through signalling and increasing capacity through additional lanes at junctions where possible;
- Dual function of strategic and local traffic – have generally sought to optimise all movements through signal control and reduce most significant delays, with strategic movements prioritised;
- Buses/Cycling/Pedestrians – considered on a junction by junction basis and generally maintaining existing facilities;
- Scale of Cost - considered to be relatively affordable solutions (£60m) compared to target price range identified at inception (£150m - £250m). Considered in more detail in Chapter 4;
- Likely Timescale – fit with short term implementation design, schemes are relatively uncontroversial and straightforward, should be able to be completed within 4 to 5 years. Considered in more detail in Chapter 7.

Table 3–1 Proposed Preferred Package

Chichester		Arundel		Worthing	
Fishbourne As per Scenario 3	'Through About' Signalised Roundabout A27 straight ahead two lanes through signalised roundabout Left signalised filter lanes, to and from, A27 provided Generally 3 lanes signalised on the circulatory carriageway No specific cycle provision	Crossbush As per Scenario 3	A27 carriageway extended under bridge to signalised junction with A284. A284 northbound diverted to west of bridge A284 northbound right turn to Brighton at signalised junction A284 southbound one way over existing bridge Pedestrian crossing provided by Crossbush Beefeater Cycleway route on west of A264 Bus stop relocated by Crossbush Beefeater Access to Crossbush Beefeater closed from A27 Land take required outside highway boundary to west of junction	Offington As per Scenario 2	'Through About' Signalised Roundabout A27 - Two straight ahead lanes through signalised roundabout Left signalised filter lanes from A27 provided Three lanes signalised on the circulatory carriageway Goodwood Road closure proposed Foot/cycle route from Findon Road to A24/A27 east via new crossing

Chichester		Arundel		Worthing	
Stockbridge As per adjusted Scenarios 1 and 2	<p>Signalised Junction A27 widened to three straight ahead lanes at traffic signals Cross roads - straight ahead lanes at traffic signals Left filter lanes with traffic signals on approach to A27 All right turn movements prohibited Potential for bus priority radial route into Chichester Footpath and Cycleway north-south route via existing footbridge to east Alternative cycle route via canal path to east</p>	Causeway As per Scenario 3	<p>Three-leg signalised junction A27 widened to two straight ahead lanes at traffic signals The Causeway two right turn lanes at traffic signals Left filter lanes provided Pedestrian crossing at junction</p>	Grove Lodge As per Scenario 1	<p>'Through About' Signalised Roundabout A27 - Two straight ahead lanes through signalised roundabout Left signalised filter lanes from A27 provided 2/3 lanes signalised on the circulatory carriageway Hill Barn improvements under Worthing College proposals Foot/cycle route from Worthing College to A24/A27 via new Toucan and Puffin crossing</p>
Whyke As per adjusted Scenarios 1 and 2	<p>Signalised Junction A27 widened to three straight ahead lanes at traffic signals Cross roads - Two straight ahead lanes at traffic signals Left filter lanes provided with traffic signals on approaches to A27 All right turn movements prohibited Potential for bus priority radial route into Chichester Footpath and Cycleway north-south route via new footbridge provided by others to west</p>	Ford As per Scenario 3	<p>'Through About' Signalised Roundabout A27 – Two straight ahead lanes through signalised roundabout Left signalised filter lanes from A27 provided Two lanes signalised on the circulatory carriageway No specific cycle provision</p>	Lyons Farm As per Scenarios 1 and 3	<p>A27 westbound two lanes after junction to improve merge A27 westbound widening in south verge Woodlands Ave and Hadley Ave closed to all traffic except authorised vehicles Automatic bollards to access Woodlands Ave and Hadley Ave for authorised vehicles A27 layby closed. Existing layby on Sompting Road retained Foot/cycle route via existing crossings Signal optimisation by use of MOVA or SCOOT control system, alterations to the phase / stage arrangements.</p>
Bognor As per Scenario 1	<p>Signalised reconfigured roundabout A27 widened to three straight ahead lanes at roundabout traffic signals A259 Bognor Road widened to three lanes approaching roundabout Vinnetrow Road diversion to signalised junction with A259 Footpath and Cycleway to Chichester via existing footbridge to south Cycleway route on old Vinnetrow Road to connect to cycle network</p>			Busticle Lane As per Scenario 1	<p>No changes to highway alignment and signal optimisation By use of MOVA or SCOOT control system, alterations to the phase / stage arrangements No specific cycle provision</p>
Oving As per Scenarios 1 and 3	<p>Signalised junction A27 - Two lanes straight ahead and left turn into Oving Road west only A27 and Oving Road west right turns prohibited Oving Road west left in left out only Oving Road east right turn bus exit only. Automatic raising bollards provided Pedestrian crossing at junction</p>			North Lancing As per Scenario 1	<p>Signalised Junction with flares A27 widened to two straight ahead and one right turn lanes at traffic signals Cross roads - two straight ahead/right turn lanes at traffic signals Left filter lanes provided with traffic signals on approaches to A27 No specific cycle provision</p>

Chichester		Arundel		Worthing	
	Cycleway route on Church Road and Oving Road west. Toucan Crossing on A27 to be considered <i>Note: Assume Shopwhyke Lake development arrangements in place</i>				
Portfield	A27 New dedicated lanes westbound and revised roundabout layout and geometry A27 revised Portfield Roundabout layout and geometry New left in left out junctions with A27 to south and east of Portfield Roundabout New footbridges to south and east of Portfield Roundabout by others Foot/Cycle path provision from Shopwhyke development to Portfield Way <i>Note: Assume Shopwhyke Lake development arrangements in place.</i>				

4. Feasibility Designs and Costs

4.1. Feasibility Designs

The feasibility designs which informed the appraisals are included in **Appendix H**. The originals of these are designed at a scale of 1:1000.

There are some elements in relation to the design and safety aspects within these designs which may want further consideration as any plans progress:

- Offington Junction Goodwood Road closure – the design recommends closure of Goodwood Road to improve operation of the junction. There appears to be available space for a turning head in this location and detailed design will need to incorporate this;
- Grove Lodge left filter lane – there is potential to improve the performance of the junction with a left hand filter lane from A27 Upper Bright Road to A24 Broadwater Street although this would require some land take from the corner property;
- Lyons Farm/Sompting Road merge – this proposal includes the closure of the entry/exit at Downlands Avenue and Hadley Avenue at the A27. This is primarily for safety reasons as the verge on the A27 would be removed as part of the design reducing sight lines. There is limited space for incorporating a turning head into the roads allowing larger vehicles to u-turn. The design suggests the use of an Automated Bollard to allow access to council and emergency vehicles. However, this could still cause concern with larger vehicles such as delivery vehicles. Options should be considered in more detail as part of any future detailed design. Alternative options could include:
 - providing a turning head at the northern ends of each road, although as there is no likely available land the most efficient design would need to incorporate the pavement width effectively becoming shared surface;
 - the junction at the A27 could be made entry only to vehicles over a certain size, this could be done in association with a no-entry sign to those vehicles at the junction with Sompting Road making it effectively one-way for larger vehicles. This could be monitored and enforced through CCTV.

4.2. Feasibility Costs

Following the outline costs a more detailed assessment was undertaken for the preferred package. The output of this exercise is shown in Table 4-1. The detailed background to these costs, along with a summary of operating cost assumptions are presented in **Appendix I**.

Key assumptions to note regarding these figures include:

- Construction costs based on Spons generalised rates for area of pavement adjusted for inflation for 2012;
- Statutory procedures and utilities costs based on 20% base construction costs at this stage;
- Land costs not included as in most cases where required appears to be owned by WSCC, other than Crossbush where an assumed estimate has been included schemes;
- Assumptions of 9% Preparation and 12% supervision costs have been included. Supervision costs are those associated with site staff and testing of materials. Preparation costs include Consulting Engineers'/Agent Authorities fees, actual costs of pursuing alternative routes (if any) in the early stages of the scheme, Public Consultation, Public Inquiry and the cost of any surveys carried out during scheme preparation;
- Project risk costs have been included generically as a 20% uplift of construction costs included and all options have a 45% optimism bias layer added.

Table 4.1 – Feasibility Costs for Preferred Package

Chichester		Arundel		Worthing and Adur	
Fishbourne - 'Through About' Signalised Roundabout	£5.8m	Crossbush – A27 carriageway extended under bridge to signalised junction with A284.	£8.0m	Offington – 'Through About' Signalised Roundabout	£3.6m
Stockbridge - Signalised Junction	£5.6m	Causeway - Three-leg signalised junction	£3.6m	Grove Lodge - 'Through About' Signalised Roundabout	£4.5m
Whyke - Signalised Junction	£5.3m	Ford – 'Through About' Signalised Roundabout	£3.8m	Lyons Farm – A27 westbound two lanes after junction to improve merge	£1.0m
Bognor – Signalised reconfigured roundabout and Vinnetrow Road diversion to signalised junction with A259	£10.5m (assumed no land cost for Vinnetrow Road diversion)			Busticle Lane – No changes to highway alignment and signal optimisation	£0.2m
Oving – Signalised junction	£0.2m			North Lancing – Signalised Junction with flares	£3.3m
Portfield - A27 New dedicated lanes westbound and revised roundabout layout and geometry	£4.2m (includes footbridge, additional land costs likely)				
Area Cost	£31.6m	£15.4m		£12.6m	
Total Cost	£59.6m				

Note: Price Base 2012

4.3. Bus Priority and Cycle Provision

Comments on the designs in relation to cycle provision have been incorporated into the designs where appropriate in order to maintain existing crossing as part of Cycle Routes or incorporate Toucans at pedestrian crossing facilities.

Similarly bus priority opportunities have been considered. There are a number of junctions within the study that currently have significant bus flows crossing the A27, they include:

- At Chichester - Fishbourne, Stockbridge, Whyke and Bognor;
- At Arundel – Crossbush, Causeway and Ford; and
- At Worthing and Adur – Offington and Lyons Farm/Sompting Road, Busticle Lane and North Lancing.

The main forms of bus priority at a junction are to include bus only lanes and where signalling is in place to prioritise signalling for buses. Bus lanes can be at the approach to and egress from the junction and signals can be 'tripped' to green by the approach of a bus improving the smooth progression of the bus.

Current bus movements are expected to benefit from the general improvements in traffic. Considering this and the relatively low current bus frequencies at most junctions no additional specific bus priority has been considered necessary at this stage. Although with an improved network there are opportunities to increase bus movements through strategic and local routes, park and ride sites and improved interchanges. Under such circumstances the potential for bus priority can be reviewed and it should be relatively simply to

incorporate additional measures. Opportunities for bus network improvements are explored further in Chapter 5.

4.4. Safety Review

The study required a safety review to be undertaken in agreement with the HA. A safety review of proposals was undertaken by Atkins in relation to each proposed scenario and the findings from this for the preferred package are reflected in the designs and appraisal summary tables in **Appendix J**. Further refinements were made to the feasibility designs of the preferred package and sent to the HA for comment. The HA have undertaken to do a formal Road Safety Audit on these designs which will not be complete for inclusion in this report but will be important for further refinement and to inform the Preliminary Design stage.

5. Complementary Local Transport Strategy

A set of high level complementary local transport strategies for Chichester, Arundel and Worthing / Lancing has been considered which are intended to 'lock in' the benefits associated with the corridor packages, and address residual problems on the network.

Recommendations are made on the types of complementary interventions required in each of the three sub-areas, based on:

- The objectives for intervention, and our understanding of the problems and underlying causes behind these objectives, as set out in the Route Strategy Framework;
- An identification of the potential residual problems and objectives, which are unlikely to be fully addressed through the preferred package of junction improvements for the A27;
- Complementary measures identified in previous studies.

Measures considered include:

- Soft demand management interventions (e.g. access restrictions, management of parking, etc.) which are intended to limit use of the A27 and local road network;
- Signing and information interventions which influence how drivers use the A27; and
- Sustainable travel interventions which encourage greater use of public transport, walking and cycling, and car-sharing, and seek to reduce the level of car dependency in the study area; and
- Interventions to create a safe travel environment for all road users and address severance issues on the network.

This chapter proposes a set of complementary strategies for each of the urban areas. The strategies focus on addressing the problems presented in **Appendix L** and incorporates the potential measures identified in previous studies.

Some of the issues to be addressed are common across the corridor, and have therefore been addressed through a corridor-wide complementary strategy. Other issues are specific to each of the three centres and are addressed through a supporting strategy for each of these locations.

5.1. Corridor-wide complementary strategy

The proposed corridor-wide complementary strategy is presented below, against the identified problems and issues across the corridor.

Table 5-1 Corridor-wide complementary strategy

Identified problems	Proposed complementary measures
<p>Insufficient driver information on A27 and insufficient capacity at junctions</p>	<p>Making better use of interventions to maximise capacity available</p> <p>Potential complementary measures could include: signing and information interventions which influence how drivers use the A27; ITS to improve incident management on the road network, including VMS signs at key locations; average speed enforcement to improve flow and reduce emissions and collisions, journey time information systems to give motorists information about road network systems; car park occupancy VMS signs; and use of urban traffic control systems.</p> <p>Recommendations from this study include:</p> <ul style="list-style-type: none"> • CCTV provision along the route for network monitoring; • VMS provision at key points on the route; • VMS provision at key points on routes into and out of Chichester and Worthing; • VMS provision for car parks in the urban centres to minimise search times and unnecessary vehicle movements; • Journey time monitoring between the A27 and Chichester, Worthing and Arundel centres; • Additional information sources and web services; • Improved bus priority measures at traffic signal junctions through the existing bus real time information / automatic vehicle location system • West Sussex-wide journey planning tool, proposed as part of the LSTF bid, which can be used for all local journeys.
<p>Lack of public transport routes for E-W traffic</p>	<p>High quality Bus Rapid Transit-style service serving the A27 corridor, with appropriate bus priority measures and bus stop improvements</p> <p>This would cater for medium distance East – West movements along the A27 corridor, and would be aimed at encouraging mode shift from car to public transport. Two such schemes have already been identified in studies to date: an express bus service from Goring-by-Sea to Hove, via the A27; and the Coastal Transport System Bus Scheme, which serves the A259 corridor between Brighton and Worthing / Goring-by-Sea. Further work is required to assess the impact that these services would have on A27 traffic flow, and likewise the impact that the traffic would have on the services.</p> <p>It is also recommended that the potential for a BRT-style service between Portsmouth, Chichester, Arundel, Worthing, and Brighton is considered. This route is already served by the Coastliner 700 service, operated by Stagecoach, but the journey time between Worthing and Chichester is currently almost 2 hours, and does not represent an attractive option for existing car users on the A27. It is worth noting that the Transport for South Hampshire authorities is currently developing a Bus Rapid Transit network for South East Hampshire.</p> <p>Measures to encourage greater rail use for trips to and from the study area, including improvements to the West Coastway rail service between Brighton and Chichester</p> <p>Liaise with the rail industry to explore opportunities for the provision of faster services and additional modern capacity along the West Coastway, but which retain a suitable balance of stopping services. A plan could be developed for signalling works along the Arun Valley Line, to improve service timings.</p> <p>Work with rail partners to improve stations in the study corridor. In particular, improve Chichester Station interchange, including opportunities for bus/rail and cycle/rail integration. Explore opportunities for improving Bognor Regis Station, to improve access and integration with other modes.</p> <p>Work with Southern to develop station travel plans. Work with the Sussex CRP through the Arun Valley Line Group to further promote rail travel amongst residents and visitors to Chichester, Arundel and Worthing and to improve the attractiveness of local Worthing stations as an alternative to the car</p>

Identified problems	Proposed complementary measures
Rat running through unsuitable and rural roads	<p>Soft demand management measures to discourage use of unsuitable and rural roads - Review road hierarchy and encourage HGVs to use the advisory lorry route network while maintaining access to areas which businesses need to access. Consider lorry bans on certain routes in environmentally sensitive areas.</p> <p>Speed reduction or traffic calming within residential and built-up areas, where there are benefits and this is supported by the community.</p>
Poor perception of bus service, and pedestrian / cycle network contributes to high car dependency	<p>Local bus improvements - Work with bus operators to improve service provision, particularly in the Arundel area. Consider the service provisions at weekends and bank holidays when congestion remains a problem but bus services are often reduced. Examine the potential for high quality bus partnerships to improve the capacity and quality of the bus fleet. Improve marketing, accessibility and quality of information, for example with the provision of real time information services at bus stops. Examine opportunities for developing integrated ticketing and smartcard initiatives.</p>
	<p>Improvements in pedestrian and cycling networks in urban areas - Address issues on the A27 including inadequate signing, poor surfacing and lack of adequate crossing points. Complete National Cycle Network Routes.</p>
	<p>Marketing and promotion initiatives - Information and 'hearts and minds' initiatives to encourage greater use of sustainable modes for local trips (e.g. personalised travel planning targeted at settlements to the south of A27, branding, information websites, publicity campaigns, etc.). Ensure cycle network maps for the each of the centres are available on the WSCC website.</p> <p>Work with key employers and education establishments in the sub-region, to encourage greater use of sustainable travel.</p>
	<p>Work with developers to encourage use of sustainable modes - Work with developers to promote 'local living' (for example shops, jobs and homes all being within easy reach of each other), provide secure cycle parking to meet the needs of the development and be within close proximity to public transport, and provide enough parking spaces to accommodate the expected number of vehicles at the site or provide measures such as car clubs which reduce the number of vehicles to match the space available.</p>
Air quality impacts	<p>Electric vehicle charging infrastructure - Encourage the use of cleaner vehicles such as electric cars, by providing electric recharging posts and recharging bays in partnership with the District Councils as part of a wider network available to all users of electric vehicles.</p>
	<p>Local Air Quality Action Plans - Continue to work towards removing AQMAs through the implementation of the Local AQAP.</p>
Noise issues	<p>Noise mitigation measures - Noise mitigation measures, such as noise barriers and use of noise reducing surfacing at locations identified within Defra's Noise Action Plan.</p>

5.2. Chichester complementary strategy

In addition to the above corridor-wide measures, Chichester-specific measures are required to address the following problems and issues:

- Availability and low cost of car-parking in City Centre encourages commuters to travel by car and park for long periods;
- Lack of safe pedestrian and cycle crossing points on the A27;
- Lack of sustainable travel options from Manhood Peninsula;
- Delays for buses entering Chichester to/from the south;
- Severance and safety issues affecting communities on the A27.

Proposed measures include:

- **A review of the parking strategy for Chichester** - Currently long term parking is perceived to be relatively cheap and this encourages commuters and shoppers to enter the city by car. A strategy that discourages the use of city centre public car-park spaces for long stay visits could encourage greater use of non-car modes and reduce traffic levels on the A27. This would need to be supported by policies to manage supply and use of Private Non Residential (PNR) parking spaces through planning process, and on-street parking;
- **Park and Ride sites** - An option that has previously been identified, as part of the HA proposals is to develop Park and Ride sites around the city, to discourage traffic from entering Chichester. Further consideration of the six sites proposed is required to understand the potential impact on the A27 traffic, and ensure that any P&R site proposed does not increase the volume of traffic on the A27 due to cars travelling around the by-pass to reach to P&R site. Also sites should be consistent with the emerging strategy for core schemes on the A27 of promoting Fishbourne, Bognor and Portfield as key accesses to the centre. Therefore there is the opportunity for Park and Ride buses to benefit from bus-only movements and quicker journey times at Stockbridge, Whyke and Oving junctions;
- **Bus service improvements to Manhood Peninsula** - Work with bus operators to improve bus services to and from the Manhood Peninsula and Arundel;
- **Longer distance cycle routes** - Improving longer distance cycle routes connecting to settlements south of A27, but within reasonable cycling distance of Chichester and areas with identified problems: Manhood peninsula, south of Stockbridge Roundabout, Fishbourne, and Lakeside Holiday Village near Bognor Rd Roundabout. Routes should utilise the opportunities offered by emerging strategy of restricting access at Stockbridge, Whyke and Oving offering opportunities for crossing and quieter routes into the city. Cycle maps must continue to be updated and made available on WSCC website;
- **Improve safe pedestrian and cycle crossing points on the A27** - There are currently bridge crossings at Stockbridge and Bognor and an at-grade crossing at Oving. It is noted that there are proposals for a bridge crossing at Whyke and at Portfield as part of development plans. The cycle network map for Chichester on WSCC website indicates cycle network crossings on the A27 at Oving, Stockbridge and west of Fishbourne. With Stockbridge, Whyke and Oving being noted for their residential nature cycle and pedestrian access should be a key feature. This would also fit with the emerging strategy of restricting access to local traffic at these junctions offering opportunities for crossing and quieter routes into the city;
- **Bus priority for routes crossing the A27** – Consider bus priority options at the key junctions and at subsequent junctions into Chichester to improve journey times;
- **Public transport access and interchange improvements** – Work with transport operators to improve interchange opportunities between rail and bus services as well as improving access to rail and bus services by walking and cycling. - Proposals are already in place for pedestrian wayfinding to the city centre to connect to work and education destinations. In addition, the Sustainable Travel Towns LSTF package includes a number of improvements which will support this objective:
 - a cross-city centre cycle route connecting the north of the city with the rail and bus stations, combining safety measures with improved connectivity to the main retail, employment and education facilities;
 - secure cycle parking facilities at the rail station;
 - improvements to the station forecourt area to enhance flows for pedestrians, cyclists and drivers (taxis, drop-off and parking) and provide a link to the bus station; and
 - cycle and pedestrian improvements at Northgate and Southgate gyratory (A286).

5.3. Arundel complementary strategy

In addition to the above corridor-wide measures, Arundel-specific measures are required to address the following problems and issues:

- Lack of alternative road or public transport routes from Littlehampton;
- Poor access to / from Littlehampton, Bognor Regis and the coastal area by public transport;
- Lack of safe pedestrian and cycle crossing points on the A27, particularly around the station and either side of Ford Road Roundabout, where there is considerable residential development to the south of the A27.

Proposed measures include:

- **Work with tourist attractions** - To encourage sustainable travel, for example, through marketing and discounts for public transport users;
- **Pedestrian access to Arundel Station** - Consider options to improve pedestrian access to the rail station and improve pedestrian interchange between bus and rail. This might involve upgrading of the

existing underpass if removal of the current at-grade crossing is removed to improve flows. If emerging options for Causeway include signalisation there is the opportunity to improve crossings at that location;

- **Bus service improvements** - Work with bus operators to improve bus services to and from the Littlehampton, Bognor and the Coastal area, but also focus on high frequency routes to Worthing and Chichester with journey times that can be competitive to the car. Also encourage peak level services to be maintained at weekends and bank holidays, particularly in the summer, to cater for increased visitor levels;
- **Reduce severance at Ford Roundabout** – There is an existing crossing along the riverside, but if signalisation is included in emerging junction options there is the opportunity to increase pedestrian and cycle crossing options;
- **Improve Cycle Routes and Information** – The Sussex Downs is a great draw for cyclists. There is no cycle map for the Arundel area on WSCC’s website. A few key routes with dedicated lanes where possible should be developed, linking to Arundel, Littlehampton, Ford and possibly Angmering and Barnham Rail stations and to any nearby country cycle route. These should be mapped and available on the WSCC website;
- **Park and Ride** – There is the potential for park and ride facilities to be provided to serve summertime weekends and bank holidays. Locations would have to be reviewed but one sited south of the Crossbush Interchange would take traffic off the A27 westbound queue and from Littlehampton.

5.4. Worthing complementary strategy

In addition to the above corridor-wide measures, Worthing-specific measures are required to address the following problems and issues:

- Three quarters of traffic on the A27 starts or ends its journey in Worthing or Lancing;
- Lack of safe pedestrian and cycle crossing points on the A27, particularly between High Salvington and Findon Valley (to the west of the A24), and associated severance issues.

Proposed measures include:

- **Bus service improvements** – Worthing does have a relatively well distributed bus network although there are no services along the A27 or serving residential areas to the north, and East Worthing railway station is not served by any regular bus route reducing its attractiveness. Opportunities to increase service provision in these areas should be investigated along with general capacity improvements on key north-south and east-west arterial routes, including a fast and regular service to Arundel. A combined bus network map for the area would support improvements in information and marketing;
- **A review of the parking strategy for Worthing** - Review the parking strategy for Worthing, and strengthen the management of parking supply and charges, in order to encourage greater use of sustainable modes for travel into Worthing, while maintaining the vitality of the centre. Parsons Brinkerhoff (2010) has identified three potential P&R sites, at Goring Rail Station, Findon, and East of Lyons Farm. Further consideration of these sites is required to understand the potential impact on the A27 traffic, and ensure that any P&R site proposed does not increase the volume of traffic on the A27 due to cars travelling further on the A27 to reach the P&R site; However, sites east of Lyons Farm would be considered to remove traffic from the worst congested areas to the north and east of the town;
- **Worthing Cycle Network** – Develop and implement schemes which contribute to the completion of the Worthing cycle network. In particular consider routes which parallel the A27 and reach core employment, retail and residential areas on either side of the A27. Ensure cycle routes incorporate appropriate crossings on the A27. Ensure any current and future network is mapped and made available on the WSCC website. The Sustainable Travel Towns LSTF Package proposes improvements to part of National Cycle Route 2 along Goring Sea Front and connections to the rest of the network. This will incentivise car users who travel short distances to switch to non motorised modes and improve accessibility to the town centre for retail, leisure, employment, hospital and education opportunities, through enabling more east-west cycle journeys across the town. It will also provide an extension to this very popular leisure facility benefiting the economy by attracting more visitors;
- **Pedestrian crossings** – The A27 sections between Sompting Road and Offington Corner are relatively attractive for pedestrians compared to other sections of the route and there are many residential areas on either side of the road resulting in the demand for many crossing sites. Currently a Puffin crossing on Warren Road is seen to conflict with many of the emerging proposals and is proposed to be incorporated into the signalising proposals. The area cited as an issue between High Salvington and Findon Valley is downstream of the main study area but a review of crossing here would clearly be beneficial;
- **Improve attractiveness and accessibility of local railway stations** - Worthing has a relatively high number of local rail stations which should be able to provide attractive alternatives to car use to Brighton,

Arundel, Chichester as well as other coastal areas. Accessibility, attractiveness, service levels, ticketing and prices are all areas that could be addressed to improve the level of their use. Sustainable Travel Towns LSTF Package focuses on improving access to Worthing's main rail station by sustainable modes (pedestrians, cyclists and bus users), through multi modal information and identification of clear onward routes for different modes, and improved facilities. It also proposes a cycle hub at the rail station and provision of secure storage facilities.

6. Appraisal of Preferred Package

To assess the potential impact of the proposals a WebTAG based appraisal has been undertaken looking in detail at strategic and local model impacts, economic and wider economic impacts, a comparison of benefits to costs and assessing these against other factors in support of the DfT 5 business cases model presented in a high level appraisal summary table.

6.1. Traffic Impacts

The modelling process made use of the highway element of the WSCC county transport model for assessing strategic assignment impacts and junction models for detailed analysis at specific junctions.

The wider road network impact of the package of improvements has been modelled in the WSCC highway model using SATURN software. This estimates interaction of the package improvements with the wider assignment of traffic across the network and the impact on journey times along the A27 corridor.

The impacts of specific improvements specific improvements at individual junctions have been modelled using LinSig (with traffic lights) and ARCADY (without traffic lights). This gives detailed information about junction performance, including delay for each traffic movement and traffic volume as a proportion of capacity.

The modelling approach was based on a fixed matrix assignment in the morning peak hour only and does not take account of the impacts at other times of day or changes in demand as a result of the package of improvements.

The most appropriate indicators to consider when assessing the impact of the junction improvements are:

- From the Saturn model the average speed, total delay, vehicle kilometres and journey time across all junctions in each area. These reflect longer term performance by focussing on results forecast for 2026;
- The capacity at each junction and the delay experienced by vehicles on the strategic route and local road entry arms from the local junction modelling results using LinSig and Arcady.

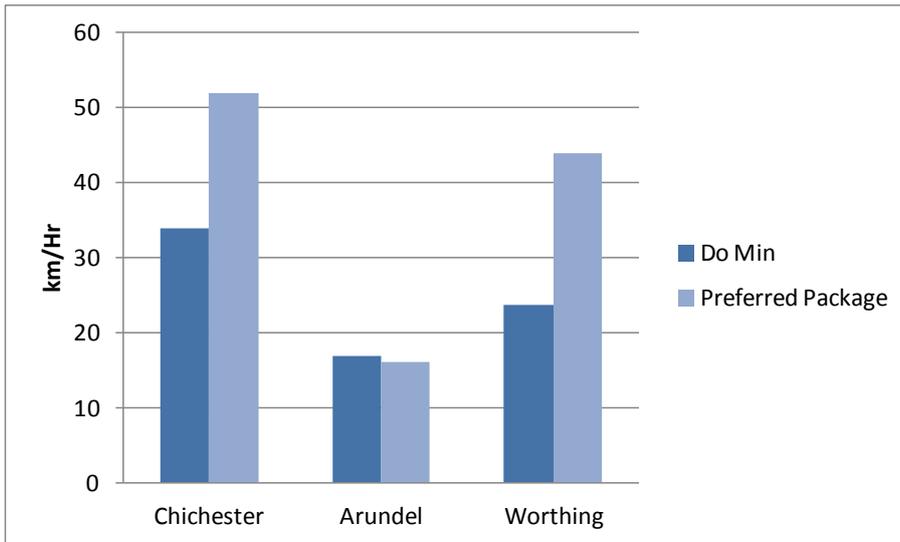
The detailed modelling results are presented in **Appendix K**.

6.1.1. Average Speed

Figure 6-1 shows the average network speed along the section of the A27 in each area. The model results demonstrate an overall improvement in average speed on the A27 for Chichester and Worthing but little change at Arundel. In Chichester, average speeds increase from 34 km/hr to 50 km/hr. In Worthing average speeds increase from 24 km/hr to 44 km/hr,

In Arundel average speeds across the length of the corridor do not change significantly. The model indicates that whilst conditions at Crossbush and Causeway junctions improve as a result of the interventions proposed, the improvements allow more traffic through the junctions. As a result, extra traffic travelling westbound on the A27 Lyminster Road is at capacity and subsequently incurs delay due to the nature of this bendy, hill road with a number of right turns (to Crossbush Lane and Burpham Road). More detailed modelling is recommended as part of the future development of these schemes to aid the understanding of the impacts of the improvements at this location.

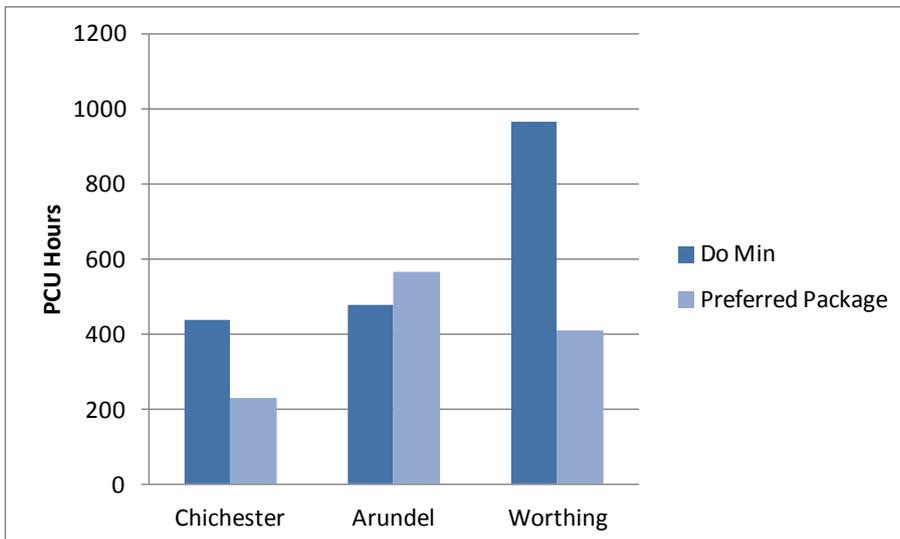
Figure 6–1 Average Speed on the A27, AM Peak 2026



6.1.2. Total Delay

Figure 6-2 shows the total network delay (PCU hours), as measured by the time taken to travel along the A27 at the three locations during the morning peak hour compared with the time it would take if no other traffic was on the network. There is a reduction in total delay on the A27 corridors at Chichester and Worthing reflecting the increase in average speeds, but in Arundel, where average speeds do not change significantly, there is in total a slight increase in delay (as described above).

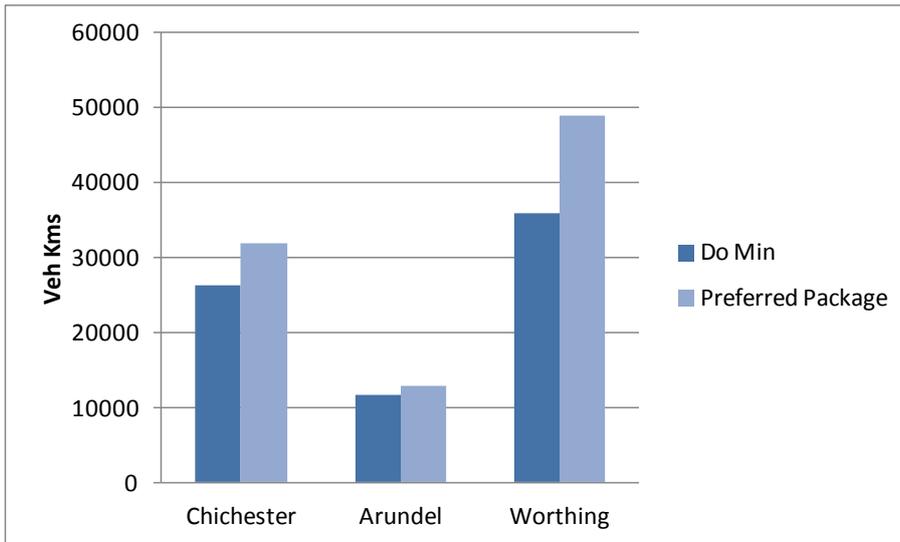
Figure 6–2 Total delay on the A27, AM Peak 2026



6.1.3. Vehicle Kilometres

Figure 6-3 shows changes in traffic as measured by vehicle kilometres passing along the A27 corridor in each area. An increase in vehicle kilometres shows that more traffic is able to pass through the corridor as a result of the improvement and that growth can be more readily accommodated. The results indicate an increase in vehicle kilometres on the A27, most noticeably so in Worthing where over 35% more traffic passes around the town on the A27.

Figure 6–3 Total vehicle kilometres on the A27, AM Peak 2026



6.1.4. Journey Time Reliability

A key indicator of improved performance is considered to be journey time reliability. Traditionally this is defined as variation in journey times that drivers are unable to predict arising from either variability in recurrent congestion at the same period each day - Day to Day Variability (DTDV) or variability in non-recurrent congestion such as incidents. It excludes predictable variation relating to varying levels of demand by time of day, day of week, and seasonal effects which travellers are assumed to be aware of.

The modelling approach alone is not capable of capturing or forecasting such random effects so the proportion of journey time delayed along each section of the A27 has been used as a proxy calculation for the degree of journey time reliability. A journey with no delay from traffic queues will be based on network speed limits and wait time at signalised or priority junctions.

Figure 6-4 and Table 6-1 shows the free flow travel time across each section of the A27 and the additional delay. The improvements in Chichester are forecast to reduce total travel time by 31% in 2026 and increase the proportion of travel time at free flow conditions from 50% to 56%. In Worthing the improvements are forecast to reduce delayed travel time by over 60%, reducing the total journey time by 33% and increasing the time spent at free flow from 44% to 66%. In Arundel, for the reasons described above, there is little change in the time taken to travel along the corridor.

Figure 6–4 Journey time and delay on the A27 by Area, Am Peak 2026

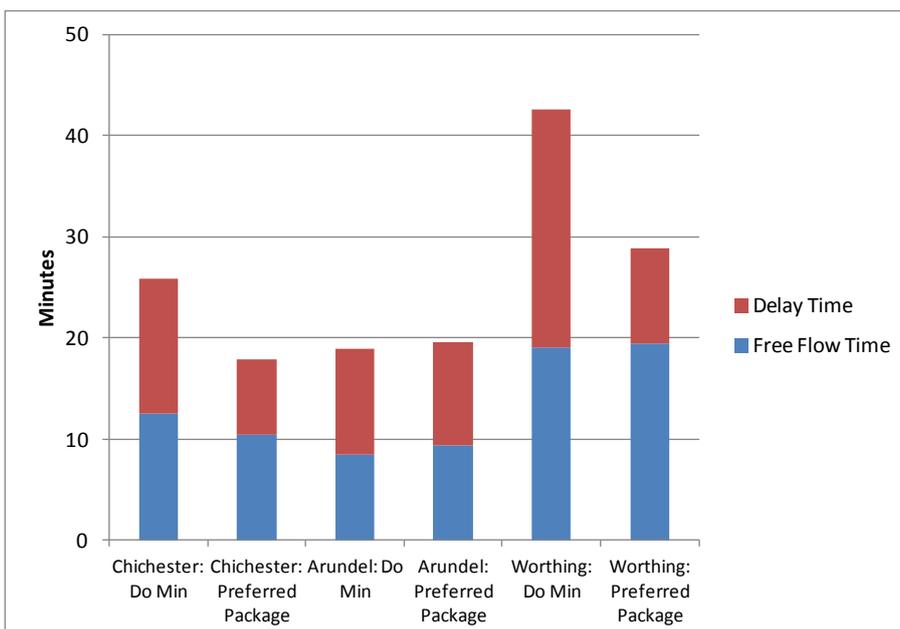


Table 6–1 Journey Time and Delay on the A27, 2026

	Free Flow Time (mins)	Delayed Time (mins)	Total Travel Time (mins)	Proportion of time at free flow
Chichester: Do Min	13	13	26	50%
Chichester: Preferred Package	10	7	18	56%
Arundel: Do Min	8	10	19	42%
Arundel: Preferred Package	9	10	20	45%
Worthing: Do Min	19	24	43	44%
Worthing: Preferred Package	19	9	29	66%

6.1.5. Displaced Trips

Due to changes in the network the strategic model reassigns some trips to be made by a different route on the network. As we have seen this has resulted in some higher flows on the main A27 route which will have the impact of reducing flows elsewhere on the network, but likewise could increase flows where traffic redirects. This section reports on areas of the network where concern about increased or displaced flows have been expressed or are obviously emerging from the model outputs and where other key areas of the network benefit from reduced flows.

6.1.5.1. Local Impacts

The impact on the traffic levels around each centre has been considered:

- In Chichester:
 - The preferred package results in some changes in routing between the Manhood Peninsular and the A27; with the preferred package resulting in more traffic travelling between the Manhood Peninsular and the A27 via the routes to Stockbridge rather than via the route to the Whyke Junction. Overall flow between the Manhood Peninsular and the A27 is similar for the two scenarios;
 - There is no evidence of flows on alternative or minor links being disproportionately affected. Flows on the B2145 decrease as do eastbound flows on the B2166 although westbound they increase slightly by around 100 vehicles an hour;
 - Outside of the junction arms off the A27 there is generally very little increase in traffic around the centre, small increases in flows are seen Westbound on Oaklands Way and Spitalfield Lane, Kingsham Avenue (parallel to the section between Stockbridge and Whyke junctions) and around Sherbourne Road where flows increase by no more than around 120 pcu's per hour;
 - Flows through the main central routes of Market Road, Market Avenue and Via Revenna all show considerable reductions in flows of up to around 500 pcu's per hour;
- In Arundel outside of the main arms of each junction there is some increase likely around the town centre particularly along the London Road southbound from the A284 with flows increasing up to around 280 pcu's per hour;
- In Worthing:
 - There is a slight increase in traffic Southbound along Broadwater Road and Eastbound along Richmond Road with flows increasing by up to 240 pcu's per hour. There are also some similar increases in flows shown Northbound on Durrington Lane and in South Lancing Northbound around Penhill Road;
 - Flows decrease on Poulter's Lane (A2032), Terringes Avenue, South Farm Road, Tarring Road and Dominion Road of around 300 pcu's per hour.

6.1.5.2. Impact of Banned Turns

Of the 14 junctions considered for analysis in A27, right turns are banned at the following junctions in Chichester: Stockbridge; Whyke; and Oving.

Using the strategic highway model it has been possible to identify traffic that is affected by the banned turns (by doing a select link analysis in the do-minimum scenario) and discover which routes they consequently

take to complete their journeys (by assigning the select link matrix to the preferred scenario). These results are from the strategic model so are not representative of all local movements. Analysis shows that:

- The total journey times for the majority of movements that are affected by banned turns are forecast to decrease due to overall improved performance of the junctions along the A27 and consequent improvements in Chichester as through traffic remains on the A27 rather than travelling through Chichester;
- Traffic turning right into Chichester will either reroute to an adjacent junction and make a straight across movement or continue on the A27 indicating that traffic was previously rerouting via Chichester to avoid delays.

6.1.5.3. Strategic Impacts

The impact on traffic levels on other strategic routes around West Sussex and the A27 has been considered:

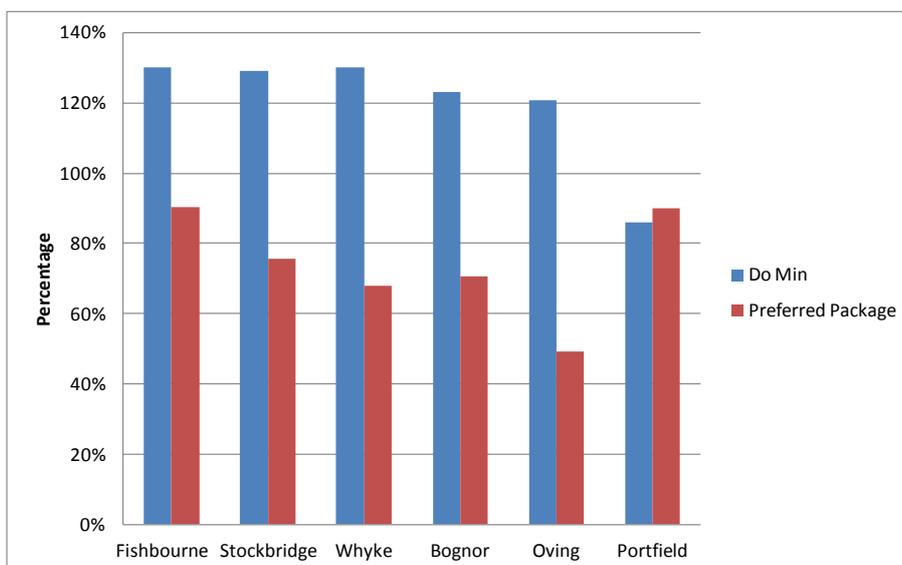
- The A259, Brighton Road section between Worthing and Lancing has reduced flows of up to around 700 pcu's per hour. Between Worthing and Arundel flows reduce although there are increases Eastbound out of Chichester;
- On the A283 between Storrington and Shoreham there is a slight reduction in flow; and
- On the A29 there are slight increases Southbound around the A27, but only of around 100 pcu's per hour and otherwise flows reduce slightly.

6.1.6. Junction Capacity

The results from the junction modelling demonstrate the extent to which the schemes increase capacity at different junctions. They show that, overall, if nothing is done to the junction most are expected to be over capacity. The modelled package demonstrates an improvement on the operation of each junction so that with forecast increases in flow by 2026 the junctions are within design capacity. The only exception to this is Portfield Junction, where the junction already operates reasonable and improvements elsewhere result in more flow through this junction, which is accommodated, albeit with a slight increase in volume to capacity ratio.

In Chichester delays are reduced on all arms and most significantly for strategic traffic, although at Portfield, Stockbridge and Bognor there are marginal increases in delays for local traffic leaving Chichester. It should be noted that the local model indicates there is potential for blocking back of queues through the roundabout junctions at Fishbourne and Bognor junctions. This could affect the preceding links. The worst case scenario is expected to be an additional 31 pcu's beyond the design stacking capacity at Fishbourne and 16 at Bognor.

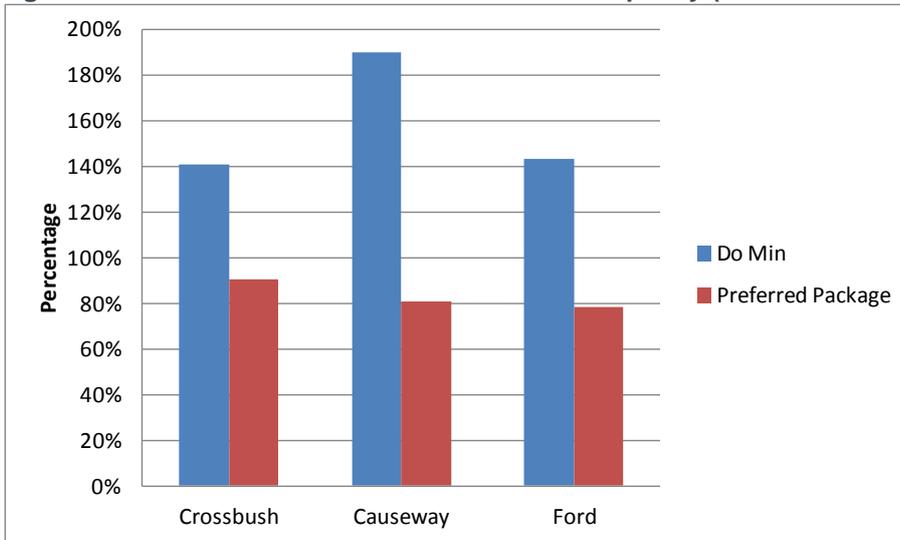
Figure 6–5 Chichester Junctions Volume over Capacity (AM Peak Hour 2026)



In Arundel generally westbound movements would have the biggest delay with Ford also demonstrating large eastbound delays. These are all essentially removed by the improvement, although this does impact slightly on local traffic from Lyminster heading to Arundel at Crossbush where delays increase as described

above. There are also delays to traffic leaving Arundel at Causeway and all local movements at Ford roundabout.

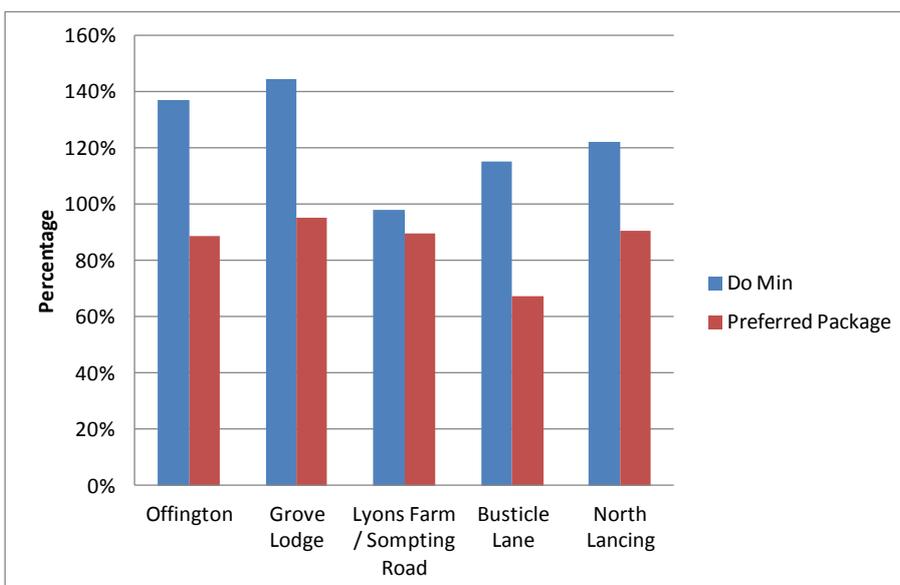
Figure 6–6 Arundel Junctions Volume over Capacity (AM Peak Hour 2026)



In Worthing, Lyons Farm/Sompting Road, Busticle Lane and North Lancing junctions all demonstrate significant delays for eastbound movements with which are all largely removed with the proposed schemes. Busticle Lane, Lyons Farm/Sompting Road and Grove Lodge Junctions all demonstrate significant westbound delays which the proposed schemes largely remove. Grove Lodge is the busiest junction and with the new college and housing development the junction design accommodates large pedestrian and cycle movements and the scale if improvements are limited by retaining proposals within highway boundary. There is also a noticeable increase in delays to local movements Southbound and at Lyons Farm/Sompting Road a more marginal increase to delays for northbound traffic. Offington Corner has the most significant delays on north and southbound movements which are removed by the proposed package.

It should be noted that the local model indicates there is potential for blocking back of queues through the roundabout junctions at Offington and Grove Lodge junctions. This could affect the preceding links. The worst case scenario is expected to be an additional 22 pcu's beyond the design stacking capacity at Fishbourne and 14 at Grove Lodge.

Figure 6–7 Worthing Junctions Volume over Capacity (AM Peak Hour 2026)



6.1.7. Modelling Results Summary

The traffic modelling has been undertaken using an updated (by Atkins) version of the WSCC SATURN highway model for the morning peak hour. The scheme testing has been undertaken using fixed matrix assignments, which do not account for possible changes in trip frequency, redistribution or modal shift that could occur and would be modelled in the WSCC demand model. No modelling has been undertaken in the evening peak and the designs have not been 'stress tested' to reflect peak summertime conditions.

The modelling of the preferred package indicates an improvement in the operation of the junctions and benefits strategic traffic without significant adverse impacts on other movements. However, as is largely the case where junction improvements are made additional traffic is attracted; which in turn reduces the overall benefit. A variable demand assignment may also attract more traffic through the junctions or enable more trips to be made along routes through the urban areas that are forecast to become decongested as a result of the improvements.

On the A27 the scheme proposals generally accommodate additional traffic generated through growth and network improvements well and continue to operate within design capacity. Although as a result of increased flows and optimising strategic movements in some cases local movements will experience increased delays. The most noticeable impact from increased traffic and existing constraints on the network is in Arundel where despite significant improvements at the junctions shown in the local models the strategic model indicates no overall improvement across the Arundel corridor. This appears to be largely due to the single lane carriageway and interaction with side roads which limits the potential benefit. It is recommended that further investigation of how the model represents these changes to the network could be undertaken at a later stage.

As a package of improvements the transport modelling does indicate the scheme to be worthwhile, offering increased junction capacity and overall journey time improvements. The value of the proposals are supported further by the economic analysis and overall appraisal but further development of the proposals and their benefits should include a review of the model, particularly at areas of concern around Arundel. The issue is Arundel being that whilst the proposed improvements have been shown to improve junction capacity, the extra demand now able to pass through the junctions is resulting in capacity problems on the A27 between the Crossbush and Causeway junctions, most notably in the westbound direction.

An immediate model review would focus upon the Arundel area and include possible revisions to network coding and zoning, including size of zone, connection to the network and a check on zonal trip ends. This would be supported by a small journey time and traffic data collection exercise to aid validation of the model in this area. Once this has been undertaken it will be possible to either re-model the proposed junction interventions in Arundel or create revised junction proposals and provide a greater degree of confidence regarding the suitability of any proposed improvements.

The question over how long these benefits will be felt for has been raised. The modelling has included known growth in the area to 2026. The forecasts demonstrate that the package provides sufficient improvement to accommodate that growth to 2026; indeed the network is forecast to be operating a better condition with the scheme than it is forecast to be operating at the time of construction in Chichester and Worthing. The longevity of these benefits beyond 2026 will depend on the actual rate of traffic growth and the effect of providing additional capacity on the A27 on travel behaviour; which may result in trips being attracted to the A27 which are currently made at different times of day or on different routes to avoid peak hour congestion on the A27. Any addition of complementary measures may influence drivers to change travel times.

6.2. Economic and Wider Economic Impacts

6.2.1. Conventional Transport Benefits

The outputs from the strategic model have been applied to the economic forecasting appraisal tool (TUBA) and the value of the schemes as a whole to the area over a 60 year period is presented below. The outputs indicate that there is a positive benefit to the local economies in all sectors with the exception from indirect taxes where there is a minor reduction. In total the schemes are worth nearly £309m in direct economic benefits over a 60 year period.

Table 6–2 Economic Efficiency of the Transport System (TEE): Benefits over 60 years (£,000's)

	ALL MODES
Consumer - Commuting user benefits	
Travel Time	69,352
Vehicle operating costs	3,327
User charges	-
During Construction & Maintenance	-
NET CONSUMER - COMMUTING BENEFITS	72,679
Consumer - Other user benefits	
Travel Time	66,549
Vehicle operating costs	2,596
User charges	-
During Construction & Maintenance	-
NET CONSUMER - OTHER BENEFITS	69,145
Business	
Travel Time	161,274
Vehicle operating costs	5,499
User charges	-
During Construction & Maintenance	-
Subtotal	166,773
Indirect Tax	- 1,608
Greenhouse Gases	798
PVB	307,787

Note: 2010 Price base

There is a minor loss in indirect tax as a result of a decrease in vehicle operating costs (subject to fuel duty and VAT) and subsequently a reduction in tax paid.

In addition £1.2m worth of benefits for accident savings has been estimated based on network wide estimates of traffic usage and using DfT accident rates for all roads and valued at DfT values for all accidents (note: a linked based COBA assessment was not undertaken and may yield different results).

6.2.2. Wider Economic Impacts

There is anecdotal evidence that the A27 acts as a constraint on economic and development activity. Congestion and slow and unpredictable journey times make the corridor a less attractive place to live, work and do business. Through improvements to the corridor local opportunities to grow the economy should emerge and improvements to other areas of the economy.

Atkins has worked in conjunction with Albion Economics to consider the potential wider economic impacts of the junction improvements along the sections of the A27. The full report of this work is included in **Appendix M** and is summarised in this chapter. This work demonstrates that between 5,770 and 9,265 housing units could currently be considered dependant on improving these junctions on the A27 and worth between £31m and £62m to the wider economy over 60 years.

6.2.2.1. Approach

A high-level analysis has been undertaken at this stage which addresses the same principles as WebTAG analysis but does not go so far as the fully robust quantified approach which would require a Land Use Interaction Model (LUTI) as highlighted in DfT guidance on Regeneration Reports WebTAG 3.5.8.

The hypothesis tested is that where accessibility can be improved, in the form of reduced congestion and/or additional capacity, this would permit additional development to come forward, or come forward more quickly. This includes an analysis of GVA impacts over time which could result from construction of the preferred package of A27 junction improvements.

The study looks at three different elements which contribute to wider economic impacts:

- Housing: Quantifies the level of potential housing development that can be accommodated due to improvements in local junctions;
- Employment: Has less evidence on the scale of potential opportunities for additional jobs through commercial development, but summarises what is identifiable;
- GVA: Examines evidence on the scale of benefits to GVA, in addition to those outlined in Chapter 6, so that an assumption to the scale of additional benefits can be made as a percentage of conventional benefits and additional benefits quantified.

6.2.2.2. Housing

A consideration of development opportunities in the vicinity of the A27 looks at evidence for additional housing units which can be supported by improvements to local junctions.

Through discussions with planning officers in each district a number of strategic housing allocations close to the A27 junctions have been identified as being under review, and which will rely on capacity enhancements in order that planning permission and/or implementation can be secured. In lieu of detailed transport assessments it is assumed that a maximum range of 5,770 to 9,265 units as detailed in Table 7-1 below would be dependent on these improvements. The figures in Table 7-1 below summarises the housing plans agreed with officers as being approved and perhaps represents a minimum range with additional housing yet to be agreed.

Table 6–3 Strategic Housing Plans in the vicinity of A27 junctions under review

Location	Planning Authority	Scale of Development (units)	Relevant A27 Junctions
West Durrington	Worthing	700 -1075	Offington Corner Grove Lodge
New Monks Farm	Adur	450 - 600	Grinstead Lane
Sompting Fringe	Adur	250 - 420	Busticle Lane Grinstead Lane
North Sompting	Adur	210	Busticle Lane
North Littlehampton	Arun	1260	Crossbush
Courtwick	Arun	500	Crossbush
Tangmere	Chichester	800 – 1,600	Portfield
Westhampnett	Chichester	500 – 1,400	Portfield
West of Chichester	Chichester	500 – 1,600	Fishbourne
Shopwyke	Chichester	600	Portfield Oving Road

6.2.2.3. Employment

Improvements to the transport network open up further development opportunities for commercial properties which support direct and indirect employment opportunities, as well as safeguarding existing jobs.

Discussions with planning officers provided little specific evidence of the extent of planned commercial development in the vicinity of the A27 junctions under review, nor of the scale of job opportunities that could

be unlocked. This is reflected in the overall objectives for the scheme improvements which focus more on improving strategic journey time reliability and contrasts with examples of DfT local pinch-point funding where specific employment expansion plans are linked to schemes (e.g. Staffordshire; Gloucestershire). Nevertheless, the following employment land allocations have been identified:

- 10,000m² at New Monks Farm, Lancing;
- Decoy Farm, east Worthing; and
- Mixed use plans alongside strategic housing allocations in Chichester.

Net additional job potential at the Chichester and Lancing sites would be in the broad range of between 1000 and 2000 jobs, although this is subject to significant uncertainty since land-use plans are not well developed for employment use, and this estimate relies on a number of assumptions. This excludes opportunities at Decoy Farm, which would require a new access road to the A27 this is not part of these proposals.

6.2.2.4. GVA

The economic assessment is the main quantified component of appraisal for trunk road improvements, although of course other elements such as safety, environmental impact and distributional impact play an important part in decision making. The conventional economic assessment is reported in **Chapter 6** of this report. However, some of the benefits included there do not contribute directly to productivity and GVA enhancements, in line with DfT WebTAG guidance.

As mentioned this exercise is a high-level one and therefore the full modelling of all the GVA impacts has not been undertaken. To calculate all agglomeration and labour market impacts from first principles requires a multi-modal model and a detailed Land Use Interaction Model to estimate, for example, the changes in labour market behaviour which may result from the accessibility gains predicted by the traffic model.

For this study the most significant contribution to GVA is calculated through an understanding of the scale of impacts by:

- Estimating time and operating cost savings for travel in the course of work in order to extend these in a fully compliant way to estimate the additional GVA through businesses operating under imperfect competition; and
- High-level estimates made of agglomeration and labour market impacts.

The evidence from these two areas is used against other benchmarking evidence to estimate the scale of GVA impacts as a percentage of conventional benefits.

Time and cost savings in the course of work

This element of appraisal is based on the assumption that travel in the course of work is usually not productive in itself and reducing journey times – either in free-flow conditions or by reducing delay – frees up time for additional productive activity. When an individual saves one hour travelling time whilst in work, the appraisal values this time at the gross cost to the firm of the worker’s time (i.e. hourly wages plus national insurance contributions and other labour related costs). This applies to those using freight vehicles, travelling by bus or by company or private cars in the course of business.

In addition, improvements in journey times and reductions in congestion lead to savings in vehicle operating costs – both fuel and non-fuel. These are efficiency improvements and count as improvements to GVA.

The traffic modelling and TUBA economic analysis reported in **Chapter 6** estimates the time savings to business users, both freight and business travel. These figures have been updated from 2010 prices from TUBA to 2010 prices as per WebTAG.

Table 6–4 GVA Impacts of time and cost savings in the course of work

	Time savings	Vehicle operating cost savings	Total GVA Impact
2016	£3.0m	£0.1m	£3.1m
2026	£3.5m	£0.2m	£3.7m
Present value over 60 Years	£161.3m	£5.5m	£166.8m

Note: Price Base 2010

Extending Impacts to account for Imperfect Conditions

Despite the above, what we really seek to measure by time savings in the course of work is the additional value to society of the additional activity the worker can now undertake instead of travelling. However, under the assumption of perfect competition these two values (hourly labour cost and marginal hourly productivity) are identical – so labour costs is a good approximation.

In reality this is not true. On average firms are able to charge more for their products and services than they cost to produce. This means that the value society places on the worker's output from one hours' additional work (i.e. the price of whatever the worker makes in one hour) is higher than the cost of the worker's time to the firm.

By valuing workers' saved time at the level of costs to the firm rather than the value to society, current transport appraisal underestimates the benefits of in-work travel time savings. The conventional benefits shown in Table 6-2 have been expanded in line with WebTAG the calculations for additional GVA impact leading to the following running total GVA impact (2010 prices) as shown in Table 6-3 below. Comparing the two outputs imperfect competition can account for an additional 10% of user benefits to freight and business travel.

Table 6–5 GVA Impacts of time and cost savings in the course of work and Imperfect Competition Adjustment

	Time savings	Vehicle operating cost savings	Total GVA Impact
2016	£3.3m	£0.1m	£3.4m
2026	£3.9m	£0.2m	£4.1m
Present value over 60 Years	£177.4m	£6.1m	£183.5m

Note: Price Base 2010

6.2.2.5. Labour Market Impacts and Agglomeration

The modelling of these specific impacts is beyond the scope of this high-level exercise. However, it is possible to assess the evidence and drive a range of a 'broad-brush' estimate of these impacts. These should be treated with caution as they do not comply fully with WebTAG.

Labour Market Impacts

By reducing commuting journey times and the uncertainty of congestion, highway improvement schemes can broaden the range of job opportunities to workers and expand the labour market catchment for firms. For existing commuters, the time savings measured as part of conventional appraisal are decreed to accrue to the worker as increased leisure time. These do not therefore count towards productivity improvements or gain in GVA. However, there are two second-order impacts which can count towards productivity and GVA:

- **More people working** – the monetary costs of travelling to work reduce the financial gains from working while commuting time costs increase the personal costs. At the margin, some people will choose to take a job rather than not and this represents an economic gain.
- **More people working in more productive jobs** – some existing workers may use their time/money commuting budget to travel further to access better paid and more productive jobs.

Agglomeration and Functional Urban Regions (FURs)

Agglomeration simply means the geographic clustering of firms and workers. Typically, firms are more productive when near other firms because they have access to a large variety of inputs to their activities. It is also often argued that proximity to other similar firms increases the chance of acquiring new knowledge and building connections and networks which support or increase productivity.

Many firms are also more productive when they have access to a large labour market since this makes recruitment quicker and it is easier to find workers with the exact skills match that they are after. Evidence supports all of this by showing that a larger and denser a location, its firms become more productive.

By bringing firms closer together in time terms, for example by reducing congestion, then *effective density* is improved. If transport is made cheaper or quicker, more firms and workers will be located within reach and productivity will increase. These agglomeration benefits are additional to those already captured in appraisal.

WebTAG suggests that agglomeration impacts are most likely to occur within Functional Urban Regions (FURs). Each FUR is constructed by firstly defining a core and then identifying a corresponding commuting field (or hinterland) for that core. The core is defined by a minimum working population (of 60,000) together with a minimum job density (of 7 jobs per hectare) for a ward. This is to reflect the fact that agglomeration impacts are most significant for transport schemes located within, or near, large and dense employment centres.

Within the districts that the A27 junctions under exam fall, the following applies based on 2001 census data:

- In Adur, the whole District lies within the hinterland of Brighton and Hove Functional Urban Region;
- In Worthing, just the Selden ward lies within the hinterland of the Brighton and Hove FUR;
- In Chichester, only the Fernhurst, Plaistow and Westbourne wards lie within the Portsmouth FUR hinterland; and
- No wards in Arun lie within a FUR.

This indicates that outside of the 2 junctions within Adur, agglomeration benefits of improved accessibility are likely to be relatively weak. Furthermore, a significant part of the labour market impacts would accrue outside of West Sussex.

6.2.2.6. Estimate of GVA Impacts

Applying the 10% to 20% of conventional benefits estimate Table 6-5 shows that the A27 preferred schemes could be expected to contribute between £31m and £62m to the wider economy over the 60 year period, although not all of this would accrue within the West Sussex boundaries. This includes the following impacts expected to add to productivity and economic activity:

- Additional benefits to time and cost savings in the course of work for both freight and business travel due to imperfect competition;
- Labour market impacts, both workers moving to more productive jobs and a greater willingness to enter the job market; and
- Agglomeration benefits.

Table 6–6 GVA Impact Range of A27 Preferred Investment Package

	Business and Freight Benefits	Wider Economic Impacts	Total GVA Impact
2016	£3.1m	£0.6m - £1.1m	£3.7m - £4.2m
2026	£3.7m	£0.7m - £1.4m	£4.4m - £5.1m
Present value over 60 Years	£166.8m	£30.9m - £61.7m	£197.7m - £228.5m

Note: Price Base 2010

6.2.2.7. Summary of Wider Economic Impacts

There is anecdotal evidence that the A27 acts as a constraint on economic and development activity. Congestion and slow and unpredictable journey times make the corridor a less attractive place to live, work and do business. Through improvements to the corridor local opportunities to grow the economy should emerge and improvements to other areas of the economy.

Atkins has worked in conjunction with Albion Economics to consider the potential wider economic impacts of the junction improvements along the sections of the A27. This work demonstrates that

- between 5,770 and 9,265 housing units could currently be considered dependant on improving these junctions on the A27;
- such improvements would release employment and mixed use development land that would have the potential to create 1000 to 2000 jobs; and
- generate a further £30.9m - £61.7m to the wider economy over 60 years.

6.3. Cost Benefit Analysis

The project has been to develop a package of schemes that will benefit the A27 corridor therefore, as with the economic benefits, the ratio between the costs of the schemes and the economic benefits is considered at a network wide level. It is worth noting that the benefits reflect the outcome of the AM peak hour model and therefore does not accurately reflect the impact of the scheme in the evening peak.

Generally a scheme with a benefit to cost ratio of 2 is considered worthwhile. The analysis in Table 6-6 below shows that an overall benefit to cost ratio of 5.0 can be achieved for the proposed package using conventional benefits alone, this would increase marginally if potential wider economic benefits were included. This indicates that the scheme is worthwhile and there is even margin for additional costs without affecting the value of the proposals.

Table 6–6 Cost Benefit Analysis of A27 proposals

Element	Present Value (£m)
Estimated Cost (C)	£61.3
Present Value of Benefits (B)	£309.0m
Net Present Value (B-C)	£247.6m
Benefit to Cost Ratio (B/C)	5.0

Note: Discounted values, 2010 prices and value base

6.4. Appraisal Summary

An appraisal based on the 5 business cases outlined by DfT WebTAG has been undertaken. The detail of this by area is included in **Appendix J** and is summarised below in Table 6-7. It indicates that generally the schemes are expected to provide moderate benefits.

Table 6-7 Summary of A27 Schemes Appraisal

Criteria	Finding	Appraisal Score
Strategic fit – why is the scheme needed?		Moderate Beneficial
Impact on the four primary objectives for the A27: <i>Improve journey times and journey time reliability for strategic (longer distance traffic) on the A27..... whilst ensuring the dual function of the A27 as a longer distance strategic route and a local access route is maintained</i> <i>Improve access by private and public transport to key employment and regeneration areas within Coastal West Sussex.</i> <i>Improve connectivity to/from the Manhood Peninsula.</i>	All junctions perform more effectively and overall journey times significantly improved across Worthing and Chichester sections with little change in journey times in Arundel as increased flows constrained by single lane sections. Local traffic generally benefits with significant delays on local roads around A27 junctions removed. Although on occasion some slight increases to junction arms with currently low delays. General access to regeneration areas around Coastal West Sussex will benefit from improved conditions on and around A27. Buses in the large do not travel on the A27 but do cross many of the junctions under review and hence benefit in the main from improved performance and reduced delays. There are reduction in delays and flows to and from Manhood Peninsula but right turn movements onto and off the A27 will be restricted resulting in longer, if more reliable, journeys.	Moderate Beneficial
Fit with wider transport and government objectives	Improvements to the A27 in Chichester, Arundel and Worthing are identified as high priority in LTP3. This WebTAG based appraisal reflects key government policy objectives and demonstrates clear alignment.	Large Beneficial
Impact on long term aspirations for the route	No impacts on long term aspirations for schemes along the route and some elements of scheme support them.	Slight Beneficial
Relationship with other junctions	Generally no adverse impact identified around adjacent centres, some reduction in flows on local and strategic routes. Where movements are restricted in Chichester there is likely to be some knock-on impacts on adjacent junctions where u-turns or alternative routes are taken. But at Stockbridge, Whyke and Oving whilst alternative routes are made and use of the A27 is increased generally journey times are improved Lyons Farm merge proposal requires closure of Hadley Avenue and Downlands Avenue in Worthing, needs consideration under future design and consultation. Goodwood Road proposed for closure at Offington Junction. Some potential impacts at junctions with Crossbush Lane and on London Road in Arundel.	Slight Beneficial
Value for money – is the scheme good value for money?		Moderate Beneficial
Economic growth	Benefits from model outputs are estimated to be worth £308m over a 60 year period. WEI Study indicates further £31m-£62m worth of benefits over 60 years.	Large Beneficial
	Housing and Employment development along the route has been identified and will benefit from improved conditions and ability to accommodate increased flows. Wider Economic Impact study does report benefits to the wider economy.	Moderate Beneficial
Carbon	Benefits from the model outputs indicate a reduction in greenhouse gases worth £800k over 60 years. This is supported at a network level where vehicle kms reduce slightly and delays to travel time are reduced.	Moderate Beneficial
Local environment - noise and air quality impacts.	Vehicle kilometres along each section of the A27 increase, although delays are reduced which is more likely to result in reduced noise levels and improved air quality.	Slight Beneficial
Local environment - natural environment, heritage and landscape, and the urban environment.	Some potential impact on historical heritage at Bognor junction and a loss of trees at Gove Lodge.	Slight Adverse
Social and well-being	Accidents: No current major concerns on accidents. Generally expected to be benefits for safety by separating movements and reducing nose-to-tail collisions. Improvements in pedestrian crossings should also reduce conflict. Analysis indicates benefit of £1.2m to the economy in reduced accidents over 60 years	Slight Beneficial
	Severance: General improvement in A27 efficiency decreases severance/improves accessibility. Pedestrian crossings have been incorporate where current arrangements would be affected. Some new footbridges included as part of wider proposals should reduce severance.	Slight Beneficial
Social and distributional impacts	There are areas of income deprivation and of older people identified around junctions which will benefit from improved conditions and public transport reliability.	Moderate beneficial
Benefit Cost Ratio	Benefit to Cost ratio at 5.0 across the network indicates schemes are worthwhile	Large beneficial

Criteria	Finding	Appraisal Score
Financial – is the scheme affordable and financially sustainable?		Slight Beneficial
Affordability	£60m – Relatively Low Cost	Slight Adverse
Potential for third party funding	Costs for Oving and Portfield Junctions expected to be met by developers. Whilst not third party note additional £10m expected to be contributed by Chichester District Council from developer contributions with potential to be match funded by WSCC.	Slight Beneficial
Management – is the scheme deliverable?		Moderate Beneficial
Public / stakeholder acceptability	Previous public consultation reported that 93% of respondents considered A27 junctions needed improving. Potential concern over banned movements Not expected to attract serious public opposition.	Moderate Beneficial
Practical feasibility	Generally feasible schemes. Some potential issues around Fishbourne, Bognor, Crossbush, Grove Lodge and North Lancing junctions for further consideration at detailed design.	Slight Beneficial
Timescale	All schemes considered deliverable within the short term, with implementation possible from 2015. Some improvements (Portfield and Oving) dependent on development.	Moderate Beneficial
Other key risks	Notable risks on this project: Implementation in short term requiring effective management approach Funding likely to be straightforward with risk in planning and agreeing financing loans.	Moderate Beneficial
Commercial – can the scheme be procured and constructed?		Slight Adverse
Commercial viability	Potential issues for funding and financing schemes but not insurmountable. Considered in more detail in Deliverable D7 - Action Plan .	Slight Adverse

Scale:

Green	Light Green	Green Accent 1 Lighter 40%	Yellow Accent 3 lighter 80%	Yellow Accent 3, lighter 40%	Orange	Red
Large beneficial	Moderate beneficial	Slight beneficial	Neutral	Slight adverse	Moderate adverse	Large adverse

7. Delivery Action Plan

Implementation can be seen as a challenge nowadays because of the lack of traditional funding sources such as grants or awards from DfT or HA for major or non-maintenance type schemes. There is a growing view that schemes that are worthwhile implementing should be worthwhile funding at a local or private sector level and that there will be little, or no, more grants from the government.

That means other sources of funding need to be identified. In reality 'Funding' sources for local government on worthwhile schemes are relatively easy to identify, it is the sources of 'Financing' to support the funding which is more difficult to identify and needs greater consideration.

7.1. Committed Development Contributions

Chichester District Council

Chichester District Council has identified a total of £10m from developer contributions which could be made available to implement major schemes on the A27 in Chichester to accommodate additional traffic movements. This previously had been linked to the major scheme development work undertaken by Jacobs for the Highways Agency. However, as many of the options identified as part of the major project schemes are included in these proposals and intended to increase capacity and accommodate additional development traffic WSCC has indicated that this would be available to fund the proposed package.

Shopwhyke Lakes Contribution to Portfield and Oving junction design

The designs at Portfield and Oving Junction have been put forward by developers as part of the Shopwhyke Lakes development plans so it is assumed will not require additional funding. Therefore the costs of implementing these schemes, estimating £5m, at Oving and Portfield junctions are to be met directly by the developer and are not included in funding considerations.

There are no additional development contributions currently identified for Worthing or Arundel areas. Although there is development planned which has the potential to impact on the A27 around the study area and may therefore generate additional developer contributions.

7.2. Funding Options

The costs identified of £59.6m are relatively low considering the original cost limitation given in the project scope of £150m-£250m. Part of the reason for this is the ability to achieve similar benefits from at grade, cheaper, schemes rather than options such as fly-overs with greater engineering challenges and costs. Therefore funding options can be considered to be relatively straight forward. However, before considering options specific to the A27 it is important to understand the difference between 'Funding' and 'Financing'. There are a number funding options where money can be granted, lent or raised to pay for schemes. In the growing number of cases where money is no longer given in the form of grants, a source of revenue is required to pay back, or 'Finance', the loan. A recent view on these sources is identified in Table 7-1 below.

Table 7–1 Transport Schemes Funding and Financing Sources

Funding	Financing
Public Works Loan Board	Council Tax
Capital Funding	PFI Credits
Asset disposal (selling assets)	Revenue Funding
Central Government Grants	Business Rates Retention
Local Transport Bodies (LTB) Funding	TIF (Tax Increment Funding)
European Grants	Planning obligations/Development contributions
Third Party Debt / Equity	New homes bonus
Municipal Bonds	Revenue generating assets
Infrastructure Funds	Workplace Parking Levy
Institutional Investors / Pension Funds (public & private)	Tolls
Tactical Government Funding (NHB, GPF, BBN, LEP funding)	User Charging
CIL (Community Infrastructure Levy) (individual and pooled)	Supplementary Business Rates
European Investment Bank	Savings
TIFU (The Infrastructure Finance Unit)	CIL (Community Infrastructure Levy)
EBRD (European Bank for Reconstruction and Development)	
Green Investment Bank	

Source: Adept and PWC Presentation on Funding and Financing Infrastructure Nov 2012

These sources of funding and financing lend themselves to different projects, depending on the nature of the project, the scale of funding required, i.e. costs, and the level of risk willing to be taken to meet those costs. Those most applicable to the scenario on the A27 are explored further in this chapter.

7.3. Funding Options for A27

In total the scale of additional funding required is considered to be of a low to medium level for transport schemes. Therefore the most likely sources are:

- Asset Disposal – this would involve selling local assets to support costs;
- Asset Acquisition – acquiring land for local benefit and investing return, likely to focus on Homes and Communities Agency remit to provide housing;
- Loan from the Public Works Loan Board (PWLB) – statutory body with interest rates set by HM Treasury;
- The Infrastructure Finance Unit (intended as last resort and only to supplement bank/capital market lending);
- Capital Funding - including allocations from government and emerging opportunities such as CIF, unlikely to require repayment;
- Central Government Grant – largely the Communities and Local Government (CLG) grant, unlikely to require repayment;
- LTB (Coast to Capital) Funding – allocations of previous Major Scheme Funds, project already identified.

Part of the reason for this additional consideration of funding sources is because traditional means such as capital funding and Government Grants are becoming scarcer although options of where these were available have been considered. The Infrastructure Finance Unit has been discounted which was formed to support the lack of available bank/capital market lending in much larger complex projects.

Asset Disposals and Acquisitions are valid sources to consider but are more likely to feature in an overall financing package rather than providing upfront funding.

Three potential scenarios for funding the A27 package of works is presented for further consideration:

1. Existing developer commitments (towards Portfield and Oving Junctions) of £5m and additional grant funding to be identified of £55m;

2. Existing developer commitments (towards Portfield and Oving Junctions) of £5m, WSCC funding of £10m to match Chichester District Council developer contributions of £10m and remaining £35m to be formed of additional grant funding to be identified and as yet uncollected developer contributions;
3. Existing developer commitments (towards Portfield and Oving Junctions) of £5m, WSCC funding of £10m to match Chichester District Council developer contributions of £10m and remaining £35m to be sourced through PWLB loan, likely be financed through a combination of revenue sources as presented in Table 3-1.

As mentioned there are no currently identifiable sources of Grants or funding from DfT or HA which could be recommended for supporting Options 1 and 2, and it is assumed these options do not 'cost' the County Council any more in contributions other than those outlined. However, Option 3 would incur additional cost in the financing of the PWLB loan.

7.3.1. Option 3 - Costs of Funding from Public Works Loan Board

The Public Works Loan Board's website provides an estimate on the cost of a loan (http://www.dmo.gov.uk/rpt_parameters.aspx?rptCode=D9A.1&page=Estimated_Costs). The cost depends on the repayment terms. Interest rates increase the longer the repayment period. The interest rates and total costs are also slightly higher if repaying by Annuity terms rather than EIP (Equal Instalment of Principal) method. The difference being that EIP repayments start higher but reduce at every repayment, whereas the Annuity repayment amount starts lower but does not change year on year.

An example repayment on the £35m funding requirement over a period of 15 years is shown below. A 15 year repayment period reduces the overall cost compared to longer repayment periods and aligns more closely with the traffic forecasting period for the operation of the junctions as part of this study up to the year 2026. If choosing the cheaper EIP method with an interest rate of 3.20% the initial ½ yearly repayment is £1.689m. Each payment then reduces by £18,064 every 6 months. Therefore the first annual repayment total is £3.4m. Over the lifetime of the loan 31 repayments would total £44m

Table 7-1 Example Repayment Profile for loan from PWLB of £35m

Repayment Period	Annual Repayment Amount	Repayment Period	Annual Repayment Amount
Year 1	£3,360,000	Year 9	£2,781,935
Year 2	£3,287,742	Year 10	£2,709,677
Year 3	£3,215,484	Year 11	£2,637,419
Year 4	£3,143,226	Year 12	£2,565,161
Year 5	£3,070,968	Year 13	£2,492,903
Year 6	£2,998,710	Year 14	£2,420,645
Year 7	£2,926,452	Year 15	£2,348,387
Year 8	£2,854,194	Year 15.5	£1,147,097
		Total	£43,960,000

7.3.1.1. Financing Options

To support the funding option identified above regular repayments are required for which a number of finance options could be considered:

- Supplementary Business Rates;
- Revenue Generating Assets;
- Workplace Parking Levies;
- Planning obligations/Development contributions
- New homes bonus
- Savings;
- Council Tax;
- Revenue Funding;
- CIL;

- Asset Disposal;
- Asset Acquisition.

The potential for the Community Infrastructure Levy (CIL) to provide an ongoing source of financing is explored further in this chapter. The remaining options will need consideration by the WSCC Chief Finance Officer as potential options for making up any shortfall in the financing requirements which would be likely to form a combination of two or more sources.

Discounted options

Other options were identified above and have been discounted for this scenario for the following reasons:

- TIF – Tax Increment Financing is a innovative and complex financing option best suited to distinct areas of economic development rather than a collection of schemes across a wide geographical area;
- Business Rate Retention – needs to be directly related to economic benefits so more relevant to localised high cost schemes where benefits are more clearly identifiable;
- Tolling or Road User charging – there are many reasons why this is not considered to be the appropriate approach for the A27:
 - Current policy is to link tolling to wholly new infrastructure projects providing benefit, where the A27 proposals are more localised improvements with no significant infrastructure changes;
 - Implementation and operation costs are very high in relation to the cost of the improvements - £162m to implement the London Congestion Charging Scheme with initial annual operating costs of around £90m (Source: Central London Congestion Charging Scheme: ex-post evaluation of the quantified impacts of the original scheme, 2007);
 - The nature of the A27 at the three centres does not loan itself to tolling sections of the route such as the M6 as there are many junctions close to each other. Also a cordon based charging arrangement such as in London would not be directly applicable to the A27 and there are no obvious congestion issues to be tackled around any of the centres such as Chichester or Worthing;
 - The mix of local and strategic traffic would beg questions of who is being targeted and the potential for the high level of exemptions that may be requested, say for local residents, would make the scheme unprofitable;
 - Any revenues from charging schemes are usually ringfenced for supporting local transport schemes in the future and therefore its longer term fiscal benefits may be limited;
 - The political implications of progressing such a localised scheme.

7.3.1.2. Community Infrastructure Levy (CIL)

CILs provide a source of funding for local community and infrastructure schemes. They are supplementary to other sources such as Section 106 contributions and business rates. Any CIL contribution would have to be considered against schemes within the local district. Also any potential contributions currently identifiable are likely to be collected over a long period. With plans ranging up to 2028 the contribution period could be over 15 years. Therefore, CIL contributions are most likely to be seen as a funding source for low cost schemes or as part of a financing package to repay other funding sources.

Worthing CIL

A Preliminary Draft Charging Schedule for a CIL in Worthing has been produced. It identifies a potential new funding source with a total value of £17m from development planned up to 2026. The majority of this is likely to be required to fund alternative community and infrastructure projects and the report does indicate that the total does not even reach the already identified infrastructure funding gap for Worthing. It could be assumed that a portion of the CIL could be used to finance local schemes on the A27, although this would be over the 13 year plan period to 2026 so is unlikely to provide a source of upfront funding.

Potential Adur, Arun and Chichester CILs

Adur, Arun and Chichester as yet have not produced similar Draft Charging Schedules.

7.3.1.3. Potential Funding Deficit

As indicated in Table 3-1 likely annual repayments on a £35m loan over 15 years would vary between £3.4m and £2.3m.

For the purposes of understanding the potential funding deficit part of the financing plan could be assumed to come from the Worthing (and ultimately other districts) CIL. A conservative estimate might be in the region of 15% of CIL revenues provided. In the case of Worthing this would be a hypothetical £3.4m, around £230,000 a year. If CIL contributions were forthcoming from all districts alongside other locally generated

revenue streams such as develop contributions the maximum contributions might be no more than £1.5m a year. This indicates that relying on CIL or developer contributions alone would be insufficient and the amount could vary considerable year on year, assuming a regular contribution there would be an annual funding gap of between £1.9m and £0.8m under the scenario presented in Table 3-1.

Therefore a financing plan to consider the options for filling the shortfall will need to be considered. The potential variability in the year on year contribution also makes the need for a flexible financing plan to cover the potential variances in shortfall.

Taking the loan out over a longer period would bring the annual repayments down. However, to make the shortfall negligible this would need to be over an unfeasibly long period, and the longer the repayment period the higher the overall cost becomes and the lower the value of the scheme. As has been clearly demonstrated in recent years government policy can change significantly in a short period of time, let alone over the 15 or more years repayment period, which could affect the source and values of contributions to a financing package and a financing plan will need to consider the long term potential for contributions.

7.4. Programme

Because of the early stage of development of these schemes a potential programme is being considered in two parts: the preconstruction; and construction stages.

7.4.1. Pre-construction Programme

The scheme preparation stages are defined by the HA Project Control Framework (PCF). This defines a project by seven stages over three phases, with the A27 currently nearing the end of Stage 1. There are no set or recommended durations for these stages and depend entirely on the scale, complexity and controversy surrounding the scheme. Typically some elements particularly related to planning and public inquiry will have response durations associated with them, although this scheme is relatively uncontroversial so would not be expected to be taken to public inquiry and any orders would be expected to be straight forward.

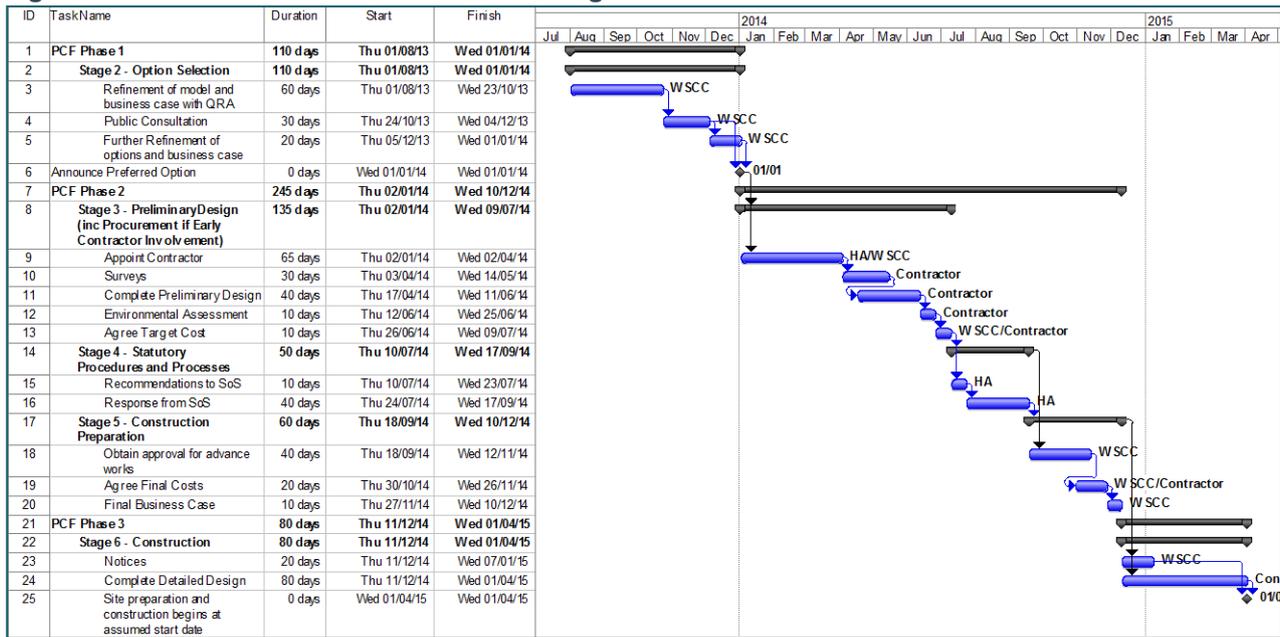
An indicative programme below outlines the key stages in relation to the HA PCF up to an assumed construction start date of April 2015. The durations are high level and are based on previous experience of similar, relatively uncontroversial, projects. It is worth noting that the A27 scheme is not considered to be 'nationally significant' and therefore not covered under the Planning Act 2008, so Stage 3 does not require additional consultation or consent orders. However, it is recommended that early contractor involvement from Stage 3 is considered in order to help streamline the process.

The programme assumes a start date for further refinement on the A27 schemes of August 2013 prior to public consultation between October and December 2013. It also includes indicative lead responsibilities for each task although officially it would be an HA led project because of the A27 trunk road status.

The estimated cost of this stage, covered in the overall scheme costs is £1.5m-2.9m, with estimates for the cost of each stage as follows:

- Stage 2 – Option selection – approximately 15% of estimated cost
- Stage 3 – Preliminary design – approximately 50% of estimated cost
- Stage 4 – Statutory procedures and processes – approximately 5% of estimated cost
- Stage 5 – Construction preparation – approximately 10% of estimated cost
- Stage 6 – Construction – approximately 20% of estimated cost

Figure 7–2 Indicative Pre-Construction Programme



7.4.2. Construction Programme

The potential for programming the implementation of the schemes as a number of tranches in order to ease funding requirements was considered. Because of the relatively low cost of the schemes, lack of foresight on any available potential third party funding, the general availability of funding from the PWLB and the objective for short term implementation this was discounted in favour of a full funding approach. It is assumed that funding to cover all the proposed schemes will be available upon commission.

Therefore a programme to optimise the construction process has been considered at this stage which will need further consideration as detailed design is completed and a contractor is appointed. The programme is intended to be high level giving an indication of the approach that could be taken to implement the schemes and how long until completion. It is not intended to support detailed construction management or tendering processes.

This approach assumes funding for all the schemes across each area is available for an assumed start date, in this case the start of April 2015, and that there are sufficient construction resources to progress each centre concurrently but that in order to manage traffic disruption in the main schemes within each area are programmed to follow each other and do not all happen at the same time. Whilst the start times may be considered optimistic there is potential for shrinking the programme as presented here by overlapping elements within each centre but this needs to be considered with the detailed design.

In each case schemes have been programmed in the order presented to reflect:

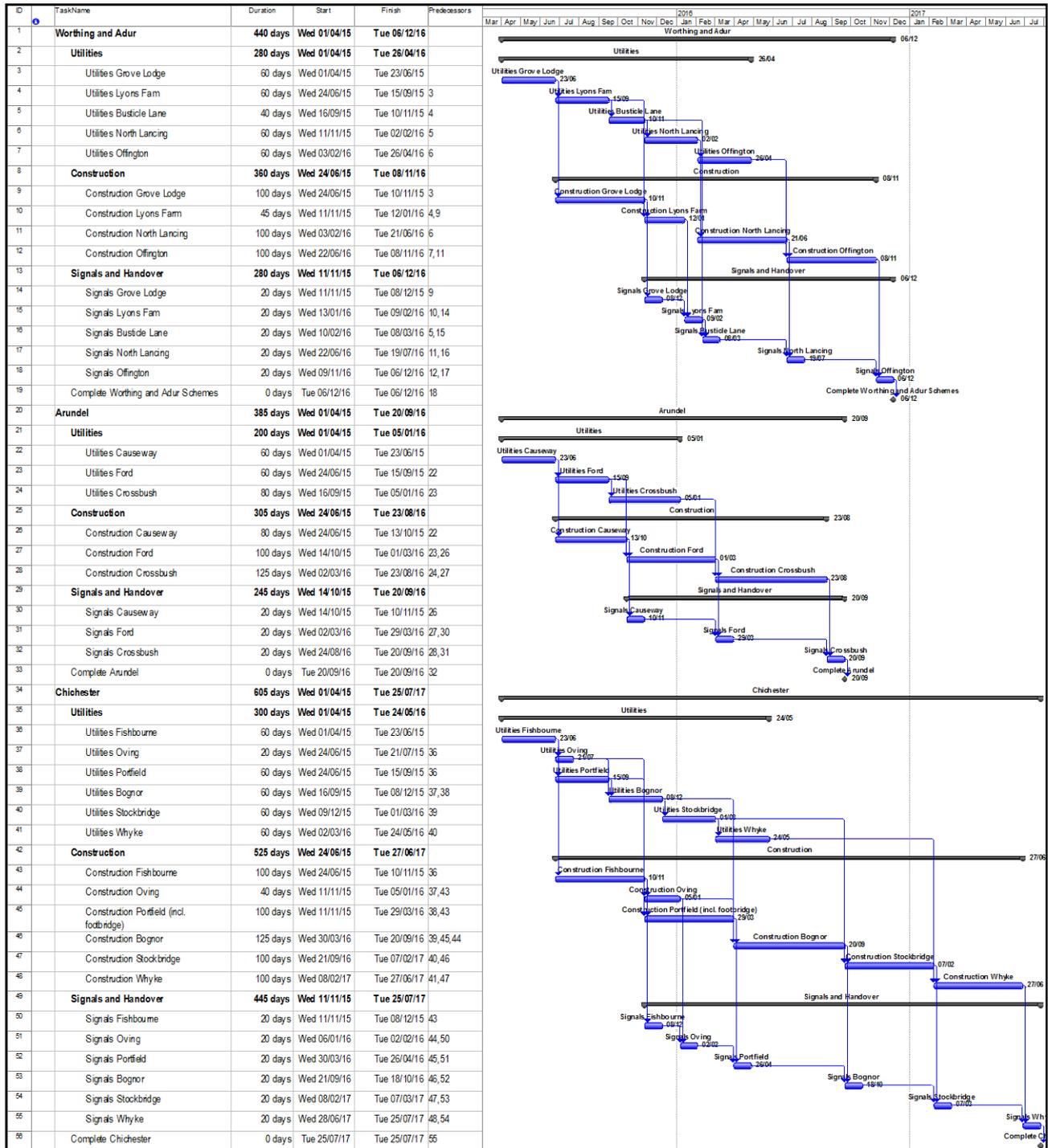
- The potential benefit from them;
- Dependencies in relation to other junction schemes, e.g. opportunities for u-turns in place where movements will be restricted;
- The distance they are away from each other to minimise disruption in any localised area;
- The scale of the scheme and the assumption that larger schemes may need longer preparation time.

In each case three stages are expected for each junction: an initial stage where traffic management can be arranged and utilities work is undertaken in preparation for; the construction stage; and followed finally by implementation and management of any signalling required and removing construction works for handover to the Highways Agency. The programme assumes all preparation work for surveys, land ownership, contracts etc are complete before commencement.

The resultant programme indicates that:

- Worthing schemes could be completed by December 2016;
- Arundel schemes could be completed by September 2016; and
- Chichester schemes would take considerably longer and could be completed by July 2017.

Figure 7-3 Full Funding Indicative Programme for Preferred Package



7.5. Project Management

Whilst having an understanding of a potential scheme programme, costs and funding arrangements helps in driving delivery it is the governance and project management arrangements surrounding the schemes that is vital to achieving goals.

The project management processes and frameworks that support public sector schemes and organisations are well documented and whilst worth noting are not intended for detailed scrutiny as part of this work. The idiosyncrasies and imminent requirements to progress the A27 schemes however are. This chapter considers the structure of relationships involved in the ongoing project and suggests key steps for early focus.

7.5.1. Current Frameworks

The two main organisations involved in this project, WSCC and the HA, both have clear project governance guidelines and frameworks.

In terms of WSCC the combination of the proposed A27 schemes would be considered a Major Project as costing over £5m. In this case a Record of Practices (ROPe) has been outlined which draws on guidelines from LTP, DMRB, Highways Act, DfT Guidance, etc. This identifies a 6 stage process from Feasibility to Post-scheme Evaluation. At this stage in the project WSCC are nearing completion of Stage 1.

The HA has a very detailed Project Control Framework (PCF) which is intended to be applied to projects costing more than £10m, which applies to the A27 schemes as a whole. It is largely based on the Prince2 approach requiring clarity in roles and responsibilities, lifecycles, product delivery and is defined across 7 stages. The A27 project would be considered to be at the end of Stage 1.

7.5.2. A27 Roles and Responsibilities

As the schemes are all on HA owned routes the ultimate responsibility for delivering the projects will be with them, and therefore project delivery will be formed under their project framework. The HA PCF defines clearly the roles to be defined as part of the project governance. Based on Prince2 principles these include:

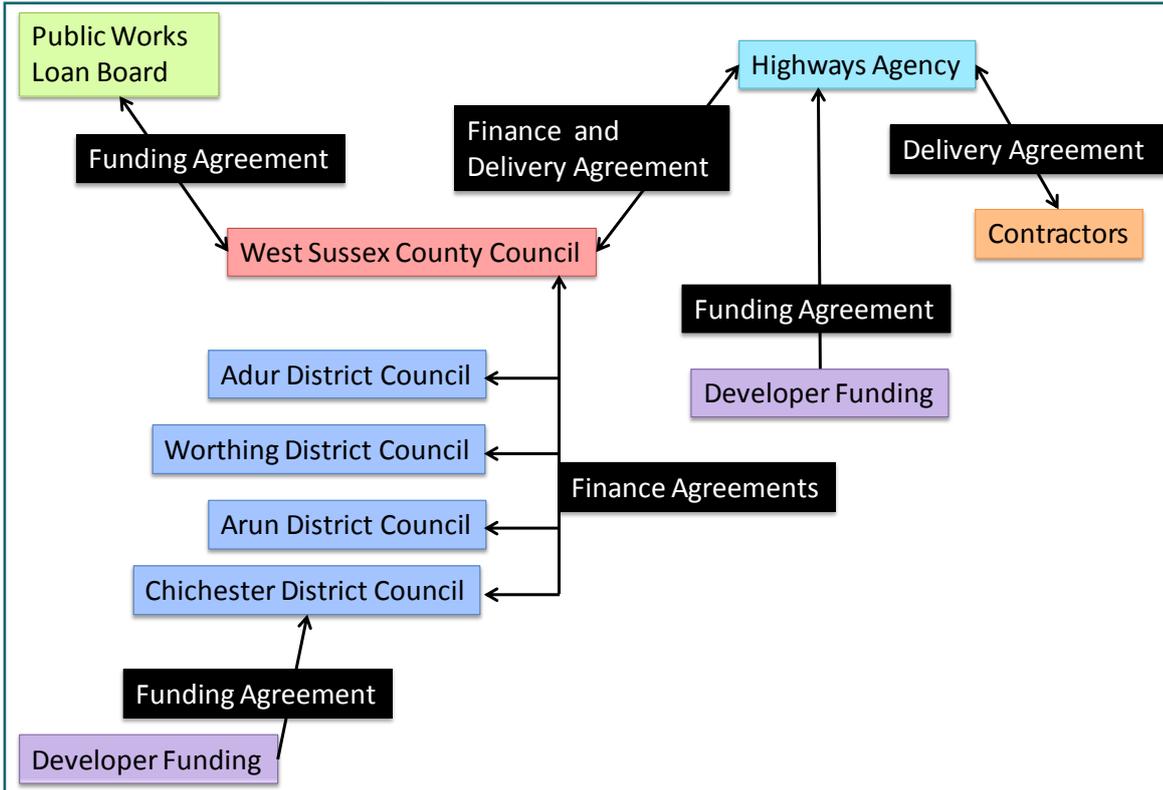
- Project manager – likely to be HA;
- DfT project sponsor – traditionally DfT, but likely to be WSCC;
- Senior responsible owner – likely to be HA;
- Project board – likely to be mix of HA, DfT and WSCC; and
- Senior users – likely to be HA.

Because the progression of these schemes is ultimately dependant on gaining funding what is really of greater concern at this point is the relationship between the various organisations involved in the funding, financing and development of the schemes:

- The HA will manage the scheme and the contractors, and presumably their payment;
- WSCC are promoting the schemes and will be the organisation which applies for and repays the loan directly. They will therefore need an agreement with the HA as to the scheme designs and payment arrangements;
- The PWLB will provide the initial funding and therefore need an agreement with WSCC; and
- The 4 district councils where the junctions are located, assuming CIL and some level of contribution is in place, will each need an agreement in relation to how payments are made.

This has been shown diagrammatically in Figure 5-1. The importance of WSCC and of their agreements with other parties in gaining funding and managing finance becomes apparent. This element of the process is not as clearly defined in the project framework guidance so needs early and particular attention. The rest of the project process should more naturally occur by following HA/WSCC framework processes.

Figure 7-4 Structure for agreements in A27 Project



8. Conclusions and Key Next Stages

8.1. Conclusions

As a package the proposals fulfil the requirements of the A27 strategy. They sit within the guiding principles set out for the project and meet the local and wider objectives providing benefits to strategic traffic on the A27 with little disbenefit to local users. In the majority of cases local traffic will also benefit from reduced delays, improvements on the A27 and reduced flows on other links.

Across the whole of the preferred package there are some generalities that can be picked out to define the improvements:

- Type of improvements - generally at-grade solutions, incorporating additional control through signalling and increasing capacity through additional lanes at junctions where possible;
- Dual function of strategic and local traffic – have generally sought to optimise all movements through signal control and reduce most significant delays, with strategic movements prioritised;
- Buses/Cycling/Pedestrians – considered on a junction by junction basis and generally maintaining existing facilities;
- Scale of Cost - considered to be relatively affordable solutions (£60m) compared to target price range identified at inception (£150m - £250m);
- Likely Timescale – fit with short term implementation design, schemes are relatively uncontroversial and straightforward, should be able to be completed within 4 to 5 years.

The improvements accommodate future growth up to 2026 under planned growth and allow the A27 to not only function more effectively, but function at all as the only East-West strategic route in the area. The improvements will have a direct impact in supporting the economy and allowing it to grow. Any longer term benefits beyond 2026 are uncertain and will depend on the actual rate of traffic growth and the response by drivers to increased capacity on the network which may encourage trips on the A27 avoiding congestion elsewhere, or rescheduling trips from other times of the day.

However, there are some elements within the proposals which could benefit from further investigation.

The benefit to traffic travelling across Worthing and Chichester is clear with significant improvements in average speed and reductions in travel time as a result of less delay. A clear recommendation would be to proceed with options for improvements at Worthing and Chichester.

Whilst in Arundel the benefits of the proposals are less clear. The proposals do improve junction performance and allow for the forecast increase in traffic to be accommodated yet the wider benefits in improved average speed and reduced delays across the Arundel A27 corridor as experience elsewhere are not realised.

The costs fall well below the guiding budget offering good value for money considering the economic benefits and overall benefit to cost ratio of 5.0. Gaining funding for the A27 schemes may be relatively straight forward but there is a noticeable gap in the ability to define where the finances to repay the funding loan will come from.

8.2. Outstanding Issues, Risks and Caveats

Before considering a set of recommendations it is worth reviewing key issues, risks and caveats;

- The Highways Agency Road Safety Review on the feasibility designs has not been received and therefore incorporated into feasibility designs;
- An optimal solution for Arundel has not yet been identified;
- A widely acceptable solution to allow the closure at Hadley Avenue and Downlands Avenue to accommodate the improved merge at Lyons Farm junction has not yet been identified;
- The difficulty in retaining all movements at Stockbridge and Whyke junctions has been established but the precise movements to be retained should be reviewed in network strategy terms;
- Possible 'blocking back' issues within junctions (at Fishbourne, Bognor Road, Ford, Offington, Grove Lodge);

- The strategic model applied cannot represent all local movements/effects as well as bespoke local models;
- Only AM peak hour modelled;
- Variable demand effects not modelled;
- Base turning movements not validated in junction models.

8.3. Recommendations

Considering all of this there are a number of recommendations that have emerged from the appraisal and Action Plan review. These include:

- A review of the model performance in Arundel and a small data collection and validation exercise in this area which will either provide greater confidence in the model results for the Arundel elements of the scheme or lead to alternatives solutions being proposed in Arundel;
- Full application of strategic model, with due consideration to the development of an evening peak hour model, which will shed further light on the operation of scheme;
- With the desire for implementation in the short term the package of schemes as a whole should still be taken forward for implementation whilst parallel work can be undertaken reviewing the case for Arundel and any subsequent recommendation incorporated at a later date;
- Prioritise a review of financing possible loan repayments. This will need to be led by the Finance team within WSCC so strong relationships need to be developed between the Transport and the Finance teams. A review should consider potential CIL contributions in more detail and the opportunities within the County Council to meet the likely shortfall in relation to loan repayments;
- Explore the development and implementation of CIL schemes across the four district councils. This should lead to discussions and drafting of potential agreements with the four district councils relating to future contributions;
- Establish the A27 Project Framework and identify individuals for key roles in Project Board as set out by HA PCF. Ongoing responsibilities for specific tasks can then be allocated; and
- Consider next stage key elements as set out in Figure 7.2 'Pre-construction Programme

An aspiration for these schemes to be implemented in the short term was identified as part of the study brief. To reflect this a construction start date of April 2015 has been, perhaps optimistically, used in indicative programming, less than two years from the completion of this study. This infers a level of immediacy to be placed against all of the above actions

Appendices



Appendix A. Summary of previous A27 studies

Date	Milestone
1990s	Proposals for a northern bypass were examined and subsequently rejected during the Public Inquiry into the A27 Havant to Chichester proposals. Any northern bypass option would be expensive and would impact significantly on the Sussex Downs (Area of Outstanding Natural Beauty and designated National Park).
July 1998	In July 1998, the Transport White Paper 'A New Deal for Trunk Roads in England' initiated several comprehensive studies to improve transportation in various regions of England. The study carried out for the South East region of England was called the South Coast Multi Modal Study (SoCoMMS) .
Sep 2002	The South Coast Multi Modal Study (SoCoMMS) recommended a range of transport improvements. <ul style="list-style-type: none"> • For the Chichester Bypass section, the study recommended the provision of two- level junctions and/ or junction closures, in association with a range of complementary measures. • For the Arundel section the road improvements include the A27 Arundel bypass. • For the Worthing and Lancing section, the measures recommended include improvements to two key A27 roundabouts and a third junction using traffic signal controls, and road improvements to the A27 through Worthing and Lancing in the form of a tunnel or series of tunnels should be investigated. User benefits were estimated at £1.7bn and the overall cost-benefit ratio was 2.8.
2003	In 2003, the Secretary of State for Transport rejected all the improvements identified for the section of the A27 around Chichester, in view of concerns over the impact of the proposals for the A27 on the environment. Instead he instructed the Highways Agency to work with the County Council, Local Authorities and environmental bodies to develop options that are environmentally acceptable and address regional and local issues. (<i>HA webpage</i>)
2004	A27 Chichester Improvement Scheme (Highways Agency) – Following the Secretary of State’s decision, the HA developed a package of strategic measures seeking to remove conflict and congestion at the bypass junctions, and improve local access, enabling other local transport improvements to be implemented. They involve improving access at A259 Fishbourne Road, Bognor Junction, Portfield Junction, with access restricted to left turns only for all vehicles except public transport at Stockbridge Junction, Whyke Junction, and Oving Road Junction. Public consultation was undertaken in December 2004. The capital cost was estimated at £85 million, with a Benefit Cost Ratio of 5.5. However, the scheme appraisal also identified adverse impacts on townscape, heritage of historical resources, biodiversity and water environment.
2006 / 2009	Arun District Strategic Transport Study – This study assessed Arun District Council’s Local Development Framework to confirm traffic impacts and where improvements would be required using the West Sussex County Model. None of the scenarios generated new areas of congestion on the A27 between Chichester and Worthing. The 2006 study was followed in 2009 with similar assessments of revised scenarios. In this case some impact was noted around the Chichester By-pass areas.
Apr 2007	Report by the A27 Worthing / Lancing Task Force - This report acknowledged that whilst the best solution to congestion in Worthing and Lancing was the construction of a bypass, given funding restrictions, this was unlikely in the short to medium term. Therefore they prepared a package of options to reduce congestion. The options are split between direct A27 schemes, traffic and network management, public transport, ‘soft measures’ and community engagement.
May 2010	Worthing Core Strategy Testing – This report by Parsons Brinckerhoff to determine the broad highway impacts of their proposed Core Strategy development, required to meet the South East Plan’s housing and employment allocations. It tested the forecast year 2026 and reports on changes in traffic flows at key junctions. In 2026 all the junctions between Offington and Lyons Farm have V/C ratios in excess of 85%. The analysis shows that the Worthing Core Strategy developments do not have a significant impact on this.
May 2010	CWS DaSTS Study - A study commissioned by the South East England Partnership Board, which develops options for transport and investment for the West Sussex Coast., which meets the DfT’s national goals for transport as set out in DaSTS. A total of six options were developed, which involve an incremental approach to investment in transport infrastructure and Integrated Demand Management (IDM).
July 2010	The Provisional West Sussex Transport Plan (2011-2026) Sustainability Appraisal Report - combines a number of assessments and appraisals required in the development of the third Local Transport Plan (LTP3). Key messages are outlined which promote sustainable transport and support local development and economy.
Oct 2010	The Spending Review announcement in October 2010 listed the A27 Chichester Improvement Scheme for potential construction in future spending review periods (post March 2015), subject to the outcome of statutory processes.
Oct 2010 (ongoing)	A27 Junction Capacity Modelling – a capacity assessment of 3 junctions to evaluate 8 future scenarios. This included the Crossbush junction relevant to this study. The eight scenarios reflected different transport and growth scenarios not directly changing the operation of the junction. The conclusion was that Crossbush junction would operate

	<p>significantly over capacity in all scenarios if no mitigation was in place. Two options of possible mitigation were tested. More recently 12 options for the Crossbush junction have been developed and an initial assessment undertaken by WSCC as to whether to progress these further. Four options have been deemed suitable for further consideration.</p>
Mar 2011	<p>A27 Worthing Congestion Study Ph 2 – HA commissioned study to look at A27 around Worthing. Using microsimulation the outcome recommendation was defined as Option B. It requires</p> <ul style="list-style-type: none"> • road layout improvements and partial signalisation at Offington Corner Roundabout; • road layout improvements and signal optimisation at Grove Lodge Roundabout; and • signal timing optimisation at Sompting Road and Lyons Way, which also includes phased order changes.
Apr 2011	<p>The third Local Transport Plan identifies the need for major investment in the strategic road infrastructure at Chichester, Arundel and Worthing, as well as in public transport. It outlines a commitment to work with all levels of government to secure improvements to the A27 and West Coastway rail line.</p> <p>The LTP Implementation Plan includes a range of short-term measures which will help to address the key issues for the area and will complement long-term major investment in the infrastructure.</p>
Feb 2012	<p>Developing an Employment and Infrastructure Strategy - The Coastal West Sussex Partnership considers the strategic employment sites in Coastal West Sussex (CWS) and related infrastructure improvements together with strategic housing sites in order to assist with the spatial vision to offer the best possible environment to deliver economic growth in the area. Transport infrastructure improvements which are necessary or desirable for the delivery of the strategic employment sites were identified.</p>
Autumn 2012	<p>A27 Arundel Bypass Economics Study – a study into the Wider Economic Impacts of the A27 Arundel Bypass. Concluded that the impact for the seven districts of West Sussex would be £493m added to GVA and 12,000 annualised jobs created. The study recommended further analysis of the Wider Impacts of the scheme, and consultation with the DfT on the best approach.</p>
Nov 2012	<p>Jacobs Chichester Report – Used the Chichester Area Transport Model to examine the area wide impacts of local growth. The key conclusion from the study was that without any mitigation, background traffic growth will reduce overall network performance without any non committed housing growth and with additional housing growth journey times and congestion levels are markedly worse than in the current year. Mitigation measures were tested to reduce congestion. The measures included :</p> <ul style="list-style-type: none"> • A27 Junction ‘at grade’ improvements within existing highway boundaries retaining all traffic movements • ‘Smarter Choice’ and demand management measures to encourage public transport use and walking / cycling
Nov 2012	<p>Chichester Local Plan – Transport Study of Strategic Development Options and Sustainable Transport Measures. This study reviews the development framework against growth scenarios and considers mitigation measures of A27 Junction ‘at grade’ improvements within existing highway boundaries retaining all traffic movements and ‘Smarter Choice’ and demand management measures to encourage public transport use and walking / cycling</p> <p>Further development work was identified for detailed design of A27 schemes with the HA and further consideration of Bognor Road/A27 junction is a specific requirement. Programming of mitigations will be important to deliver a coherent strategy linked to housing growth.</p>
Dec 2012	<p>Arun Transport Study for Strategic Development Locations – Includes detail on developments and model zones. Covers key junction relevant to this study including Bognor Road Roundabout, Arundel Roundabout, (Crossbush) Partial signals, Oving Rd/Shopwyke Rd Signals.</p> <p>Modelling three development scenarios indicated that all junctions are at or exceed capacity by 2031 by up to 22%.</p>
Jan 2013	<p>Adur Transport Study of Strategic Development Options and Sustainable Transport Measures – This study looks at various development scenarios and impacts and mitigation measures on key junctions. This included the A27 Grinstead Lane Junction relevant to our study.</p>
Jan 2013	<p>A27 Route Strategy and Action Plan - WSCC commissioned Atkins to prepare a short term route strategy for the A27 in West Sussex.</p>

Appendix B. Potential Options from Initial List

A summary of the 43 potential options is shown in Table B-1. A full list is included in the previous deliverable **Option Identification and Sifting (D2)**.

Table B-1 Summary of potential options by location and junction

Junction	Scheme description
Chichester	
Fishbourne Roundabout – strategic access route to City Centre	Local road over A27 without Stockbridge Link Road Local road over A27 with Stockbridge Link Road A27 over local road 'Hamburger' roundabout
Stockbridge Roundabout – lower capacity access route to City Centre	Signalised junction replaces roundabout
Whyke Roundabout – lower capacity access route to City Centre	Convert roundabout to a signalised junction Signalise roundabout
Bognor Road Roundabout – strategic access route to City Centre	Grade separated junction, local road over A27 Grade separated junction, A27 over local road Signalised junction Signalised roundabout Roundabout improvements
Oving Road – lower capacity access route to City Centre	Changes to movements on the signalised junction
Portfield Roundabout – strategic access route to City Centre	Minor junction improvements Additional Lane between Portfield and Oving Road A27 mitigation schemes Signalised roundabout Signalised junction
Arundel	
Arundel Bypass	A27 Arundel Bypass
Ford Roundabout	Layout improvements to the junction Hamburger Roundabout Signalised roundabout
Causeway Junction	Signalised roundabout Signalised junction
Crossbush Junction	Two lanes merge further along A27 with some slight widening. Two lanes merge further along A27 with some widening and dedicated e/b lane to A27. New signal controls for A284 to A27 e/b. Relocate slip road to A284 s/b further east on A27. Use current overbridge for s/b A27 to A284 traffic. Construct new lanes for A27 to west of current overbridge and relocate bus stop. Removes current Gyrotary approach. Comprises a new three-arm roundabout located on 3 rd party land to the west linked to an extension of the existing dual carriageway, bridged by the current gyrotary north-south aligned section revised for southbound flow only.
Worthing	
Offington Corner	Minor Junction improvements Road layout and signalisation of Westbound entry Hamburger roundabout Three Lanes Roundabout Convert to signalised junction
Warren Road	Warren Road - road widening
Grove Lodge Roundabout	Minor Junction improvements Option B Road layout and signal optimisation Hamburger Roundabout
Lyons Farm / Sompting Road	Signal optimisation Layout improvement and signal optimisation Atkins proposals

Junction	Scheme description
Busticle Lane	Signal optimisation
North Lancing Roundabout	Major junction improvements including signalised junction Signalised junction
All junctions	Limit side road access to A27

Of the 43 initial options only 6 were discarded from potential inclusion in the scenario packages, shown in Table B-2, under the criteria that they:

- Would clearly fail to meet the objectives identified for intervention on the A27 (assessed as part of the strategic case);
- Clearly do not fit with the guiding principles identified for the strategy (assessed across all five cases); or
- Would be unlikely to pass other key viability and acceptability criteria (or represent significant risk).

Table B–2 Summary of discarded options

Junction	Reason for discarding option
Chichester	
Ch.Why.2 - Whyke Roundabout: Signalise roundabout	The proposal to signalise the roundabout has been rejected on the grounds that the existing roundabout is too small to be able to successfully signalise it with the volume of traffic experienced at the site.
Ch.Bgr.1 – Bognor Road Roundabout: Grade separated junction, local road over A27	This option has been rejected on financial grounds, and it would require land take from an industrial area to the north of the junction.
Ch.Bgr.2 - Bognor Road Roundabout: Grade separated junction, A27 over local road	This option has been rejected on financial grounds, and the required widening of the railway bridge, which would be costly and cause significant disruption and require complex partnership working with Network Rail.
Arundel	
AR.BP.1 - A27 Arundel Bypass	This option has been considered, but rejected on the basis of its very serious adverse environmental impact on Binstead Woods and public and stakeholder opposition, which means it is unlikely to be feasible in the short term.
Ar. Caus.1 - Causeway Junction : Signalise Roundabout	The option has been rejected on the basis that the size of the existing roundabout is too small to be able to successfully signalise it with the volume of traffic experienced at this site.
Worthing	
Wo.LFSR.2 - Includes kerb realignment and Signal timing. Potential changes in traffic manoeuvres.	This option has been rejected because the proposals for the layout improvements at the Lyons Farm / Sompting Road junctions involve use of private roads which is not considered feasible.

Appendix C. Scenario Packages

A maximum of three options per centre were defined and tested which meant that not every permutation was possible. The scenarios chosen aimed to reflect the strategy and objectives described above.

As a result some scenarios represented themes in terms of solutions and managing residual impacts, others identified an 'alternative' option at one or more junction so that variations in impacts can be assessed. There were only a few options that did make the initial sift and were not selected for testing. These tend to be options that fitted less well within the overall A27 route strategy, offered the potential for fewer benefits or involved greater disbenefits to other users.

C.1. Chichester

In this area the scenarios aimed to test packages of options that:

- Prioritised Fishbourne, Bognor Road and Portfield junctions as key access routes into the City Centre; and
- Restricted access via Stockbridge, Whyke and Oving Road to various degrees for all traffic except buses.

The different scenarios tested higher and lower cost options at Fishbourne, Bognor Road and Portfield junctions (e.g. flyover, hamburger junctions/roundabouts, signalised roundabouts, and capacity improvements to existing roundabouts), but maintained at least two roundabouts at these junctions to allow u-turns for traffic that has been restricted elsewhere.

- Scenario 1 – Includes options that offer the most in support of prioritising Fishbourne, Bognor Road and Portfield junctions as key access routes into the City Centre. It is dominated by the flyover option at Fishbourne with signalisation of roundabouts at Bognor Road and Portfield. This scenario represents a high level of intervention.
- Scenario 2 – Considers a lower cost Hamburger Junction at Fishbourne, a lower cost Roundabout Improvement at Bognor Road junction (without signalisation), and a similar option as Scenario 1 at Portfield (Signalise Roundabout) but without closure of north Chichester bypass arm. Restrictions at Stockbridge and Whyke junctions are the same as in Scenario 1. At Oving junction, the improvements proposed as part of the Shopwyke Lakes development are assumed not to be in place. This scenario generally represents the lowest level of intervention.
- Scenario 3 – Includes a lower cost Hamburger Junction at Fishbourne, introduction of a signalised junction at Bognor Road, and layout improvements at Portbridge. Full movement for local traffic is retained at Stockbridge and Whyke junctions. Improvements proposed as part of the Shopwyke Lakes development are assumed to be in place (as in Scenario 1). This scenario represents a medium level of intervention.

Table C-1 Scenarios Tested at Chichester

Junction	Scenario 1	Scenario 2	Scenario 3
	Prioritises strategic access routes into City Centre, restricted access elsewhere	Lower cost at-grade improvements, with restricted movements	Lower cost at-grade improvements, with fewer restricted movements
	(Highest intervention)	(Lowest intervention)	(Medium intervention)
Fishbourne Roundabout <i>Strategic access route to City Centre</i>	Ch.Fish.3 – A27 Flyover With Local road roundabout. Speed restriction on A27.	Ch.Fish.4a – Hamburger Junction A signalised junction which allows direct access across A27 whilst maintaining all local movements. Diversion of Terminus Road onto Cathedral Way. HGV arrangements to be considered at design stage.	Ch.Fish.4b – Hamburger Junction A signalised junction which allows direct access across A27 whilst maintaining all local movements. As Scenario 2, without Terminus Rd diversion

Junction	Scenario 1	Scenario 2	Scenario 3
	Prioritises strategic access routes into City Centre, restricted access elsewhere (Highest intervention)	Lower cost at-grade improvements, with restricted movements (Lowest intervention)	Lower cost at-grade improvements, with fewer restricted movements (Medium intervention)
Stockbridge Roundabout	Ch.Stock.1a - Signalised Junction (Restricted movement) As a minor access road to Chichester access is restricted with banned right turns and bus only straight over movements. Dedicated left turns.	Ch.Stock.1a - Signalised Junction (Restricted movement) As a minor access road to Chichester access is restricted with banned right turns and bus only straight over movements. Dedicated left turns.	Ch.Stock.1b - Signalised Junction (With full movement) Signalised junction with full movements maintained, as in Chichester Local Plan design, Jacobs 2012.
Whyke Roundabout	Ch.Why.1a – Signalised Junction (Restricted movement) As a minor access road to Chichester access is restricted with banned right turns and bus only straight over movements. Dedicated left turns.	Ch.Why.1a – Signalised Junction (Restricted movement) As a minor access road to Chichester access is restricted with banned right turns and bus only straight over movements. Dedicated left turns.	Ch.Why.1b – Signalised Junction (With full movement) Signalised junction with full movements maintained, as in Chichester Local Plan design, Jacobs 2012.
Bognor Rd Roundabout <i>Strategic access route to City Centre</i>	Ch.Bgr.4 – Signalised Roundabout. Signals added to current roundabout. Full movements retained. No change to current lane capacity i.e. two lanes retained on all approaches and on roundabout. Enables local traffic restricted from turning right at Stockbridge, Whyke and Oving to make a U-turn and turn left at these junctions. Vinnetrov Road diverted wholly onto new roundabout on Bognor Road. Vinnetrov Road no longer accessed from Bognor Rd Junction.	Ch.Bgr.5 – Roundabout Enlargement (No signals) Involves widening circulatory carriageway to three lanes; and flared/dedicated left lanes on A27 w/b and A27 e/b. Full movements retained. Enables local traffic to make a U-turns (as in Scenario 1). Based on modified version of Jacobs 2013 design (option 5). Does not include three lanes between Bognor and Oving Rd proposed by Jacobs as this would require major construction over a rail line. Vinnetrov Road arm becomes exit only for s/b traffic; with a left in/left out link provided onto Bognor Road. This would be used by n/b traffic on Vinnetrov Road and n/b traffic on A259 Bognor Road wishing to access Vinnetrov Road.	Ch.Bgr.3 – Signalised Junction. Roundabout converted to a 4-arm signalised junction. Full movements retained, with dedicated left turns. Enables local traffic to make a U-turns (as in Scenario 1). Vinnetrov Road diverted wholly onto new roundabout on Bognor Road. Vinnetrov Road no longer accessed from Bognor Rd Junction.
Oving Junction	Ch.Oving.1 – Changes to movement in junction. Not a primary access to Chichester so banned right turn and bus only access to Chichester with automatic bollards. Dedicated left turn. Assume alternative accesses to A27 East and West of Portfield Roundabout included under Shopwhyke Lakes plans.	Do Nothing – retain as junction with full movement. No significant changes expected under Site 6 plans, Assume Shopwhyke Lakes plans not included.	Ch.Oving.1 – Changes to movement in junction. Not a primary access to Chichester so banned right turn and bus only access to Chichester with automatic bollards. Dedicated left turn. Assume alternative accesses to A27 East and West of Portfield Roundabout included under Shopwhyke Lakes plans.
Portfield Roundabout <i>Strategic access route to City Centre</i>	Ch.Port.4a – Signalise Roundabout Retaining all key movements but allows control of access to subsequent junctions. Closure of north Chichester by-pass arm.	Ch.Port.4b – Signalise Roundabout Retaining all movements but allows control of access to subsequent junctions. As Scenario 1, without closure of north Chichester by-pass arm.	Ch.Port.3 – New dedicated lane Westbound and revised layout and geometry Option included as part of Shopwhyke Lakes development. Includes safety and pedestrian measures.

C.2. Arundel

There were limited options in Arundel so the three scenarios incorporated all the options identified as 'credible' in Deliverable D2. The three scenarios represented different levels of intervention, from low to high, across the three junctions on this section of the A27.

- Scenario 1 – Combines a low cost option at Crossbush (involving modifying the lane layout so that two westbound lanes continue north of the gyratory), no change at Causeway Roundabout, and no change at Ford Roundabout (beyond the improvements to be delivered using Pinch Point Funding. This scenario represents the lowest level of intervention.
- Scenario 2 – Based on an alternative low cost option at Crossbush (similar to Scenario 1 but involving a dedicated left turn lane for eastbound traffic from Arundel), converts Causeway Roundabout to a signalised junction, and involves signalising Ford Roundabout. This scenario represents a medium level of intervention.
- Scenario 3 – Combines more ambitious options for increasing capacity at both Ford and Crossbush junctions. The scheme at Crossbush Junction would involve a continuation of the existing built but unused dual carriageway under the current bridge, terminating at a new signal controlled 'T' -junction with pedestrian crossings. The existing bridge would carry the southbound A27 to A284 movement and the right turn from the A284 the A27 eastbound, both signal controlled at the north side of the bridge. The scheme at Ford Roundabout involves a Hamburger Junction (being considered by the Highways Agency), to provide additional control, greater capacity and improved accessibility. This scenario represents a high level of intervention.

Table C-2 Scenarios Tested at Arundel

Junction	Scenario 1	Scenario 2	Scenario 3
	Minor Improvements and Do Nothing (Lowest intervention)	Signalised Junctions (Medium intervention)	Signalising and increased capacity (Highest intervention)
Crossbush Junction	Ar.CB.4 – Option 4 Two Lanes merge further north. New Specification and MOVA set up with review of queue control strategy with existing priority arrangement and widening at northern node of gyratory.	Ar.CB.5 – Option 5 Two Lanes merge further north and dedicated left turn Eastbound. Some widening and new signal controls for A284 to A27 e/b.	Ar.CB.8 – Extension to overbridge at A27. Relocate slip road to A284 s/b further east on A27. Use current overbridge for s/b A27 to A284 traffic. Construct new lanes for A27 to West of current overbridge and relocate bus stop. Removes current Gyratory approach.
Causeway Roundabout	Do Nothing	Ar.Caus.2 - Signalised Junction. To allow control of traffic and increase capacity. Relocate Pedestrian Crossing.	Ar.Caus.2 - Signalised Junction. To allow control of traffic and increase capacity. Relocate Pedestrian Crossing.
Ford Roundabout	Do Minimum - Ar.Ford.1 – Layout Improvements (to be delivered using Pinch Point Funding) Assumes current plans for two lanes at the westbound entry to the roundabout and providing new lane markings on the roundabout and associated roads. Jarvis Road is not included in the model so options to restrict access cannot be tested. Design can be considered at later stages.	Ar.Ford.3 – Signalised Roundabout. To allow greater control and improve accessibility. Jarvis Road is not included in the model so options to restrict access cannot be tested. Design can be considered at later stages.	Ar.Ford.2 – Hamburger Junction. HA plans to be provided. Will provide additional control, greater capacity and improve accessibility. Jarvis Road is not included in the model so options to restrict access cannot be tested. Design can be considered at later stages.

C.3. Worthing

In this area the number of potential options varied significantly by site. Offington, Grove and Lyons Farm/Sompting Road junctions were considered to be interdependent and Busticle and North Lancing were considered to operate quite separately.

- Scenario 1 – Combines more major signalisation and capacity improvements with a fully signalised junction at Offington, a signalised junction at Grove Lodge and optimised signals and improved merge facilities at Lyons Farm/Sompting Road. This scenario represents a high level of intervention.
- Scenario 2 – Represents schemes that whilst not ruled out are not expected to have a major impact including a Hamburger Junction at Offington, layout and signal improvements at Grove Lodge and signal optimisation at Lyons Farm/Sompting Road. This scenario represents a medium level of intervention.
- Scenario 3 - Looks at lower cost options across the route with flared entries at Offington Roundabout, minor junction improvements at Grove Lodge but the signal optimisation and improved merge at Lyons Farm/Sompting Road to remove blocking back across the junction. This scenario represents a low level of intervention.

Table C-3 Scenarios Tested at Worthing

Junction	Scenario 1	Scenario 2	Scenario 3
	High Impact Options	Moderate Impact Options	Lower Cost Options
Offington Roundabout	<p>Wo.Off.6 – Signalised Junction</p> <p>Introducing control and increasing capacity.</p> <p>Goodwood Road not in model so can consider closing as part of final design but cannot test in model.</p>	<p>Wo.Off.3 – Hamburger Junction.</p> <p>With priority for traffic across A27.</p> <p>Goodwood Road not in model so can consider closing as part of final design but cannot test in model.</p>	<p>Wo.Off.4 – Three Lane Entry/Exit</p> <p>Providing three lanes with flares at the entry and exit to A27.</p> <p>Goodwood Road not in model so can consider closing as part of final design but cannot test in model. Consider relocating Puffin.</p>
Grove Lodge Roundabout	<p>Wo.Gro.3 - Hamburger Junction.</p> <p>Improve utilisation of space and optimising control.</p>	<p>Wo.Gro.2 – Road Layout and Signal Optimisation.</p> <p>Includes kerb line adjustment, bus lay-by relocation, and adjustment of traffic signal timings.</p>	<p>Wo.Gro.1 – Minor Junction Improvements.</p> <p>Widening lanes and relocating kerbs and bus stop. Some optimisation of signal timings.</p>
Lyons Farm/Sompting Road Junctions	<p>Wo.LFSR.3 – Signal Optimisation and Merge Improvements.</p> <p>The A27 westbound egress widened to two lanes further west than present.</p> <p>The operation of the signals optimised and replacing the two separate controllers with one central unit.</p>	<p>Wo.LFSR.1 – Signal Optimisation.</p> <p>Improvements to increase capacity.</p>	<p>Wo.LFSR.3 – Signal Optimisation and Merge Improvements.</p> <p>The A27 westbound egress widened to two lanes further west than present.</p> <p>The operation of the signals optimised and replacing the two separate controllers with one central unit.</p>
Busticle Lane Junction	<p>Wo.BL.1 – Signal Optimisation.</p> <p>Improving flow and capacity.</p>	<p>Wo.BL.1 – Signal Optimisation.</p> <p>Improving flow and capacity.</p>	<p>Wo.BL.1 – Signal Optimisation.</p> <p>Improving flow and capacity.</p>
North Lancing Roundabout	<p>Wo.NL.2 – Signalised Junction with Flared Entry/Exits.</p> <p>A left turn slip lane from the A27 east. The east approach widened to accommodate two full lanes with a flare either side, the west approach with an additional offside flare, Manor Road would have a nearside flare and Grinstead Lane would have one full lane with a flare either side.</p>	<p>Wo.NL.1 – Signalised Junction.</p> <p>A signalised cross road retaining all movements as scheme linked with restrictions at Sussex Pad has not been developed further.</p>	<p>Wo.NL.1 – Signalised Junction.</p> <p>A signalised cross road retaining all movements as scheme linked with restrictions at Sussex Pad has not been developed further.</p>

Appendix D. Model Development

Technical Note

Project:	A27	To:	West Sussex CC
Subject:	Model Forecast Note (AD3) v2	From:	Graham Bown
Date:	12 June 2013	cc:	Click to enter text

1. Introduction

This Technical Note summarises the processes updating the base year and forecast year networks, new junctions coded and the assumptions/changes made to the model. Previous notes describe changes to the base year network and an assessment of the fitness of purpose of the model for junction testing.

2. Forecast Year Matrices

The matrix development process for forecast years 2016 and 2026 involved the following steps:

- Quantum for the Local Plan developments provided by WSCC (Guy Perfect 6/3/13) along with donor zones and access points (below);

District	Site Name	Homes	Sqm GFA B1	Sqm GFA B2	Sqm GFA B8
Chichester	Shopwyke	500	10000		
Chichester	North East of Chichester	900	18000		
Chichester	Tangmere	1000	20000		
Chichester	West of Chichester (access from north)	500	10000		
Chichester	West of Chichester (access from southeast)	500	10000		
			Jobs B1	Jobs B2	Jobs B8
Adur	New Monks Farm	600			
Adur	Sompting Fringe	420			
Adur	Sompting North	210			
Adur	Shoreham Airport		832	278	143
Adur	Shoreham Harbour - Western Arm	1530	482	482	482
Adur	Shoreham Harbour - Port Operational North		57	57	57
Adur	Shoreham Harbour - Port Operational South		55	55	55
Brighton & Hove	Shoreham Harbour - Port Operational East		55	55	55
Brighton & Hove	Shoreham Harbour - South Portslade	200	763	763	763
Brighton & Hove	Shoreham Harbour - Aldrington Basin	200	425	425	425

- Adjusted TEMPRO background growth factors for the quantum of growth provided by WSCC were established;
- Growth factors applied to the base year matrix to establish the number of future year trips. The percentage growth from base to 2016 is 3% and from base to 2026 is 10%;
- TRICS growth rate is applied to the new developments to establish the number of trip ends that these developments would generate. This is arrived at by applying:
 - trip rate of 0.507 departures and 0.091 arrivals per unit for dwelling units;
 - trip rate of 0.08 departures and 1.73 arrivals per 100sqm GFA for Industrial/Offices/Warehousing;
- The trip ends generated by TRICS were controlled to TEMPRO levels of growth;
- Trip distribution from donor zones as specified by WSCC is applied to new development zones;

- For HGV trips a trip rate of 0.020 arrivals and 0.027 departures per 100sqm GFA was applied for Industrial Estate land use and for Commercial Warehousing a trip rate of 0.021 arrivals and 0.025 departures per 100sqm GFA was applied. These trips assumed to be long-distance in nature and were distributed to zones that were outside East Sussex and West Sussex. No other freight growth was assumed as this is implicit in the forecasts;
- All the trip ends are furnished to produce 2016 and 2026 forecast year matrices.

The resultant changes to the matrix totals are shown in Table 1. The overall level of growth between the base and 2016 was 3.02% and between base and 2026 was 10.2%.

Table 1 - Change in Matrix Totals

Year	Matrix Total Provided by WSCC	Modified Matrix Total
Base	135534	135967
2016	153845	140049
2026	161152	149900

3. Forecast Networks

All the network changes that were made to the base year network as part of the network checking and calibration exercise (described in **TN01-WSCC - Model Fit for Purpose_V2 and County model highway network issues**) were made to 2016 and 2026 networks provided as part of the WSCC model handover.

The only other changes made to the do-minimum networks were adjusting nodes to enable like for like comparisons between do-minimum and do-something networks.

4. Scenarios for Testing

4.1. Initial Testing

As part of the development of a final preferred package up to 3 scenarios per centre are tested by coding for 14 junctions along A27 corridor. Details of the interventions tested in the initial phase are described in **AD1 - Scenarios for Testing**. When coding the network the following principles were observed:

- All junctions were coded as simulation nodes;
- Junction turning capacities were calculated using: RR67 for priority junctions and RR35 for Roundabouts;
- Signal timings were estimated using LINSIG;
- Link lengths were corrected where links were split.

The impact of the specific junction improvements at individual junctions is modelled using LinSig (with traffic lights) and ARCADY (without traffic lights). For this, the first set of flows obtained from the forecast assignment is given as an input. The optimised signal timings are then fed into the SATURN model to check for delays, blocking backs and routing pattern. Since this is an iterative process, signal timings were optimised in LINSIG until the flows are stabilised in SATURN.

4.2. Final Testing

The proposed preferred package is shown in the table below and described in **AD2 – Identification of Preferred Package**:

Table 2 – Proposed Preferred Package

Chichester		Arundel		Worthing	
<p>Fishbourne As per Scenario 3</p>	<p>'Through About' Signalised Roundabout A27 straight ahead two lanes through signalised roundabout Left signalised filter lanes, to and from, A27 provided Generally 3 lanes signalised on the circulatory carriageway No specific cycle provision</p>	<p>Crossbush As per Scenario 3</p>	<p>A27 carriageway extended under bridge to signalised junction with A284. A284 northbound diverted to west of bridge A284 northbound right turn to Brighton at signalised junction A284 southbound one way over existing bridge Pedestrian crossing provided by Crossbush Beefeater Cycleway route on west of A264 Bus stop relocated by Crossbush Beefeater Access to Crossbush Beefeater closed from A27 Land take required outside highway boundary to west of junction</p>	<p>Offington As per Scenario 2</p>	<p>'Through About' Signalised Roundabout A27 - Two straight ahead lanes through signalised roundabout Left signalised filter lanes from A27 provided Three lanes signalised on the circulatory carriageway Goodwood Road closure proposed Foot/cycle route from Findon Road to A24/A27 east via new crossing</p>
<p>Stockbridge As per adjusted Scenarios 1 and 2</p>	<p>Signalised Junction A27 widened to three straight ahead lanes at traffic signals Cross roads - straight ahead lanes at traffic signals Left filter lanes with traffic signals on approach to A27 All right turn movements prohibited Potential for bus priority radial route into Chichester Footpath and Cycleway north-south route via existing footbridge to east Alternative cycle route via canal path to east</p>	<p>Causeway As per Scenario 3</p>	<p>Three-leg signalised junction A27 widened to two straight ahead lanes at traffic signals The Causeway two straight right turn lanes at traffic signals Left filter lanes provided Pedestrian crossing at junction</p>	<p>Grove Lodge As per Scenario 1</p>	<p>'Through About' Signalised Roundabout A27 - Two straight ahead lanes through signalised roundabout Left signalised filter lanes from A27 provided 2/3 lanes signalised on the circulatory carriageway Hill Barn improvements under Worthing College proposals Foot/cycle route from Worthing College to A24/A27 via new Toucan and Puffin crossing</p>

Chichester		Arundel		Worthing	
Whyke As per adjusted Scenarios 1 and 2	<p>Signalised Junction</p> <p>A27 widened to three straight ahead lanes at traffic signals</p> <p>Cross roads - Two straight ahead lanes at traffic signals</p> <p>Left filter lanes provided with traffic signals on approaches to A27</p> <p>All right turn movements prohibited</p> <p>Potential for bus priority radial route into Chichester</p> <p>Footpath and Cycleway north-south route via new footbridge provided by others to west</p>	Ford As per Scenario 3	<p>'Through About' Signalised Roundabout</p> <p>A27 – Two straight ahead lanes through signalised roundabout</p> <p>Left signalised filter lanes from A27 provided</p> <p>Two lanes signalised on the circulatory carriageway</p> <p>No specific cycle provision</p>	Lyons Farm As per Scenarios 1 and 3	<p>A27 westbound two lanes after junction to improve merge</p> <p>A27 westbound widening in south verge</p> <p>Woodlands Ave and Hadley Ave closed to all traffic except authorised vehicles</p> <p>Automatic bollards to access Woodlands Ave and Hadley Ave for authorised vehicles</p> <p>A27 layby closed. Existing layby on Sompting Road retained</p> <p>Foot/cycle route via existing crossings</p> <p>Signal optimisation by use of MOVA or SCOOT control system, alterations to the phase / stage arrangements.</p>
Bognor As per Scenario 1	<p>Signalised reconfigured roundabout</p> <p>A27 widened to three straight ahead lanes at roundabout traffic signals</p> <p>A259 Bognor Road widened to three lanes approaching roundabout</p> <p>Vinnetrow Road diversion to signalised junction with A259</p> <p>Footpath and Cycleway to Chichester via existing footbridge to south</p> <p>Cycleway route on old Vinnetrow Road to connect to cycle network</p>			Bustle Lane As per Scenario 1	<p>No changes to highway alignment and signal optimisation</p> <p>By use of MOVA or SCOOT control system, alterations to the phase / stage arrangements</p> <p>No specific cycle provision</p>
Oving As per Scenarios 1 and 3	<p>Signalised junction</p> <p>A27 - Two lanes straight ahead and left turn into Oving Road</p> <p>A27 and Oving Road west right turns prohibited</p> <p>Oving Road west left in left out only</p> <p>Oving Road east right turn bus exit only. Automatic raising bollards provided</p> <p>Pedestrian crossing at junction</p> <p>Cycleway route on Church Road and Oving Road west.</p> <p>Toucan Crossing on A27 to be considered</p> <p><i>Note: Assume Shopwhyke Lake development arrangements in place</i></p>			North Lancing As per Scenario 1	<p>Signalised Junction with flares</p> <p>A27 widened to two straight ahead and one right turn lanes at traffic signals</p> <p>Cross roads - two straight ahead/right turn lanes at traffic signals</p> <p>Left filter lanes provided with traffic signals on approaches to A27</p> <p>No specific cycle provision</p>

Chichester		Arundel		Worthing	
Portfield	<p>A27 New dedicated lanes westbound and revised roundabout layout and geometry</p> <p>A27 revised Portfield Roundabout layout and geometry</p> <p>New left in left out junctions with A27 to south and east of Portfield Roundabout</p> <p>New footbridges to south and east of Portfield Roundabout by others</p> <p>Foot/Cycle path provision from Shopwyke development to Portfield Way</p> <p><i>Note: Assume Shopwhyke Lake development arrangements in place.</i></p>				

Forecast year networks were coded as per the final feasibility designs. When coding the network the following principles were observed:

- All junctions were coded as simulation nodes;
- Junction turning capacities were calculated using: RR67 for priority junctions and RR35 for Roundabouts
Signal timings were estimated using LINSIG;
- Link lengths were corrected where links were split.

Again the flows obtained from the first assignment of preferred package were given as input to updated LINSIG models of the preferred junction designs. The optimised signal timings are then fed into the SATURN model to check for delays, blocking back and routing pattern. Since this is an iterative process, signal timings were optimised in LINSIG until the flows are stabilised in SATURN.

5. Summary

The modelling framework adopted by Atkins is the WSCC highway model. Some work, described in detail in other technical notes, has been undertaken to improve the suitability of the model for testing schemes on the A27. The model is strategic in nature, has only one time period and all of the assessments have been undertaken using fixed matrix assignments.

The forecasting work described above, and reported in detailed in AD5, aimed to enable the relative merits of the proposed junction designs to be determined in combination with each other using the SATURN model and in isolation using LINSIG and ARCADY models.

Further work is required to understand the effects of variable demand and different time periods (evening peak and a summer period for instance). Further work is also recommended in the Preferred Package Appraisal Report (D7) to improve the detail of the model along the A27 corridor, notably in Arundel. Micro-simulation model may further enhance the understanding of the performance of the improvements.

Appendix E. Scenario Testing Model Summary Results

The detailed modelling results are presented in **Scenarios Appraisal Report AD2 v1.4** and the key findings are summarised in the remainder of this chapter.

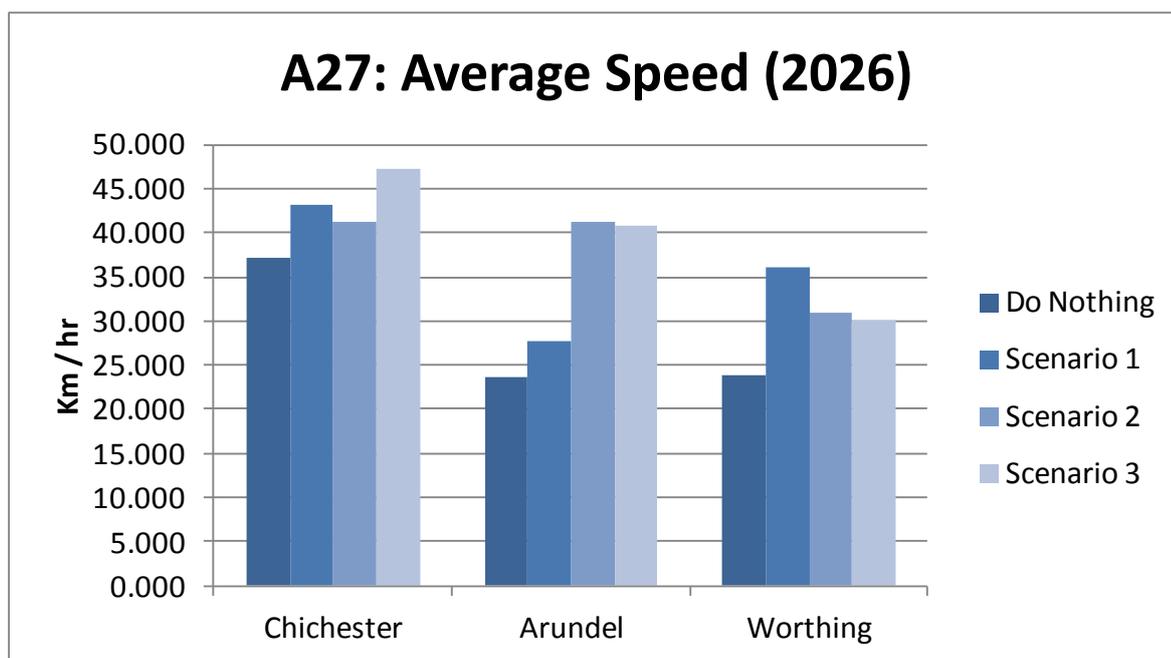
E.1. Network-wide Modelling

The scope of the SATURN highway network model is the entirety of Coastal West Sussex (CWS) as included in the SWCC Model, which has been updated in the study area by Atkins for the purpose of this study.

E.2. Average Speed

The model results demonstrate an overall improvement in average speed on the A27. Figure E-1 shows the average network speed on the A27 in each area. In Chichester, Scenario 3 increases speed the most and Scenario 2 the least. In Arundel, average speed is increased slightly in Scenario 1, with significant increases in Scenarios 2 and 3. In Worthing, the Scenario 3 package of options increases average speed the least, and Scenario 1 the most.

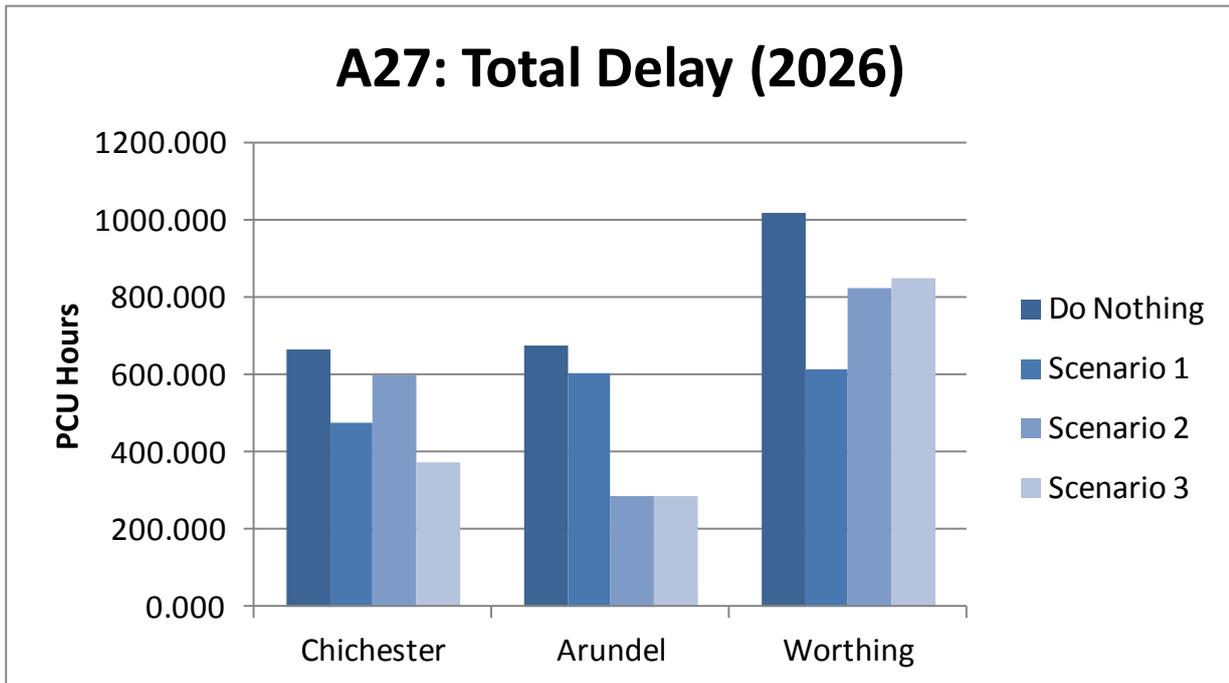
Figure E-1 Average Speed on the A27, 2026



E.2.1. Total Delay

There is a reduction in total delay (measured in PCU hours) on the A27 in the modelled scenarios. This is most significant in Worthing and Arundel. Figure E-2 shows the total delay on the A27 in the each area

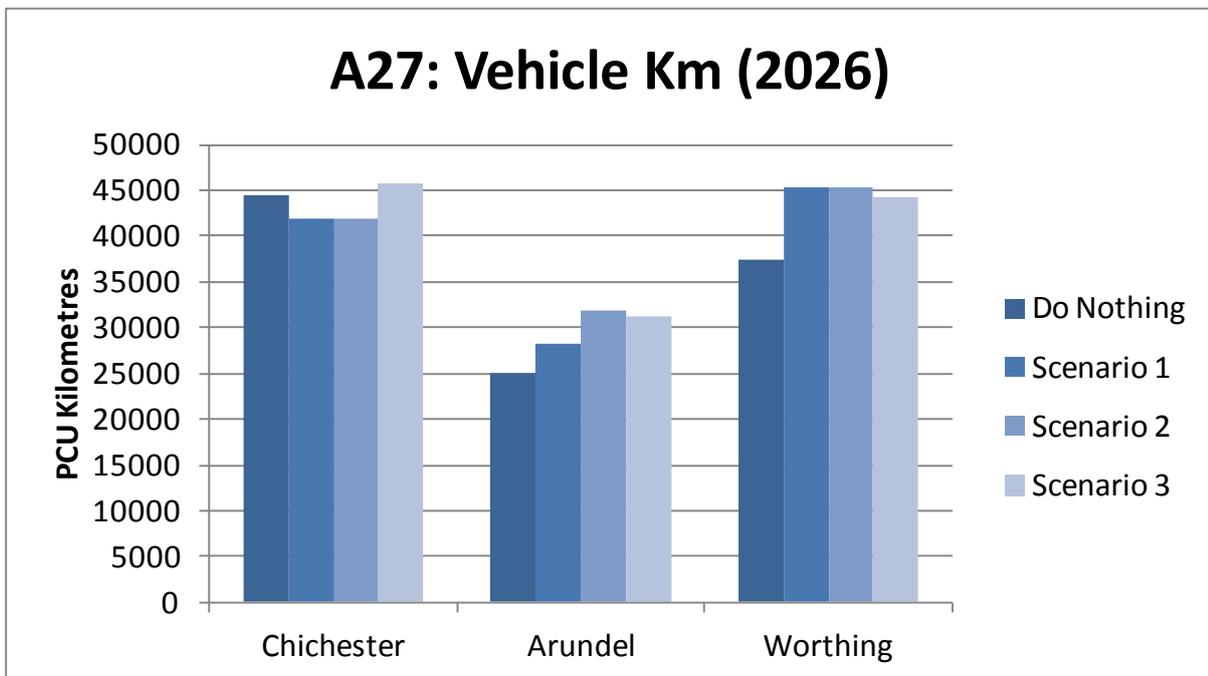
Figure E-2 Total delay on the A27, 2026



E.2.2. Vehicle Kilometres

Changes in traffic as measured by vehicle kilometres passing along the A27 corridor in each area is shown below. An increase in vehicle kilometres shows that more traffic is able to pass through the corridor as a result of the changes and that growth can be accommodated. The results generally indicate an increase in vehicle kilometres on the A27 with the exception of Scenarios 1 and 2 in Chichester.

Figure E-3 Total vehicle kilometres on the A27, 2026

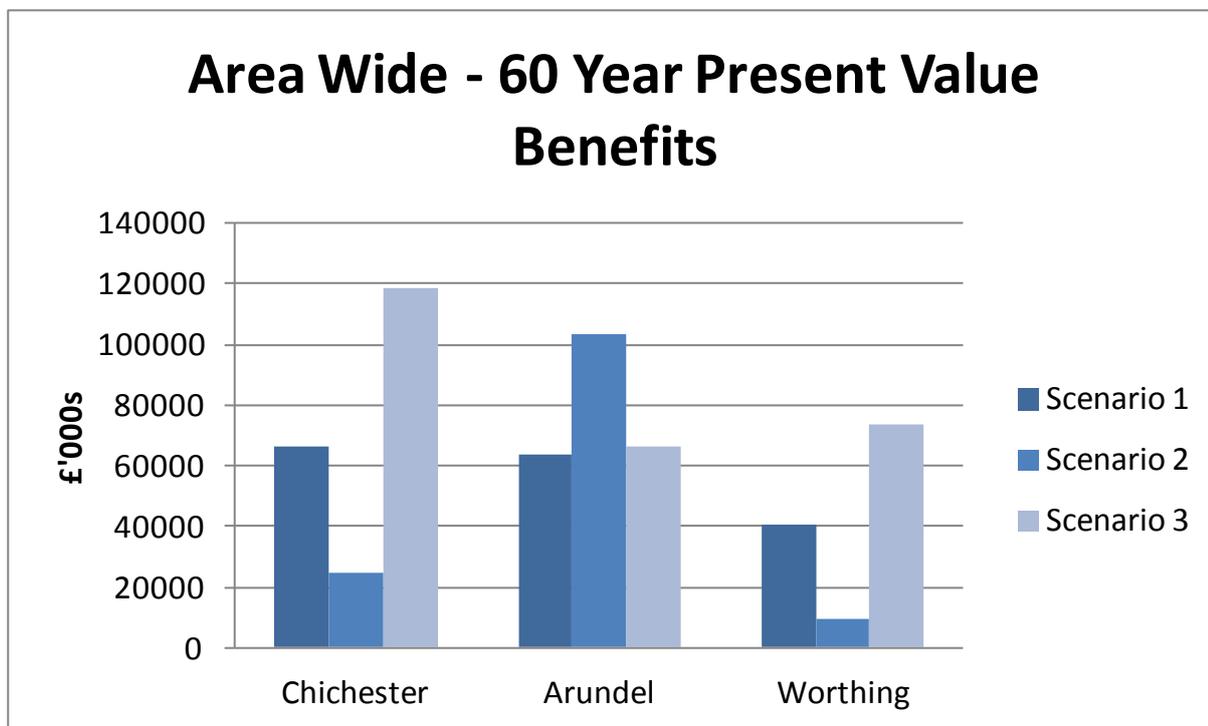


E.2.3. Economic Benefits

The outputs from the model have been applied to the economic forecasting appraisal tool (TUBA) and the value of each Scenario in each area over a 60 year period is presented below.

The outputs indicate that all scenarios provide an economic benefit. The results report a mixture of the impacts in delay and speed amplifying the benefits in certain areas so that in Chichester Scenario 3 outperforms Scenarios 1 and 2, in Arundel Scenario 2 performs best and in Worthing Scenario 3 offers the most benefit.

Figure E-4 Economic Benefits over 60 years for each Scenario by Area



E.2.4. Journey Time Reliability

A key indicator of improved performance is considered to be journey time reliability. Traditionally this is defined as variation in journey times that drivers are unable to predict arising from either variability in recurrent congestion at the same period each day - Day to Day Variability (DTDV) or variability in non-recurrent congestion such as incidents. It excludes predictable variation relating to varying levels of demand by time of day, day of week, and seasonal effects which travellers are assumed to be aware of.

The modelling approach alone is not capable of capturing or forecasting such random effects so the proportion of journey time delayed along each section of the A27 has been used as a proxy calculation for the degree of journey time reliability,

A journey with no delay from traffic queues will be based on network speed limits and wait time at signalised or priority junctions.

Figure E-5, E-5 to E-7 show the average travel time across each section of the A27 with the proportion of that time which is considered to be additional delay.

In Chichester Scenario 3 offers the best improvement in travel time from 32 to 20 minutes, 8 minutes of which are delay, reduced from 19 minutes.

In Arundel Scenario 3 offers the best improvement in travel time from 25 to 20 minutes, 9 minutes of which are delay, reduced from 14 minutes.

In Worthing Scenarios 1 and 3 offers the best improvements in travel time from 44 minutes to 34 minutes, 14 of which are delay, reduced from 25 minutes.

Figure E-5 Journey time and delay on the A27 at Chichester, 2026

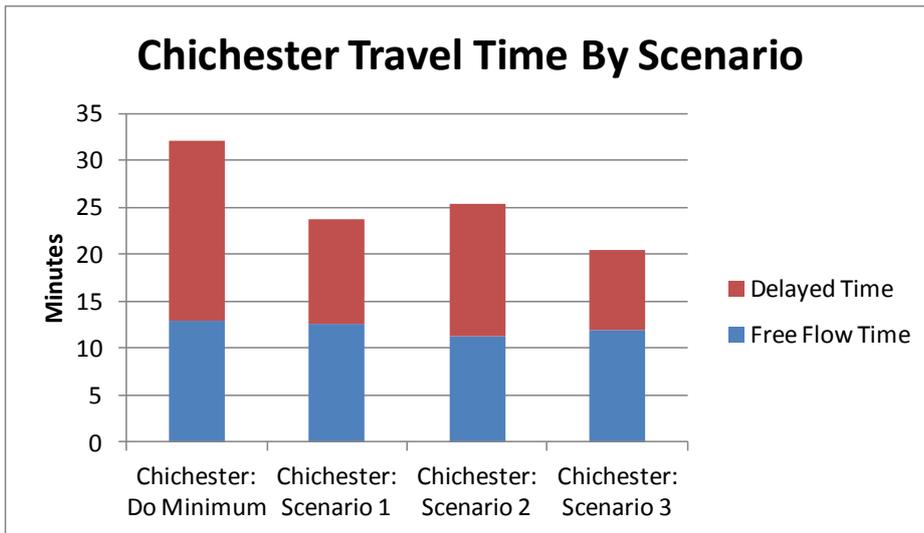


Figure E-6 Journey time and delay on the A27 at Arundel, 2026

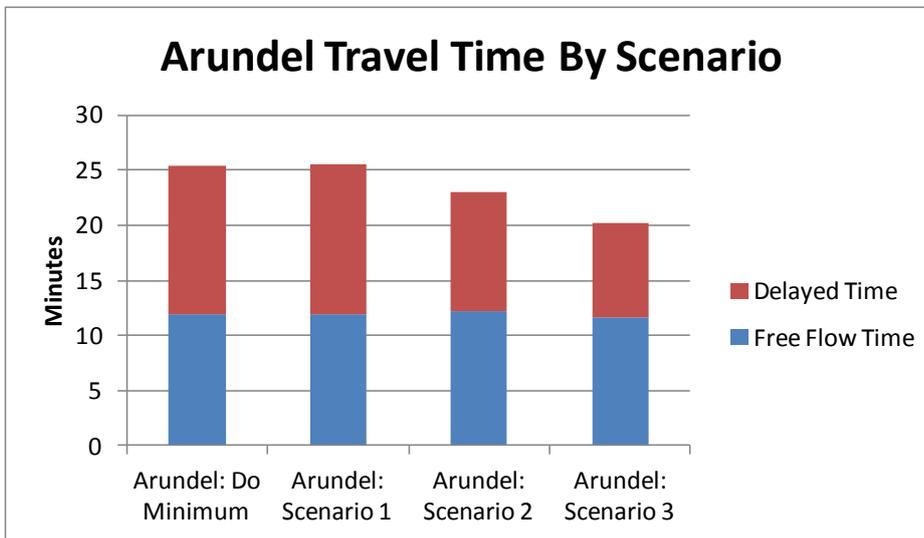
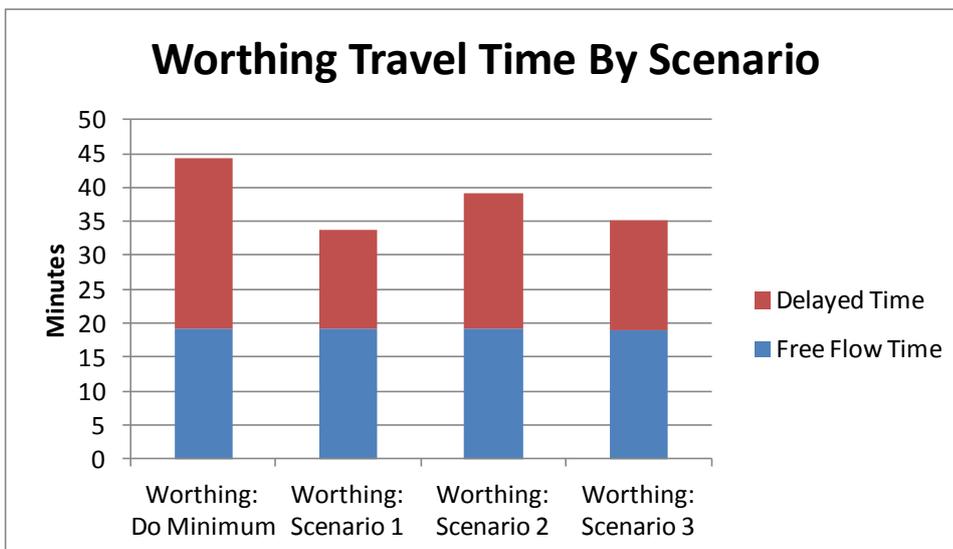


Figure E-7 Journey time and delay on the A27 at Worthing, 2026



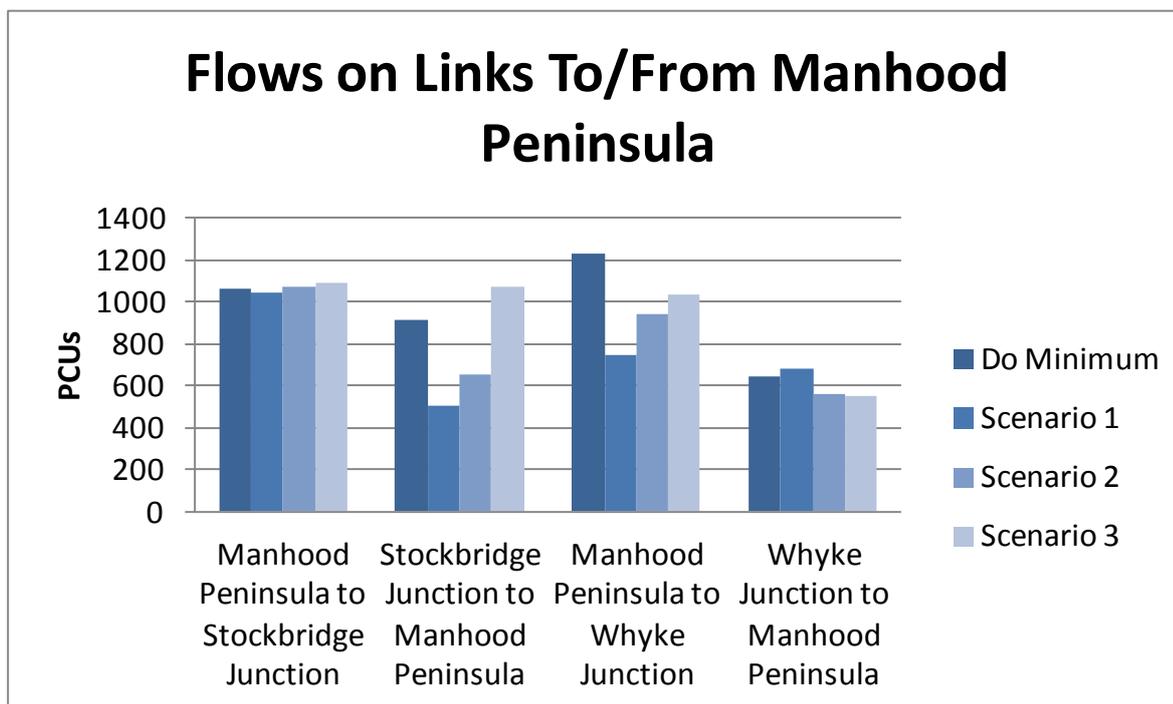
E.3. Access to Manhood Peninsula

Particular concern has been expressed about the impact on access and egress from the Manhood Peninsula around Stockbridge and Whyke junctions at the A27. Model outputs have been examined to determine the impact of the scenarios on journeys.

Scenarios 1 and 2 involve restricted movements at the junctions which have been shown to slightly increase delay at Stockbridge for what was considered 'inbound' movements, but otherwise reduces delay overall. Scenario 3 which retained all movements at those junctions generally improved movements along the A27 but did increase delays for traffic on the Chichester/Manhood Peninsula arms.

Looking in more detail at the links in and out of the Peninsula Figure E.8 indicates that flows are variable but in the main reduce or stay similar. If the movements at both links are added together there is a notable reduction in trips under Scenario 1, a slight reduction under Scenario 2 and little change under Scenario 3.

Figure E–8 Access to Manhood Peninsula: Traffic Flows (PCU's)



Generally these results should be reassuring that under Scenarios 1 and 2 whilst traffic wishing to make right turns or straight over movements at the A27 might have to travel further to fulfil their journey, delays and capacity along their route will be improved. However, around 20% of trips from the model appear to have 'reassigned'. Scenario 3 sees little change in flows but traffic could expect to experience worsening traffic conditions around the A27 junctions.

E.4. Junction Modelling Results

The different software packages each report results slightly differently. To make comparisons between scenarios easier the report has focused upon volume to capacity ratios.

E.4.1. Chichester

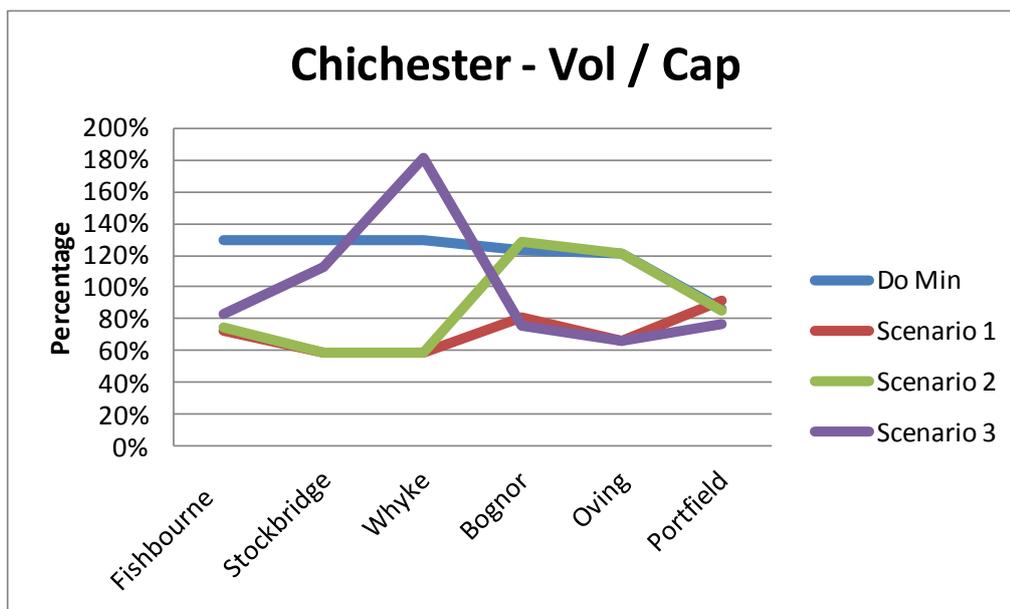
The results from the junction modelling demonstrate the scenarios vary in the extent to which they increase capacity at different junctions. The junction modelling results for the Chichester options are presented in

Figure E–9. They show that, overall, if nothing is done to the junction most are expected to be over capacity. In the main the modelled scenarios improve on or match the Do Minimum results, with the notable exception of Whyke roundabout option in Scenario 3. It is worth noting that in 2026 Portfield Roundabout is expected to operate below capacity without any intervention.

The key points identified in the analysis of the results are:

- **Fishbourne:** all modelled scenarios significantly reduce delays for traffic on the A27 and accessing Chichester. However, the ‘Hamburger’ roundabout options in Scenarios 2 and 3 perform slightly worse, demonstrate some potential additional queuing and also slightly increase delay for traffic leaving Chichester;
- **Stockbridge:** the proposals to convert to a signalised junction with traffic movement restrictions (Scenarios 1 and 2) provide the biggest reductions in delay, although there is some increase in the delay for movements accessing the A27. If right turns are allowed, then there is little benefit to traffic in any direction;
- **Whyke:** as with Stockbridge a signalised traffic junction restricted movements provides the biggest decrease in delay for strategic and local movements. Allowing full movement of traffic at a signalised junction has minimal impact on strategic traffic but leads to significant delays for through traffic;
- **Bognor:** The option to simply improve the roundabout, Scenario 2, does not offer any improvement whereas Scenarios 1 and 3 demonstrate improvements to all movements except those out from Chichester and Scenario 1, the signalised roundabout, offers slightly greater improvements to strategic traffic;
- **Oving Road:** The option, Scenario 1 and 3, to restrict movements does offer significant improvements compared to Doing Nothing in Scenario 2 although with slight increase in eastbound delay;
- **Portfield Roundabout:** is estimated to work well in 2026 without any further improvements. Options to signalise the roundabout (Scenarios 1 and 2) increase delays slightly whilst the option to revise the layout and geometry and add a new dedicated Westbound lane reduces delays slightly.

Figure E-9 Chichester Junctions Volume over Capacity

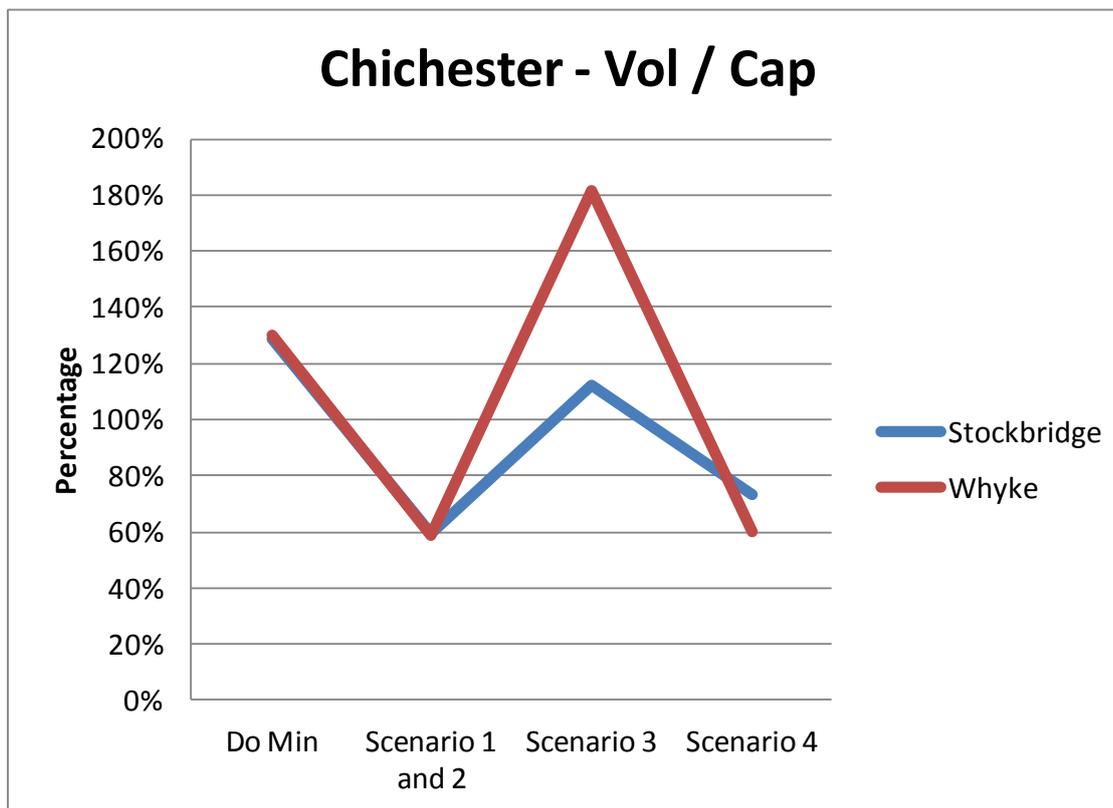


E.4.2. Additional Tests at Stockbridge and Whyke

Following consultation with the Project Development Group further investigation into the impact of having a different arrangement for restrictions at Stockbridge and Whyke have been undertaken. Scenario 4 has been tested in the LinSig junction model only and looks at allowing all traffic to make left and straight over movements but not right turns.

This test indicates that there is an increase in use of Stockbridge junction but no change in the overall capacity performance of Whyke. There is also a slight increase in the delay on most arms of the junctions compared to restricting these movements but this may not be significant enough to rule it out when considered against the benefit to residents in being able to access Chichester directly at those junctions.

Figure E-10 Chichester Junctions Volume over Capacity



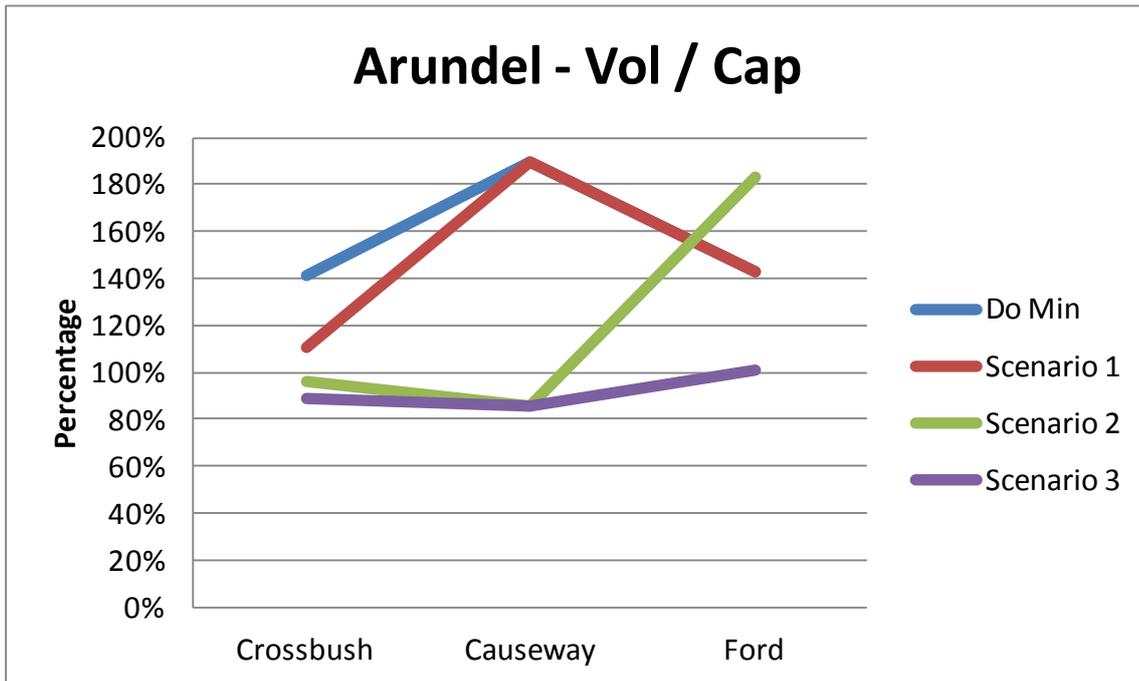
E.5. Arundel

The junction modelling results for the Arundel options are presented in Figure E-11. They show that left unchanged the junctions are forecast to be over capacity. The results for the options in Scenario 1 are similar to those in the Do Minimum, offering few benefits. Scenario 2 works nearly as well as Scenario 3 at Crossbush, but is significantly over capacity at Ford Roundabout.

The key points identified in the analysis are:

- **Crossbush:** The options identified in Scenarios 2 and 3 are expected to reduce delays significantly, with Scenario 3 shown to be the best performing option;
- **Causeway:** the model forecasts significant delays if nothing is done as tested in Scenario 1. Converting the roundabout to a signalised junction as in Scenarios 2 and 3 there is a significant increase in capacity and reduction in delay, although there is an additional delay possible for outbound traffic from Arundel.
- **Ford:** with just the pinch point funding improvements, forecast delays are high particularly for eastbound traffic on the A27 and a signalised roundabout is likely to perform even worse than that. Converting the junction to a 'hamburger' roundabout (Scenario 3) does reduce delay significantly.

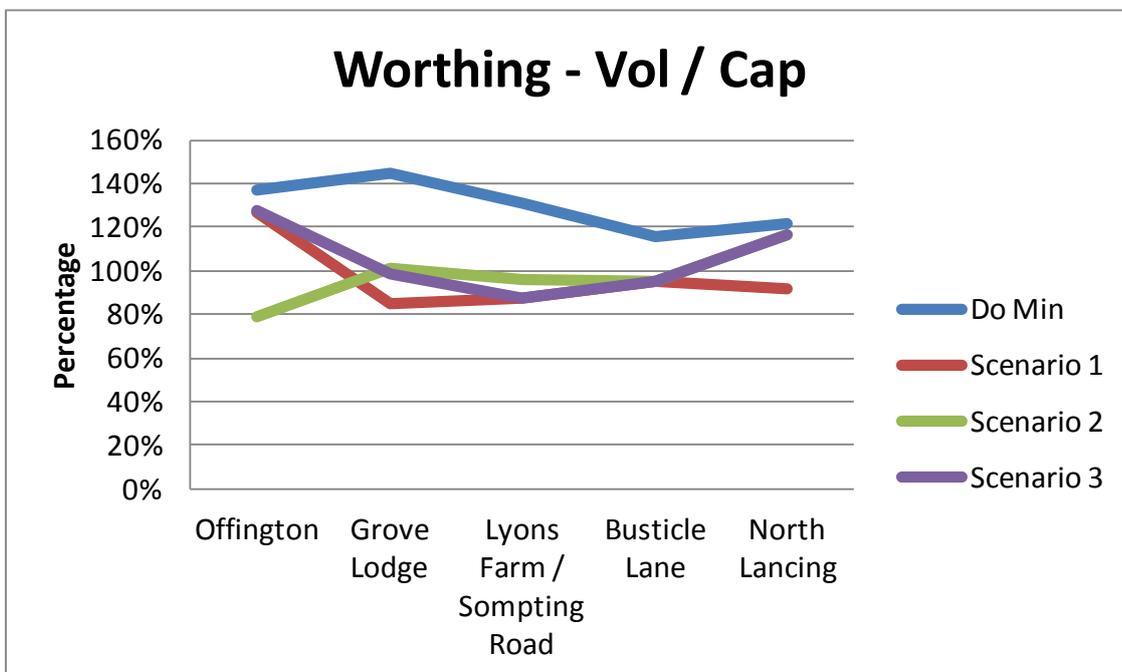
Figure E-11 Arundel Junctions Volume over Capacity



E.5.1. Worthing

The junction modelling results for the Worthing options are presented in Figure E-12. They show that if nothing is done the junctions are forecast to be over capacity. All options tested improve the operation of the junctions but the scenarios increase capacity differently at different junctions and therefore it is not clear that any one scenario out-performs the others across all junctions.

Figure E-12 Worthing Junctions Volume over Capacity



The key points identified in the analysis are:

- Offington Corner:** Only one option, the Hamburger roundabout as part of Scenario 2, forecasts operation under capacity with significant reductions to delays in all directions. The options identified in Scenarios 1 and 3 also reduce delays but the junction is still forecast to operate above capacity;

- **Grove Lodge Roundabout:** All modelled options will reduce delays, but the ‘hamburger’ roundabout (Scenario 1) reduces delay for local and through movements the most, and provides spare capacity beyond 2026. The options identified in Scenarios 2 and 3 will operate at capacity and also reduce delays for local and through traffic;
- **Lyons Farm / Sompting Road:** The options tested for Scenarios 1 and 3 improve operation of the junction to below capacity. Scenario 2 whilst improving operation is only to just under 100%. In all cases delay increases slightly for Northbound traffic, major improvements are shown for Westbound traffic and Eastbound traffic improves marginally;
- **Busticle Lane:** Optimising the signals as tested in all Scenarios increases capacity particularly for through traffic on the A27, but at the expense of slightly higher delays for traffic crossing the A27;
- **North Lancing Roundabout:** Converting to a signalised junction will require flares for entries and exits (Scenario 1) to improve capacity. Traffic crossing the A27 will experience slightly higher delays.

E.5.2. Modelling Results Summary

Results from the strategic and local modelling differ in some of their implications.

In Chichester, Scenario 3 demonstrates the biggest decrease in vehicle kilometres and delay and the biggest increases average speed the most so as indicated in the economic benefits is considered to be the best performing. It improves average travel time by 8 minutes. Scenario 2 is the worst. However, when considering impacts at local junctions at Stockbridge and Whyke the restricted options in Scenarios 1 and 2 look most favourable with the potential for relaxing restrictions to allow straight over movements.

In Arundel, Scenario 3 performs best overall improving average travel time by 5 minutes. Scenario 1 performs worst. The local model results largely support this.

In Worthing, Scenario 1 is the best performing package of options, although Scenario has a higher economic benefit. And improves travel time by 10 minutes. The local modelling supports this with better results at Grove Lodge, Lyons Farn and North Lancing under Scenario 1. At Offington the Hamburger junction under Scenario 2 performed better.

Appendix F. Outline Costs of Options in Scenario Packages

Costs for each option have been identified within a cost range category at this stage to give an indication of affordability. Outline costs for each of the package schemes have been estimated using outline designs and simple but robust spreadsheet methods based on average unit rates.

This has allowed an assessment under the financial business case element of the appraisal tables.

Whilst a detailed Cost benefit analysis is not being undertaken at this stage to get an indication of the range of potential maximum costs the top of each price range has been summed across each area in the table below.

Table F.1 – Outline Cost Ranges

	Scenario 1	Scenario 2	Scenario 3
Chichester	<p>Ch.Fish.3 – £25-50 million Ch.Stock.1a – £2-5 million Ch.Why.1a – £2-5 million Ch.Bog.4 – £2-5 million Ch.Oving.1 – £0-1 million Ch.Port.4a – £0-1 million</p>	<p>Ch.Fish.4a – £5-10 million Ch.Stock.1a – £2-5 million Ch.Why.1a – £2-5 million Ch.Bog.5 – £5-10 million Ch.OvingDo Nothing – £0 Ch.Port.4b – £0-1 million</p>	<p>Ch.Fish.4b – £2-5 million Ch.Stock.1b – £2-5 million Ch.Why.1b – £2-5 million Ch.Bog.3 – £5-10 million Ch.Oving.1 – £0-1 million Ch.Port.3 – £0-1 million</p>
	Total maximum cost: £67m	Total maximum cost: £26m	Total maximum cost: £27m
Arundel	<p>A4.CB.4 – £0-1 million. Ar.Caus.DoNothing - £0-1 million. Ar.Ford.1 (DoMin) - £0-1 million.</p>	<p>A4.CB.5 – £0-1 million. Ar.Caus.2 - £0-1 million. Ar.Ford.3 - £0-1 million.</p>	<p>A4.CB.8 – £2-5 million. Ar.Caus.2 - £0-1 million. Ar.Ford.2 - £2-5 million.</p>
	Maximum cost = £3m	Maximum cost = £3m	Maximum cost = £11m
Worthing	<p>Wo.Off.6 – £2-5 million Wo.Gro.3 – £2-5 million Wo.LTSR.3 – £0-1 million Wo.BL.1 – £0-1 million Wo.NL.2 – £0-1 million</p>	<p>Wo.Off.3 – £2-5 million Wo.Gro.2 – £0-1 million Wo.LTSR.1 – £0-1 million Wo.BL.1 – £0-1 million Wo.NL.1 – £2-5 million</p>	<p>Wo.Off.4 – £1-2 million Wo.Gro.1 – £0-1 million Wo.LTSR.3 – £0-1 million Wo.BL.1 – £0-1 million Wo.NL.1 – £2-5 million</p>
	Maximum cost = £13m	Maximum cost = £13m	Maximum cost = £10m

Note: 2012 Price Base

Appendix G. Overall Assessment of Scenario Package Options

Table G-1 Assessment of the Options: Chichester

Criteria	Do Minimum Scenario		Chichester Scenario 1 Prioritises strategic access routes into City Centre, restricted access elsewhere	Chichester Scenario 2 Lower cost at-grade improvements, with restricted movements	Chichester Scenario 3 Lower cost at-grade improvements, with fewer restrictions
Strategic fit – why is the scheme needed?					
<p>Intervention objective: Improve journey times and journey time reliability for strategic (longer distance traffic) on the A27.....</p> <p><i>Degree of junction saturation used as a proxy measure for journey time. Data taken from Arcady (DoMin) and Linsig (Scen 1-3).</i></p> <p><i>See Appendices B and C for further information.</i></p> <p><i>Average A27 speed taken from Saturn</i></p>	Degree of junction saturation (% Flow / Capacity)				
	Fishbourne	130%	Ch.Fish.3 = 73% (Moderate beneficial)	Ch.Fish.4a = 75% (Slight beneficial) Model indicates potential maximum increase in queue of 15 pcus	Ch.Fish.4b = 83% (Slight beneficial) Model indicates potential maximum increase in queue of 8 pcus
	Stockbridge	129%	Ch.Stock.1a = 59% (Large beneficial)	Ch.Stock.1a = 59% (Large beneficial)	Ch.Stock.1b = 112% (Slight beneficial, but still over capacity)
	Whyke	130%	Ch.Why.1a = 59% (Large beneficial)	Ch.Why.1a = 59% (Large beneficial)	Ch.Why.1a = 181% (Moderate adverse)
	Bognor Rd	123%	Ch.Bgr.4 = 81% (Moderate beneficial) Model indicates potential maximum increase in queue of 10 pcus	Ch.Bgr.5 = 128% (Neutral, still over capacity)	Ch.Bgr.3 = 76% (Moderate beneficial)
	Oving Rd	121%	Ch.Oving.1 = 66% (Moderate beneficial)	Ch.Oving.Do Nothing = 121% (Neutral, still over capacity)	Ch.Oving.1 = 66% (Moderate beneficial)
	Portfield	86%	Ch.Port.4a = 92% (Moderate adverse) Model indicates potential maximum increase in queue of 14 pcus	Ch.Port.4b = 85% (Moderate adverse) Model indicates potential maximum increase in queue of 7 pcus	Ch.Port.3 = 77% (Slight beneficial)
	All Junctions (Degree of junction saturation)		All Junctions: Large beneficial	All Junctions: Moderate beneficial	All Junctions: Slight beneficial
	WB = 225 secs; EB = 706 secs.		WB = 59 secs; EB = 62 secs.	WB = 47 secs; EB = 261 secs.	WB = 301 secs; EB = 153 secs.
	Average A27 speed		Slight beneficial	Slight beneficial	Moderate beneficial
37 km/hr		43 km/hr	41 km/hr	47km/hr	
<p>Intervention objective: whilst ensuring the dual function of the A27 as a longer distance strategic route and a local access route is maintained</p> <p><i>Based on delay by arm from from Arcady (DoMin) and Linsig (Scen 1-3), and supporting evidence from Saturn plots.</i></p> <p><i>See Appendix B for further information....</i></p>	Fishbourne (Delay by arm)		Ch.Fish.3: Large beneficial	Ch.Fish.4a: Moderate beneficial	Ch.Fish.4b: Moderate beneficial
	EB = 185s; WB = 37s; IB = 264s; OB = 5s Most significant delays: EB (though traffic) and IB (local).		EB = 3s; WB = 2s; IB = 5s; OB = 2s EB and IB delay largely removed; no adverse effects on other arms.	EB = 4s; WB = 13s; IB = 2s; OB = 34s EB and IB delay largely removed; moderate increase in delay to OB (local) traffic.	EB = 7s; WB = 15s; IB = 3s; OB = 41s EB and IB delay largely removed; moderate increase in delay to OB (local) traffic.
	Stockbridge (Delay by arm)		Ch.Stock.1a: Moderate beneficial	Ch.Stock.1a: Moderate beneficial	Ch.Stock.1b: Moderate adverse (Increases WB,IB,OB delay)
	EB = 292s; WB = 131s; IB = 16s; OB = 8s Most significant delays: EB and WB (through traffic).		EB = 6s; WB = 7s; IB = 16 / 47s (left / bus straight over); OB = 10s (bus straight over) EB and WB delay largely removed; moderate increase in delay to IB (bus) traffic. Other IB and OB traffic restricted to left turn only onto A27. U-turn permitted at Fishbourne (assessed as large beneficial) and Bognor Rd junction (assessed as slight beneficial). Involves significant diversion for OB traffic from Chichester, but demand for this movement is relatively low.	EB = 6s; WB = 7s; IB = 16 / 47s (left / bus straight over); OB = 10s (bus straight over) EB and WB delay largely removed; moderate increase in delay to IB (bus) traffic. Other IB and OB traffic restricted to left turn only onto A27. U-turn permitted at Fishbourne (assessed as moderate beneficial) and Bognor Rd junction (assessed as moderate adverse). Involves significant diversion for OB traffic from Chichester, but demand for this movement is relatively low.	EB = 56s; WB = 199s; IB = 266s; OB = 280s EB delay improved, but substantial increase in delay on all other arms.
	Whyke (Delay by arm)		Ch.Why.1a: Moderate beneficial	Ch.Why.1a: Moderate beneficial	Ch.Why.1a: Slight adverse
	EB = 46s; WB = 24s; IB = 250s; OB = 91s Most significant delays: IB and OB (local traffic).		EB = 5s; WB = 5s; IB = 3 / 47s (left / bus straight over); OB = 24s (bus straight over) Other IB and OB traffic restricted to left turn only onto A27. U-turn permitted at Fishbourne (assessed as large beneficial) and Bognor Rd junction (assessed as slight beneficial). Involves significant diversion for IB traffic from Chichester, but demand for this movement is relatively low. Delay to EB and WB (through) traffic largely removed.	EB = 5s; WB = 5s; IB = 3 / 47s (left / bus straight over); OB = 24s (bus straight over) Other IB and OB traffic restricted to left turn only onto A27. U-turn permitted at Fishbourne (assessed as large beneficial) and Bognor Rd junction (assessed as slight beneficial). Involves significant diversion for IB traffic from Chichester, but demand for this movement is relatively low. Delay to EB and WB (through) traffic largely removed.	EB = 30s; WB = 39s; IB = 951s; OB = 483s IB and OB delay increases substantially (but demand for this movement is relatively low); small increase in delay to WB traffic.
	Bognor Rd (Delay by arm)		Ch.Bgr.4: Moderate beneficial	Ch.Bgr.5: Moderate adverse (Increases EB delay)	Ch.Bgr.3: Moderate beneficial
	EB = 164s; WB = 15s; IB = 172s; OB = 6s Most significant delays: EB (though traffic) and IB (local).		EB = 19s; WB = 26s; IB = 20s; OB = 68s EB and IB delay significantly reduced; moderate increase in delay to OB (local) traffic and to a lesser extent WB (through) traffic.	EB = 224s; WB = 4s; IB = 8s; OB = 6s EB delay increases substantially; delay largely removed on other arms.	EB = 33s; WB = 34s; IB = 25s; OB = 24s EB and IB delay significantly reduced; small increase in delay to OB (local) traffic and WB (through) traffic.
	Oving Rd (Delay by arm)		Ch.Oving.1: Slight beneficial	Ch.Oving.Do Nothing: Neutral	Ch.Oving.1: Slight beneficial
	EB = 12s; WB = 12s; IB = 203s; OB = 394s Most significant delays: IB and OB (local traffic).		EB = 21s; WB = 12s; IB and OB = N/A (restricted, not currently used by any buses) IB and OB traffic restricted to left turn only onto A27. U-turn permitted at Bognor Rd (assessed as slight beneficial) and Portfield junctions (assessed as slight adverse).	EB = 12s; WB = 12s; IB = 203s; OB = 394s No change.	EB = 21s; WB = 12s; IB and OB = N/A (restricted) IB and OB traffic restricted to left turn only onto A27. U-turn permitted at Bognor Rd (assessed as moderate beneficial) and Portfield junctions (assessed as neutral).
Portfield (Delay by arm)		Ch.Port.4a: Slight adverse	Ch.Port.4b: Moderate adverse (Increases IB and OB delay)	Ch.Port.3: Neutral	
EB = 7s; WB = 7s; IB = 3s; (N Chi Bypass); OB = 4s (Portfield Way) Minimal delay on all arms.		EB = 8s; WB = 6s; IB = N/A; OB = 44s Moderate increase in delay to OB (local) traffic using Portfield Way, as a result of closure of N Chi Bypass.	EB = 10s; WB = 6s; IB = 43s; OB = 41s Moderate increase in delay to IB (local) traffic using N Chi. Bypass and OB (local) traffic using Portfield Way.	EB = 6s; WB = 2s; IB = 3s; OB = 4s Minimal delay on all arms.	

Criteria	Do Minimum Scenario	Chichester Scenario 1 Prioritises strategic access routes into City Centre, restricted access elsewhere	Chichester Scenario 2 Lower cost at-grade improvements, with restricted movements	Chichester Scenario 3 Lower cost at-grade improvements, with fewer restrictions
Intervention objectives: Improve access by private and public transport to key employment and regeneration areas within Coastal West Sussex, including Chichester, Worthing and key regeneration areas such as Bognor Regis and Littlehampton. Enable proposed housing, employment and retail growth to take place within Coastal West Sussex without undue congestion. <i>Based on overall network performance statistics from Saturn</i>	N/A N/A Chichester A27 Corridor Statistics: Average Speed (km / h): 40 Vehicle Kilometres: 40,812 Total Delay (PCU Hours): 524 PCU-Hrs Delay per veh km: 46 secs/PCU-Km	Slight Beneficial Public transport – Provision for bus only access at Stockbridge, Whyke and Oving Junctions. General access – Increase in journey speed on the A27, vehicle kilometres declines. Total delay on the A27 in Chichester reduces. Chichester A27 Corridor Statistics: Average Speed (km / h): 43 Vehicle Kilometres: 41,872 Total Delay: 474 PCU-Hrs; Delay per veh km: 41 secs/PCU-Km	Neutral Public transport – Provision for bus only access at Stockbridge, Whyke and Oving Junctions. General access – Small increase in journey speed on the A27, total vehicle kilometres and delay increases. Minor increase in delay per vehicle Chichester A27 Corridor Statistics: Average Speed (km / h): 41 Vehicle Kilometres: 45,724 Total Delay (PCU Hours): 601 PCU-Hrs; Delay per veh km: 47 secs/PCU-Km	Slight Beneficial Public transport – Provision for bus only access at Oving Junction. General access – Increase in journey speed on the A27, vehicle kilometres declines. Total delay on the A27 in Chichester reduces due to less traffic, arising from additional overall capacity Chichester A27 Corridor Statistics: Average Speed (km / h): 47 Vehicle Kilometres: 39,314 Total Delay (PCU Hours): 379 PCU-Hrs; Delay per veh km: 35 secs/PCU-Km
Intervention objective: Improve connectivity to/from the Manhood Peninsula (including Selsey and the Witterings).	N/A -	Moderate adverse Reduction in Volume over Capacity on most links, minor increase Whyke to Manhood Peninsula. Reduction in Traffic flow arising from restricted turning movements at Whyke and Stockbridge	Slight Adverse Reduction in Volume over Capacity on all links. Reduction in Traffic flow arising from restricted turning movements at Whyke and Stockbridge.	Slight Adverse Reduction in Volume over Capacity on most links, minor increase Stockbridge to Manhood Peninsula. Reduction in Traffic flow arising from restricted turning movements at Whyke and Stockbridge, although extra traffic travelling from Stockbridge junction to Manhood Peninsula
Fit with wider transport and government objectives	N/A -	Large beneficial Improvements to the A27 and complementary public transport improvements at Chichester, Arundel and Worthing are identified as a high priority in the LTP3.	Large beneficial Improvements to the A27 and complementary public transport improvements at Chichester, Arundel and Worthing are identified as a high priority in the LTP3.	Large beneficial Improvements to the A27 and complementary public transport improvements at Chichester, Arundel and Worthing are identified as a high priority in the LTP3.
Impact on long term aspirations for the route	N/A -	Moderate beneficial Partly delivers longer term aspiration for flyovers at Fishbourne and Bognor Road junctions. Diversion of Vinnetrov Road onto Bognor Road is beneficial in terms of providing a flyover at Bognor Road junction in the longer-term.	Slight beneficial Does not adversely affect longer term aspiration for flyovers at Fishbourne and Bognor Road junctions. Diversion of Terminus Road and Vinnetrov Road is beneficial in terms of providing flyovers at both these locations.	Slight beneficial Does not adversely affect longer term aspiration for flyovers at Fishbourne and Bognor Road junctions. Diversion of Vinnetrov Road onto Bognor Road is beneficial in terms of providing a flyover at Bognor Road junction in the longer-term.
Impact on other junctions - Any evidence of delays being moved from one junction to another, or to other parts of the corridor (e.g. Arundel or Worthing)?	N/A N/A	Slight adverse Turning restrictions at Stockbridge and Whyke will lead to traffic routing to Fishbourne / Bognor to access Chichester / perform right turns. SATURN forecasts increased delay at Bognor. No adverse impact identified in Worthing or Arundel.	Slight adverse Turning restrictions at Stockbridge and Whyke will lead to traffic routing to Fishbourne / Bognor to access Chichester / perform right turns. SATURN forecasts increased delay at Bognor. No adverse impact identified in Worthing or Arundel.	Neutral No adverse impact identified in Worthing or Arundel.
Value for money – is the scheme good value for money?				
Monetised estimate of journey time and operating cost benefits (From TUBA). Present Value of Benefits, 2010 prices discounted to 2010.	N/A	PVB = £38.2m	PVB = £9.9m	PVB = £92.2m
Qualitative assessment of housing development and wider economic impacts, based on existing evidence and professional judgement (where appropriate) <i>(Source: CWS Employment and Infrastructure Strategy)</i>	N/A -	Slight Beneficial Employment: Bognor Road Junction improvements identified as essential for development at Old MOD site, Chichester. Bognor Road improvements desirable and improvements at Portfield / Oving likely to be essential to support development at Land at Barnfield Drive (500 plus retail jobs) and Old Tarmac Site. Housing: 100 units at Barratt Site, Donnington will increase pressure on Stockbridge Junction. Other sites identified that will increase pressure on A27 junctions and require upgrades are: Tangmere (500-1100 units), North East of City (1500 units), West of Chichester (500-1500 units) and Shopwhyke Lakes (600 units) DaSTS (2010) identified improvements at Fishbourne, Whyke and Oving Road as critical to housing delivery.	Slight Beneficial	Slight Beneficial
Carbon	N/A -	Carbon Benefits = £-1.4m	Carbon Benefits = £-1.3m	Carbon Benefits = £-0.9m
Local environment – noise and air quality impacts: Change in vehicle km on A27 in Chichester used as a proxy for noise and air quality impacts.	N/A -	Slight adverse Change in vehicle km on A27: 3%	Moderate adverse 12%	Slight beneficial -4%
Local environment – natural environment, heritage and landscape and the urban environment <i>(See Appendix D for further information)</i>	N/A -	Moderate adverse Moderate adverse impact on landscape at Fishbourne Junction. Embankments associated with the A27 flyover visible in the flat landscape to the south. Adverse impacts on views of Chichester Cathedral from the Harbour. Further consideration of impact on the visual landscape required, as this option was rejected in SoCoMMS due to its visual impact. Slight adverse impact on historical heritage at Bognor Road	Slight adverse Slight adverse impact on historical heritage at Bognor Road junction: diversion of Vinnetrov Road could impact on archaeological site (cropmark rings). In addition, there is potential for unrecorded sites to be discovered, particularly Iron Age and Roman remains. Listed buildings may be visually impacted. Some loss of arable land.	Slight adverse Slight adverse impact on historical heritage at Bognor Road junction: diversion of Vinnetrov Road could impact on archaeological site (cropmark rings). In addition, there is potential for unrecorded sites to be discovered, particularly Iron Age and Roman remains. Listed buildings may be visually impacted. Some loss of arable land.

Criteria	Do Minimum Scenario	Chichester Scenario 1 Prioritises strategic access routes into City Centre, restricted access elsewhere	Chichester Scenario 2 Lower cost at-grade improvements, with restricted movements	Chichester Scenario 3 Lower cost at-grade improvements, with fewer restrictions
		junction: diversion of Vinnetrod Road could impact on archaeological site (cropmark rings). In addition, there is potential for unrecorded sites to be discovered, particularly Iron Age and Roman remains. Listed buildings may be visually impacted. Some loss of arable land.		
Accident Impacts	N/A	Moderate beneficial Ch.Fish.3 separates traffic flows. (Large beneficial) Ch.Stock.1a – benefits from banned turns. (slight beneficial) Ch.Why.1a – benefits from banned turns. (Slight beneficial) Ch.Bgr.4 – may have benefits for lane changing accidents. (slight beneficial) Ch.Oving.1 - if failure to conform accidents at traffic signals reduced. (Moderate beneficial) Ch.Port.4a – benefits achieved at roundabout by closure of northern arm but effects of diverted traffic needed to be considered. (Slight beneficial)	Slight beneficial Ch.Fish.4a – benefits with fewer arms on roundabout. (Moderate beneficial) Ch.Stock.1a – benefits from banned turns (Slight beneficial) Ch.Why.1a – benefits from banned turns. (Slight beneficial) Ch.Bgr.5 – Design raises safety concerns. More adverse to pedal cyclists and pedestrians. (Moderate adverse) Ch.Oving Do Nothing – No change. Ch.Port.4a – has potential to reduce failure to conform accidents. (Moderate beneficial)	Slight beneficial Ch.Fish.4b – benefits in separating traffic flows. (Slight beneficial) Ch.Stock.1b – No change. (Neutral) Ch.Why.1a – benefits from banned turns. (Slight beneficial) Ch.Bgr.3 – No change - depends upon junction design. (Neutral). Ch.Oving.1 – if failure to conform accidents at traffic signals reduced (moderate beneficial). Ch.Port.3 – depends upon whether pedestrians use footbridge. (slight beneficial)
Assessment of Impact on Severance	N/A	Moderate beneficial Ch.Fish.3 – Reduced traffic on roundabout provides opportunity to provide at grade pedestrian and cycle route. Crossings would be on roundabout slip roads, under A27 flyover, to the east of the roundabout. (Moderate beneficial) Ch.Stock.1a – Jacobs proposed new footbridge (included in scheme cost). Introduction of signals provides opportunity to provide at grade pedestrian and cycle crossing. Would require larger central reserve for cyclists. (Moderate beneficial) Ch.Why.1a – As above. (Moderate beneficial) Ch.Bgr.4 – Existing A27 footbridge retained. (No change) Ch.Oving.1 - With restricted movements at junction opportunity to improve at grade pedestrian and cycle crossings. (Moderate beneficial) Ch.Port.4a – No change.	Slight beneficial Ch.Fish.4a – Pedestrian crossing north-south through signals may cause delays to through traffic. (No change) Ch.Stock.1a – Jacobs proposed new footbridge (included in scheme cost). Introduction of signals provides opportunity to provide at grade pedestrian and cycle crossing. Would require larger central reserve for cyclists. (Moderate beneficial) Ch.Why.1a – As above. (Moderate beneficial) Ch.Bgr.5 – Existing A27 footbridge retained. (No change) Ch.Oving.Do Nothing – No change. Ch.Port.4a – No change.	Slight beneficial Ch.Fish.4b – Pedestrian crossing north-south through signals may cause delays to through traffic. (No change) Ch.Stock.1b – At grade crossing provided as part of the design. (Moderate beneficial) Ch.Why.1a – Splitter islands for right turns and at-grade pedestrian crossing not provided in current design, but could be included. (Moderate beneficial) Ch.Bgr.3 – Footbridge replaced with new footbridge, as part of Jacobs scheme design. Ch.Oving.1 – No change. Ch.Port.3 – No change.
Social and Distributional Impacts	N/A	Slight beneficial There are areas of income deprivation and older people identified around Stockbridge and Fishbourne Junctions. Generally reductions in delay will improve access and the economy. Slight Beneficial At Fishbourne residents would benefit from reduced congestion. Moderate Beneficial At Stockbridge residents would benefit from reduced delay on A27 but could be impacted by restricted movements, increase delay on local links and longer journeys. Moderate Adverse	Slight Adverse There are areas of income deprivation and older people identified around Stockbridge and Fishbourne Junctions. Generally reductions in delay will improve access and the economy. Slight Adverse At Fishbourne residents would benefit from reduced congestion. Moderate Beneficial At Stockbridge residents would benefit from reduced delay on A27 but could be impacted by restricted movements, increase delay on local links and longer journeys. Moderate Adverse	Slight beneficial There are areas of income deprivation and older people identified around Stockbridge and Fishbourne Junctions. Generally reductions in delay will improve access and the economy. Moderate Beneficial At Fishbourne residents would benefit from reduced congestion. Moderate Beneficial At Stockbridge residents could experience increased delay in local movements. Slight Adverse
Financial – is the scheme affordable and financially sustainable?				
Affordability (Cost – 2012 prices including optimism bias, undiscounted) See notes below.	N/A	Higher cost Ch.Fish.3 – £25-50 million Ch.Stock.1a – £2-5 million Ch.Why.1a – £2-5 million Ch.Bog.4 – £2-5 million Ch.Oving.1 – £0-1 million Ch.Port.4a – £0-1 million Total maximum cost: £67m	Moderate cost Ch.Fish.4a – £5-10 million Ch.Stock.1a – £2-5 million Ch.Why.1a – £2-5 million Ch.Bog.5 – £5-10 million Ch.OvingDo Nothing – £0 Ch.Port.4b – £0-1 million Total maximum cost: £26m	Moderate cost Ch.Fish.4b – £2-5 million Ch.Stock.1b – £2-5 million Ch.Why.1b – £2-5 million Ch.Bog.3 – £5-10 million Ch.Oving.1 – £0-1 million Ch.Port.3 – £0-1 million Total maximum cost: £27m
Commercial and Management — can the scheme be procured and constructed, and is it deliverable?				
Public / Stakeholder Acceptability	N/A	Moderate Adverse (Source: Chichester Area and A27 Transport Proposals Public Consultation Report, 2005) Options in the scenarios considered: Ch.Stock.1 44% agreed, 41% disagreed Ch.Why.1 42% agreed, 40% disagreed	Moderate Adverse Ch.Oving.1 45% agreed, 35% disagreed Ch.Port.3 – new lane W/B 70% agreed, 10% disagreed	Slight Adverse Public consultation: 93% of respondents said A27 junctions needed to be improved. Movement restrictions at Stockbridge, Whyke (Scenarios 1 and 2) likely to generate significant public opposition. Movement restri
Practical Feasibility	N/A	Moderate adverse - Potential for substantial issues.	Slight – moderate adverse - Some potential issues.	Slight – moderate adverse - Some potential issues.

Criteria	Do Minimum Scenario	Chichester Scenario 1 Prioritises strategic access routes into City Centre, restricted access elsewhere	Chichester Scenario 2 Lower cost at-grade improvements, with restricted movements	Chichester Scenario 3 Lower cost at-grade improvements, with fewer restrictions
	-	<p>Ch.Fish.3 - Potential for substantial buildability issues with high traffic management costs, due to location of bridge construction over existing roundabout carriageway. Sliproads and roundabout outside highway boundary. Stats diversions assumed. Flyover at Fishbourne would require 50mph limit on A27. Possible lower cost and easier construction if dumbell roundabout junction with single overbridge provided - dependent on further traffic analysis.</p> <p>Ch.Stock.1a - No significant issues. Changes appear to be within highway boundary.</p> <p>Ch.Why.1a - No significant issues. Changes appear to be within highway boundary.</p> <p>Ch.Bog.4 - Potential for substantial issues. The size of the existing roundabout may be too small to be able to successfully signalise it with the volume of traffic experienced at this site, resulting in significant blocking back. Vinnetro Rd diversion requires land-take. A259 roundabout requires outline design as traffic may cause queuing to A27.</p> <p>Ch.Oving.1 - No significant issues. Changes appear to be within highway boundary.</p> <p>Ch.Port.4a - No significant issues. Changes appear to be within highway boundary.</p>	<p>Ch.Fish.4a – Some potential issues. Hamburger design within highway land; but dedicated left turns are outside highway boundary and may require stats diversions.</p> <p>Ch.Stock.1a - No significant issues. Changes appear to be within highway boundary.</p> <p>Ch.Why.1a - No significant issues. Changes appear to be within highway boundary.</p> <p>Ch.Bog.5 - Potential for substantial buildability issues with high traffic management costs. Requires reconfiguration of roundabout, to the east of the existing layout and possibly outside of highway boundary. May require total pavement reconstruction and numerous stats diversions.</p> <p>Ch.Oving.Do Nothing – No works required.</p> <p>Ch.Port.4b - No significant issues. Changes appear to be within highway boundary.</p>	<p>Ch.Fish.4a – Some potential issues. Hamburger design within highway land; but dedicated left turns are outside highway boundary and may require stats diversions.</p> <p>Ch.Stock.1a - No significant issues. Changes appear to be within highway boundary. Stats diversions possible.</p> <p>Ch.Why.1b - No significant issues. Changes appear to be within highway boundary. Stats diversions possible.</p> <p>Ch.Bog.3 - Some potential issues. Slip roads outside of highway boundary. Vinnetro Rd diversion requires land-take. A259 roundabout requires outline design as traffic may cause queuing to A27.</p> <p>Ch.Oving.1 - No significant issues. Changes appear to be within highway boundary.</p> <p>Ch.Port.3 - Potential for substantial issues. Dedicated left turn outside highway land. Possible stats diversions. Appears to be insufficient weaving between dedicated lane and exit at Shopwyke Junction.</p>

Scale:

Green	Light Green	Green Accent 1 Lighter 40%	Yellow Accent 3 lighter 80%	Light Orange	Orange	Red
Large beneficial	Moderate beneficial	Slight beneficial	Neutral	Slight adverse	Moderate adverse	Large adverse

Notes on cost estimates:

1. Construction costs based on Spons rates for area of pavement adjusted for inflation for 2012.
2. Statutory undertakes costs based on 20% construction costs at this stage.
3. Land costs not included.
4. Preparation & Supervision costs not included.
5. Project risk costs not included.
- 6.If maximum cost is <10m low cost, 10-30m medium cost, 30m + high cost
7. All options have a 45% optimism bias.

Table G-2 Assessment of the Options: Arundel

Criteria	Do Minimum	Arundel Sc 1 Minor Improvements and Do Nothing	Arundel Sc 2 Signalised Junctions	Arundel Sc 3 Signalising and increased capacity	
Strategic fit – why is the scheme needed?					
Intervention objective: Improve journey times and journey time reliability for strategic (longer distance traffic) on the A27..... <i>Degree of junction saturation used as a proxy measure for journey time. Data taken from Arcady (DoMin) and Linsig (Scen 1-3).</i> See Appendices B and C for further information. Average A27 speed taken from Saturn	Degree of junction saturation (% Flow / Capacity)				
	Crossbush	141%	Ar.CB.4 = 111% (Slight beneficial)	Ar..CB.5 = 96% (Moderate beneficial)	Ar.CB.8 = 89% (Moderate beneficial)
	Causeway	190%	Ar.Caus.DoNothing = 190% (Neutral)	Ar.Caus.2 = 86% (Large beneficial)	Ar.Caus.2 = 86% (Large beneficial)
	Ford	143%	Ar.Ford.1 = 143% (Neutral)	Ar.Ford.3 = 184% (Moderate Adverse) Model indicates potential maximum increase in queue of 108 pcus	Ar.Ford.2 = 101% (Moderate beneficial) Model indicates potential maximum increase in queue of 13 pcus
	All Junctions (Degree of junction saturation)		All Junctions: Slight beneficial	All Junctions: Large beneficial	All Junctions: Large beneficial
	WB = 2006 secs; EB = 435 secs.		WB = 984 secs; EB = 429 secs.	WB = 98 secs; EB = 111 secs.	WB = 121 secs; EB = 58 secs.
Average A27 speed		Slight beneficial	Large beneficial	Large beneficial	
24 km/hr		28 km/hr	41 km/hr	41 km/hr	
Intervention objective: whilst ensuring the dual function of the A27 as a longer distance strategic route and a local access route is maintained Based on delay by arm from from Arcady (DoMin) and Linsig (Scen 1-3), and supporting evidence from Saturn plots. See Appendix C for further information....	Crossbush (Delay by arm)		Ar.CB.4: Slight beneficial	Ar.CB.5: Large beneficial	Ar.CB.8: Large beneficial
	EB = 7s; WB = 603s; IB / OB = 520s Most significant delays: WB (through traffic) and IB/OB (local).		EB = 7s; WB = 33s; IB / OB = 733s WB delay largely removed; adverse effects on local traffic.	EB = 66s; WB = 33s; IB / OB = 30s WB and IB/OB delay largely removed; slight adverse effects on EB traffic.	EB = 5s; WB = 24s; IB / OB = 34s WB and IB/OB delay largely removed; no adverse effects on EB traffic.
	Casueway (Delay by arm)		Ar.Caus.DoNothing: Neutral	Ar.Caus.2 Large beneficial	Ar.Caus.2 Large beneficial
	EB = 22s; WB = 945s; IB = 484s; OB = 6s Most significant delays: WB (through traffic).and IB (local traffic)		EB = 22s; WB = 945s; IB = 484s; OB = 6s Most significant delays: WB (through traffic).and IB (local traffic). As Do Minimum: no change. WB delays do not account for extra traffic moving through Crossbush.	EB = 41s; WB = 19s; IB = 35s; OB = 93s WB and IB delay mostly removed. Minor increase in EB delay. Adverse impact on OB (local) traffic WB delays do not account for extra traffic moving through Crossbush.	EB = 41s; WB = 19s; IB = 35s; OB = 93s WB and IB delay mostly removed. Minor increase in EB delay. Adverse impact on OB (local) traffic WB delays do not account for extra traffic moving through Crossbush.
	Ford (Delay by arm)		Ar.Ford.1: Neutral	Ar.Ford.3: Neutral	Ar.Ford.2: Large beneficial
	EB = 406s; WB = 458s; IB = 233s; OB = 37s Most significant delays: EB and WB (through traffic) and IB (local traffic).		EB = 406s; WB = 458s; IB = 233s; OB = 37s Do Nothing – No change	EB = 4s; WB = 46s; IB = 343s; OB = 457s Through traffic delays largely removed WB and most ly removed EB traffic. Significant increase in delays for local traffic both IB and OB.	EB = 12s; WB = 78s; IB = 35s; OB = 2s Significant reduction in delays for through traffic. IB and OB (local traffic) delays largely removed
Intervention objectives: Improve access by private and public transport to key employment and regeneration areas within Coastal West Sussex, including Chichester, Worthing and key regeneration areas such as Bognor Regis and Littlehampton. Enable proposed housing, employment and retail growth to take place within Coastal West Sussex without undue congestion. Based on overall network performance statistics from Saturn	N/A	Slight beneficial	Large beneficial	Large beneficial	
	N/A	Public transport – Potential provision of improved pedestrian access to rail station. General access – (Change) in journey speed on the A27, vehicle kilometres. Total delay on the A27 in Chichester increases due to extra traffic arising from additional overall capacity Arundel A27 Corridor Statistics: Average Speed (km / h): 28 km/hr Vehicle Kilometres: 28,310 Total Delay (PCU Hours): 602 PCU hrs Delay per vehicle km: 77 secs / PCU km	Public transport – Potential provision of improved pedestrian access to rail station. General access – (Change) in journey speed on the A27, vehicle kilometres. Total delay on the A27 in Chichester increases due to extra traffic arising from additional overall capacity Arundel A27 Corridor Statistics: Average Speed (km / h): 44 km/hr Vehicle Kilometres: 31,298 Total Delay (PCU Hours): 233 PCU hrs Delay per vehicle km: 27 secs / PCU km	Public transport – Potential provision of improved pedestrian access to rail station. General access – (Change) in journey speed on the A27, vehicle kilometres. Total delay on the A27 in Chichester increases due to extra traffic arising from additional overall capacity Arundel A27 Corridor Statistics: Average Speed (km / h): 41 km/hr Vehicle Kilometres: 30,591 Total Delay (PCU Hours): 267 PCU hrs Delay per vehicle km: 31 secs / PCU km	
Intervention objective: Improve connectivity to/from the Manhood Peninsula (including Selsey and the Witterings).	N/A	N/A	N/A	N/A	
	N/A	N/A	N/A	N/A	
Fit with wider transport and government objectives	N/A	Large beneficial	Large beneficial	Large beneficial	
	-	Improvements to the A27 and complementary public transport improvements at Chichester, Arundel and Worthing are identified as a high priority in the LTP3.	Improvements to the A27 and complementary public transport improvements at Chichester, Arundel and Worthing are identified as a high priority in the LTP3.	Improvements to the A27 and complementary public transport improvements at Chichester, Arundel and Worthing are identified as a high priority in the LTP3.	
Impact on long term aspirations for the route	N/A	Moderate beneficial	Moderate beneficial	Slight beneficial	
	-	Does not adversely affect longer term aspiration for Arundel Bypass	Does not adversely affect longer term aspiration for Arundel Bypass	Does not adversely affect longer term aspiration for Arundel Bypass. Some improvements at Crossbush would be demolished to build eastern end of a potential bypass	
Impact on other junctions - Any evidence of delays being moved from one junction to another, or to other parts	N/A	Slight adverse	Moderate adverse	Moderate adverse	
	N/A	No adverse impact on Chichester or Worthing identified.	No adverse impact on Chichester or Worthing identified.	No adverse impact on Chichester or Worthing identified.	

Criteria	Do Minimum	Arundel Sc 1 Minor Improvements and Do Nothing	Arundel Sc 2 Signalised Junctions	Arundel Sc 3 Signalising and increased capacity
of the corridor (e.g. Arundel or Worthing)?		SATURN identifies increase in west bound flow at Causeway arising from capacity improvements at Crossbush, worsening V/C ratio measured by SATURN at Causeway	SATURN identifies significant increase in west bound flow at Causeway arising from capacity improvements at Crossbush, worsening V/C ratio measured by SATURN at Causeway	SATURN identifies increase in west bound flow at Causeway arising from capacity improvements at Crossbush, worsening V/C ratio measured by SATURN at Causeway
Value for money – is the scheme good value for money?				
Monetised estimate of journey time and operating cost benefits (From TUBA). Present Value of Benefits, 2010 prices discounted to 2010.	N/A	PVB = -£8.8m	PVB = £52.4m	PVB = £115.1m
Qualitative assessment of housing development and wider economic impacts, based on existing evidence and professional judgement (where appropriate) (Source: CWS Employment and Infrastructure Strategy)	N/A	Slight Beneficial	Slight Beneficial	Slight Beneficial
		<p>Employment: Improvements at Crossbush junction would improve access to St Martins Littlehampton (50 jobs) and Wick Site (500 jobs) and are therefore desirable. It may also increase interest in the development at West Bank of River Arun (400 jobs).</p> <p>Housing: 1,000 units identified at West Bank of River Arun delivered after 2015 may require completion of Lyminster Bypass / Crossbush improvement</p> <p>Improvements to Ford Junction (bid for Pinchpoint funding) supports several development sites, anticipated to create 10,400 jobs, and several residential developments, anticipated to create 8,400 homes by 2020. To start 2013 and end 2015. (source: HA website – note consistency with above)</p> <p>Crossbush: Proposals for 2000 new homes at Littlehampton have recently been approved, along with plans to upgrade the A284. This will result in more traffic coming up from the South Coast, some of which will wish to turn right. This will exacerbate the above problem. (source: Crossbush Junction Study)</p>		
Carbon	N/A	Carbon Benefits = £0.5m	Carbon Benefits = £0.6m	Carbon Benefits = -£0.7m
Local environment – noise and air quality impacts: Change in vehicle km on A27 in Arundel used as a proxy for noise and air quality impacts.	N/A	Moderate Adverse	Moderate Adverse	Moderate Adverse
		Change in vehicle km on A27: 13%	Change in vehicle km on A27: 25%	Change in vehicle km on A27: 23%
Local environment – natural environment, heritage and landscape and the urban environment (See Appendix D for further information)	N/A	Neutral	Neutral	Slight adverse
		Schemes involve minimal changes to the footprint of the junctions concerned, and minimal loss of habitat. All options are at-grade and have minimal impact on landscape / townscape.	Schemes involve minimal changes to the footprint of the junctions concerned, and minimal loss of habitat. All options are at-grade and have minimal impact on landscape / townscape.	Scheme at Crossbush Junction involves some landtake to west of existing junction. Slight loss of habitat. Minimal impact on arable land. Underpass already built so unlikely to have significant impact on the water environment.
Accident Impacts	N/A	Slight beneficial	Slight beneficial	Neutral
		<p>A4.CB.4 – depending upon location of nose-to-tail collisions (Slight beneficial)</p> <p>Ar.Caus.DoNothing – roundabout has good safety record. (neutral)</p> <p>Ar.Ford.1 (DoMin) – may give slight improvements (Slight beneficial)</p>	<p>A4.CB.5 – depending upon location of nose-to-tail collisions + benefits from signalised control from A284 to A27 east (Moderate beneficial)</p> <p>Ar.Caus.2 – could create nose-to-tail collisions (Slight adverse)</p> <p>Ar.Ford.3 – roundabout has relatively good safety record. (Neutral)</p>	<p>A4.CB.8 – +1 potentially +2 depending upon location of nose-to-tail collisions. However, exit (right-turn) from garage on to A284 difficult and could reduce benefits. (Slight beneficial).</p> <p>Ar.Caus.2 – could create nose-to-tail collisions (Slight adverse).</p> <p>Ar.Ford.2 – roundabout has relatively good safety record – hamburger could add conflicts (Slight adverse).</p>
Assessment of Impact on Severance	N/A	Neutral	Slight beneficial	Slight beneficial
		<p>A4.CB.4 – No change. Note , additional traffic queuing into Arundel could be detrimental to pedestrians and cyclists.</p> <p>Ar.Caus.DoNothing – No change (existing pedestrian crossing retained). Pedestrian crossing could be relocated closer to the railway station.</p> <p>Ar.Ford.1 (DoMin) – No change</p>	<p>A4.CB.5 – No change. Note , additional traffic queuing into Arundel could be detrimental to pedestrians and cyclists.</p> <p>Ar.Caus.2 – Pedestrian crossing could be relocated within the signalised junction or closer to the railway station.</p> <p>Ar.Ford.3 – Signalisation provides opportunity to improve facilities for pedestrians and cyclists.</p>	<p>A4.CB.8 – Scheme design includes a pedestrian underpass and pedestrian crossings at signals.</p> <p>Ar.Caus.2 – Pedestrian crossing could be relocated within the signalised junction or closer to the railway station.</p> <p>Ar.Ford.2 – Signalisation provides opportunity to improve facilities for pedestrians and cyclists, but potentially to a lesser extent than Scenario 2 due to more complex arrangement.</p>
Social and Distributional Impacts	N/A	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
		There are areas of income deprivation and older people identified around the Ford junction area Generally reductions in delay will improve access and the economy. Slight Beneficial Ford - Neutral	There are areas of income deprivation and older people identified around the Ford junction area Generally reductions in delay will improve access and the economy. Moderate Beneficial Ford – Slight Beneficial	There are areas of income deprivation and older people identified around the Ford junction area Generally reductions in delay will improve access and the economy. Moderate Beneficial Ford – Moderate Beneficial
Financial – is the scheme affordable and financially sustainable?				
Affordability (Cost – 2012 prices including optimism bias, undiscounted) See notes below.	N/A	Slight Adverse	Slight Adverse	Moderate Adverse
		<p>A4.CB.4 – £0-1 million.</p> <p>Ar.Caus.DoNothing - £0-1 million.</p> <p>Ar.Ford.1 (DoMin) - £0-1 million.</p> <p>Maximum cost = £3m</p>	<p>A4.CB.5 – £0-1 million.</p> <p>Ar.Caus.2 - £0-1 million.</p> <p>Ar.Ford.3 - £0-1 million.</p> <p>Maximum cost = £3m</p>	<p>A4.CB.8 – £2-5 million.</p> <p>Ar.Caus.2 - £0-1 million.</p> <p>Ar.Ford.2 - £2-5 million.</p> <p>Maximum cost = £11m</p>

Criteria	Do Minimum	Arundel Sc 1 Minor Improvements and Do Nothing	Arundel Sc 2 Signalised Junctions	Arundel Sc 3 Signalising and increased capacity
Commercial and Management — <i>can the scheme be procured and constructed, and is it deliverable?</i>				
Public / Stakeholder Acceptability	N/A	Slight beneficial	Slight beneficial	Moderate beneficial
	-	Anticipated that none of the options would attract significant opposition from the public / stakeholders.	Anticipated that none of the options would attract significant opposition from the public / stakeholders.	Anticipated that none of the options would attract significant opposition from the public / stakeholders. A4.CB.8 potentially more popular than other options for Crossbush, as improvement is more tangible / visible.
Practical Feasibility	N/A	Neutral – No significant issues	Neutral – No significant issues	Slight adverse – Some potential issues
	-	A4.CB.4 – No significant issues. Changes within highway boundary. Ar.Caus.DoNothing – No significant issues. Ar.Ford.1 (DoMin) – No significant issues.	A4.CB.5 – No significant issues. Changes within highway boundary. Ar.Caus.2 – No significant issues. Changes assumed to be within highway boundary. Ar.Ford.3 – No significant issues. Changes assumed to be within highway boundary.	A4.CB.8 – Changes appear to be within highway boundary. Possible stats diversions. Ar.Caus.2 – No significant issues. Changes assumed to be within highway boundary. Ar.Ford.2 – No significant issues. Changes assumed to be within highway boundary.

Scale:

Green	Light Green	Green Accent 1 Lighter 40%	Yellow Accent 3 lighter 80%	Light Orange	Orange	Red
Large beneficial	Moderate beneficial	Slight beneficial	Neutral	Slight adverse	Moderate adverse	Large adverse

Notes on cost estimates:

1. Construction costs based on Spons rates for area of pavement adjusted for inflation for 2012.
2. Statutory undertakes costs based on 20% construction costs at this stage.
3. Land costs not included.
4. Preparation & Supervision costs not included.
5. Project risk costs not included.
6. If maximum cost is <10m low cost, 10-30m medium cost, 30m + high cost
7. All options have a 45% optimism bias.

Table G-3 Assessment of the Options: Worthing

Criteria	Do Minimum	Worthing Scenario 1 High impact options	Worthing Scenario 2 Moderate impact options	Worthing Scenario 3 Lower cost options	
Strategic fit – why is the scheme needed?					
Intervention objective: Improve journey times and journey time reliability for strategic (longer distance traffic) on the A27..... <i>Degree of junction saturation used as a proxy measure for journey time. Data taken from Arcady (DoMin) and Linsig (Scen 1-3). See Appendices B and C for further information. Average A27 speed taken from Saturn</i>	Degree of junction saturation (% Flow / Capacity)				
	Offington	137%	Wo.Off.6 = 127% (Slight beneficial)	Wo.Off.3 = 79% (Moderate beneficial) Model indicates potential maximum increase in queue of 11 pcus	Wo.Off.4 = 128% (Slight beneficial)
	Grove Lodge	145%	Wo.Gro.3 = 85% (Moderate beneficial) Model indicates potential maximum increase in queue of 2 pcus	Wo.Gro.2 = 101% (Slight beneficial) Model indicates potential maximum increase in queue of 16 pcus	Wo.Gro.1 = 99% (Slight beneficial) Model indicates potential maximum increase in queue of 14 pcus
	Lyons Farm / Sompting Road	131%	Wo.LFSR.3 = 87% (Moderate beneficial)	Wo.LFSR.1 = 96% (Slight beneficial)	Wo.LFSR.3 = 87% (Moderate beneficial)
	Busticle Lane	115%	Wo.BL.1 = 95% (Slight beneficial)	Wo.BL.1 = 95% (Slight beneficial)	Wo.BL.1 = 95% (Slight beneficial)
	North Lancing Roundabout	122%	Wo.NL.2 = 92% (Moderate beneficial)	Wo.NL.2 = 116% (Slight beneficial)	Wo.NL.2 = 116% (Slight beneficial)
	All Junctions (Degree of junction saturation)		All Junctions: Large beneficial	All Junctions: Large beneficial	All Junctions: Large beneficial
	WB = 1141 secs; EB = 354 secs.		WB = 236 secs; EB = 170 secs.	WB = 215 secs; EB = 128 secs.	WB = 228 secs; EB = 143 secs.
	Average A27 speed		Large beneficial	Moderate beneficial	Moderate beneficial
	24 km/hr		36 km/hr	31 km/hr	30 km/hr
Intervention objective: whilst ensuring the dual function of the A27 as a longer distance strategic route and a local access route is maintained <i>Based on delay by arm from from Arcady (DoMin) and Linsig (Scen 1-3), and supporting evidence from Saturn plots. See Appendix C for further information....</i>	Offington (Delay by arm)		Wo.Off.6: Slight beneficial	Wo.Off.3: Large beneficial	Wo.Off.4: Moderate beneficial
	EB = 42s; WB = 16s; NB = 312s; SB = 314s Most significant delays: IB and OB (local traffic) and some delays WB (through traffic).		EB = 40s; WB = 124s; NB = 51s; SB = 250s Increase in delays WB (through traffic). Significant reduction in delay for NB traffic and slight reduction for SB traffic (local traffic)	EB = 4s; WB = 13s; NB = 2s; SB = 2s All delay reduced for through traffic and local traffic	EB = 6s; WB = 13s; NB = 186s; SB = 254s Significant reduction in EB delay (through traffic). NB and SB delays are reduced but still significant
	Grove Lodge (Delay by arm)		Wo.Gro.3: Large beneficial	Wo.Gro.2: Large beneficial	Wo.Gro.1: Large beneficial
	EB = 31s; WB = 320s; NB = 127s; Most significant delays: WB (through traffic).and NB (local traffic). Some delay on EB (through traffic)		EB = 20s; WB = 15s; NB = 86s; Delays mostly removed, with slight worsening for NB	EB = 9s; WB = 16s; NB = 72s; Delays mostly removed, with slight worsening for NB	EB = 20s; WB = 15s; NB = 86s; Delays mostly removed, with slight worsening for NB
	Lyons Farm / Sompting Road (Delay by arm)		Wo.LFSR.3: Moderate beneficial	Wo.LFSR.1: Large beneficial	Wo.LFSR.3: Moderate beneficial
	EB = 39s; WB = 443s; NB = 23s; SB = 0s Most significant delays: WB (through traffic) and some delays to EB traffic.		EB = 23s; WB = 20s; NB = 104s; SB = 0s WB (through traffic) delays largely removed, additional delay to NB (local) traffic.	EB = 9s; WB = 12s; NB = 72s; SB = 0s WB (through traffic) delays largely removed, additional delay to NB (local) traffic	EB = 23s; WB = 20s; NB = 104s; SB = 0s WB (through traffic) delays largely removed, additional delay to NB (local) traffic
	Busticle Lane (Delay by arm)		Wo.BL.1: Slight beneficial	Wo.BL.1: Slight beneficial	Wo.BL.1: Slight beneficial
	EB = 226s; WB = 156s; NB = 18s; SB = 47s Most significant delays: EB and WB (through traffic), with some delays SB (local traffic)		EB = 52s; WB = 43s; NB = 21s; SB = 61s Significant reduction in delays EB and WB (through traffic), slight increase in delay for NB and SB (local) traffic	EB = 52s; WB = 43s; NB = 21s; SB = 61s Significant reduction in delays EB and WB (through traffic), slight increase in delay for NB and SB (local) traffic	EB = 52s; WB = 43s; NB = 21s; SB = 61s Significant reduction in delays EB and WB (through traffic), slight increase in delay for NB and SB (local) traffic
	North Lancing (Delay by arm)		Wo.NL.2: Moderate beneficial	Wo.NL.1: Slight adverse	Wo.NL.1: Slight adverse
	EB = 5s; WB = 201s; NB = 28s; SB = 7s Most significant delays WB (through traffic) with some delay NB (local traffic)		EB = 15s; WB = 28s; NB = 48s; SB = 61s Significant reduction in delays WB (through traffic) with an increase in delay both NB and SB (local traffic)	EB = 17s; WB = 131s; NB = 327s; SB = 153s Some reduction in delays WB (through traffic); significant increase in delays NB and SB (local traffic)	EB = 17s; WB = 131s; NB = 327s; SB = 153s Some reduction in delays WB (through traffic); significant increase in delays NB and SB (local traffic)
Intervention objectives: Improve access by private and public transport to key employment and regeneration areas within Coastal West Sussex, including Chichester, Worthing and key regeneration areas such as Bognor Regis and Littlehampton. Enable proposed housing, employment and retail growth to take place within Coastal West Sussex without undue congestion. <i>Based on overall network performance statistics from Saturn</i>	N/A		Large beneficial	Moderate beneficial	Moderate beneficial
	N/A		Public transport – Potential provision of improved pedestrian access to rail station. General access – Increase in journey speed on the A27 and , vehicle kilometres. Total delay and delay per vehicle reduces on the A27 in Worthing. Worthing A27 Corridor Statistics: Average Speed (km / h): 37 km/hr Vehicle Kilometres: 45,426 Total Delay (PCU Hours): 597 PCU hrs Delay per vehicle km: 47 secs / PCU km	Public transport – Potential provision of improved pedestrian access to rail station. General access – Increase in journey speed on the A27 and , vehicle kilometres. Total delay and delay per vehicle reduces on the A27 in Worthing. Worthing A27 Corridor Statistics: Average Speed (km / h): 30 km/hr Vehicle Kilometres: 45,427 Total Delay (PCU Hours): 888 PCU hrs Delay per vehicle km: 70 secs / PCU	Public transport – Potential provision of improved pedestrian access to rail station. General access – Increase in journey speed on the A27 and , vehicle kilometres. Total delay and delay per vehicle reduces on the A27 in Worthing. Worthing A27 Corridor Statistics: Average Speed (km / h): 34 km/hr Vehicle Kilometres: 44,278 Total Delay (PCU Hours): 681 PCU hrs Delay per vehicle km: 55 secs / PCU

Criteria	Do Minimum	Worthing Scenario 1 High impact options	Worthing Scenario 2 Moderate impact options	Worthing Scenario 3 Lower cost options
Intervention objective: Improve connectivity to/from the Manhood Peninsula (including Selsey and the Witterings).	N/A	N/A	N/A	N/A
Fit with wider transport and government objectives	N/A	Large beneficial Improvements to the A27 and complementary public transport improvements at Chichester, Arundel and Worthing are identified as a high priority in the LTP3.	Large beneficial Improvements to the A27 and complementary public transport improvements at Chichester, Arundel and Worthing are identified as a high priority in the LTP3.	Large beneficial Improvements to the A27 and complementary public transport improvements at Chichester, Arundel and Worthing are identified as a high priority in the LTP3.
Impact on long term aspirations for the route	N/A	Neutral No impact on long term aspirations for route	Neutral No impact on long term aspirations for route	Neutral No impact on long term aspirations for route
Impact on other junctions - Any evidence of delays being moved from one junction to another, or to other parts of the corridor (e.g. Arundel or Chichester)?	N/A	Neutral No adverse impacts identified in Arundel or Chichester. No adverse impacts identified on other junctions in Worthing.	Neutral No adverse impacts identified in Arundel or Chichester. No adverse impacts identified on other junctions in Worthing.	Neutral No adverse impacts identified in Arundel or Chichester. No adverse impacts identified on other junctions in Worthing.
Value for money – is the scheme good value for money?				
Monetised estimate of journey time and operating cost benefits (From TUBA). Present Value of Benefits, 2010 prices discounted to 2010.	N/A	PVB = £40.1m	PVB = £10.7m	PVB = £58.3m
Qualitative assessment of housing development and wider economic impacts, based on existing evidence and professional judgement (where appropriate) <i>(Source: CWS Employment and Infrastructure Strategy)</i>	N/A	Slight Beneficial Employment: Site at Teville Gate (500 plus jobs), pressure on Grove Lodge Roundabout identified as an obstacle to delivery. Housing: 1,000 units at Teville Gate / Durrington will increase pressure on A27 junctions in Worthing. North Lancing: Improved access to Shoreham Airport essential. Improved access to Shoreham Harbour Regeneration and Shoreham Cement Works desirable. (CWS DaSTS Study Report)	Slight Beneficial	Slight Beneficial
Carbon	N/A	Carbon Benefits = £0.6m	Carbon Benefits = £0.4m	Carbon Benefits = £0.9m
Local environment – noise and air quality impacts: Change in vehicle km on A27 in Arundel used as a proxy for noise and air quality impacts.	N/A	Moderate Adverse Change in vehicle km on A27: 22%	Moderate Adverse Change in vehicle km on A27: 22%	Moderate Adverse Change in vehicle km on A27: 19%
Local environment – natural environment, heritage and landscape and the urban environment <i>(See Appendix D for further information)</i>	N/A	Slight adverse Some loss of established trees associated with conversion of Grove Lodge Roundabout to a Hamburger Junction.	Neutral Schemes involve minimal changes to the footprint of the junctions concerned, and minimal loss of habitat. All options are at-grade and have minimal impact on landscape / townscape.	Neutral Schemes involve minimal changes to the footprint of the junctions concerned, and minimal loss of habitat. All options are at-grade and have minimal impact on landscape / townscape.
Accident Impacts	N/A	Slight beneficial Wo.Off.6 – may benefit failure to give way accidents and less arms on roundabout (Moderate beneficial) Wo.Gro.3 – relatively good safety record at present. Hamburger roundabout could add more conflict points (slight adverse) Wo.LTSR.3 – may reduce nose-to-tail collisions (moderate beneficial) Wo.BL.1 – right-turns main problem unlikely to be reduced (slight adverse) Wo.NL.2 – may benefit failure to give way and nose-to-tail accidents. (Moderate beneficial)	Neutral Wo.Off.3 – small roundabout to make a ‘Hamburger’; benefits less arms on roundabout (Neutral). Wo.Gro.2 – relatively good safety record at present (Neutral) Wo.LTSR.1 – may reduce nose-to-tail collisions. (Slight beneficial) Wo.BL.1 – right-turns main problem unlikely to be reduced (Slight adverse). Wo.NL.1 – may benefit failure to give way accidents (Slight beneficial).	Neutral Wo.Off.4 – benefits from less arms on roundabout but increased flow likely to lead to more merging and circulating conflicts (Slight adverse) Wo.Gro.1 – relatively good safety record at present (Neutral) Wo.LTSR.3 – may reduce nose-to-tail collisions (moderate beneficial) Wo.BL.1 – right-turns main problem unlikely to be reduced (Slight adverse). Wo.NL.1 – may benefit failure to give way accidents (Slight beneficial).
Assessment of Impact on Severance	N/A	Moderate beneficial Wo.Off.6 – Possible to provide footbridge or at-grade crossing at signals. Wo.Gro.3 – Possible to provide footbridge over hamburger or at-grade crossing at signals. Wo.LTSR.3 – No change. Wo.BL.1 – No change. Wo.NL.2 – Possible to provide at-grade footway crossing at signals.	Moderate beneficial Wo.Off.3 – Possible to provide footbridge or at-grade crossing at signals. Wo.Gro.2 – Possible to provide at-grade footway crossing at signals. Wo.LTSR.1 – No change. Wo.BL.1 – No change. Wo.NL.1 – Possible to provide at-grade footway crossing at signals.	Moderate beneficial Wo.Off.4 – Possible to provide footbridge or at-grade crossing at signals. Wo.Gro.1 – Possible to provide at-grade footway crossing at signals. Wo.LTSR.3 – No change. Wo.BL.1 – No change. Wo.NL.1 – Possible to provide at-grade footway crossing at signals.

Criteria	Do Minimum	Worthing Scenario 1 High impact options	Worthing Scenario 2 Moderate impact options	Worthing Scenario 3 Lower cost options
Social and Distributional Impacts	N/A -	Moderate Beneficial There are areas of income deprivation identified around the whole section of the A27 in Worthing Generally reductions in delay will improve access and the economy. Moderate Beneficial	Slight Beneficial There are areas of income deprivation identified around the whole section of the A27 in Worthing Generally reductions in delay will improve access and the economy. Slight Beneficial	Moderate Beneficial There are areas of income deprivation identified around the whole section of the A27 in Worthing Generally reductions in delay will improve access and the economy. Moderate Beneficial
Financial – is the scheme affordable and financially sustainable?				
Affordability (Cost – 2012 prices including optimism bias, undiscounted) See notes below.	N/A -	Medium cost Wo.Off.6 – £2-5 million Wo.Gro.3 – £2-5 million Wo.LTSR.3 – £0-1 million Wo.BL.1 – £0-1 million Wo.NL.2 – £0-1 million Maximum cost = £13m	Medium cost Wo.Off.3 – £2-5 million Wo.Gro.2 – £0-1 million Wo.LTSR.1 – £0-1 million Wo.BL.1 – £0-1 million Wo.NL.1 – £2-5 million Maximum cost = £13m	Medium cost Wo.Off.4 – £1-2 million Wo.Gro.1 – £0-1 million Wo.LTSR.3 – £0-1 million Wo.BL.1 – £0-1 million Wo.NL.1 – £2-5 million Maximum cost = £10m
Commercial and Management — can the scheme be procured and constructed, and is it deliverable?				
Public / Stakeholder Acceptability	N/A -	Moderate beneficial Anticipated that none of the options would attract significant opposition from the public / stakeholders.	Moderate beneficial	Moderate beneficial
Practical Feasibility	N/A -	Slight – moderate adverse - Some potential issues. Wo.Off.6 – Some potential issues. Assumed to be within highway land. Junction construction within roundabout may require stats diversions and pavement reconstruction. Wo.Gro.3 – Some potential issues. Exit left turns widening required. Hamburger within highway land. Possible stats diversions. Wo.LTSR.3 – No significant issues. Changes within highway boundary. Wo.BL.1 – No significant issues. Wo.NL.2 – Some potential issues. Flares possibly outside highway land. Possible stats diversions.	Slight – moderate adverse - Some potential issues. Wo.Off.3 – Some potential issues. Dedicated left turns outside highway boundary. May require stats diversions. Hamburger within highway land. Wo.Gro.2 – Some potential issues. Exit left turns widening required. Possible stats diversions. Wo.LTSR.1 – No significant issues. Wo.BL.1 – No significant issues. Wo.NL.1 – Some potential issues. Changes assumed to be within highway land. Junction construction within roundabout. Possible stats diversions and pavement reconstruction.	Moderate adverse - Potential for substantial issues. Wo.Off.4 – Potential for substantial buildability issues with high traffic management costs. Roundabout reconfigured outside highway boundary. May require total pavement reconstruction and numerous stats diversions. Wo.Gro.1 – Some potential issues. Exit left turns and roundabout widening required. Bus stop possibly outside highway boundary. Possible stats diversions. Wo.LTSR.3 – No significant issues. Changes within highway boundary. Wo.BL.1 – No significant issues. Wo.NL.1 – Some potential issues. Changes assumed to be within highway land. Junction construction within roundabout. Possible stats diversions and pavement reconstruction.

Scale:

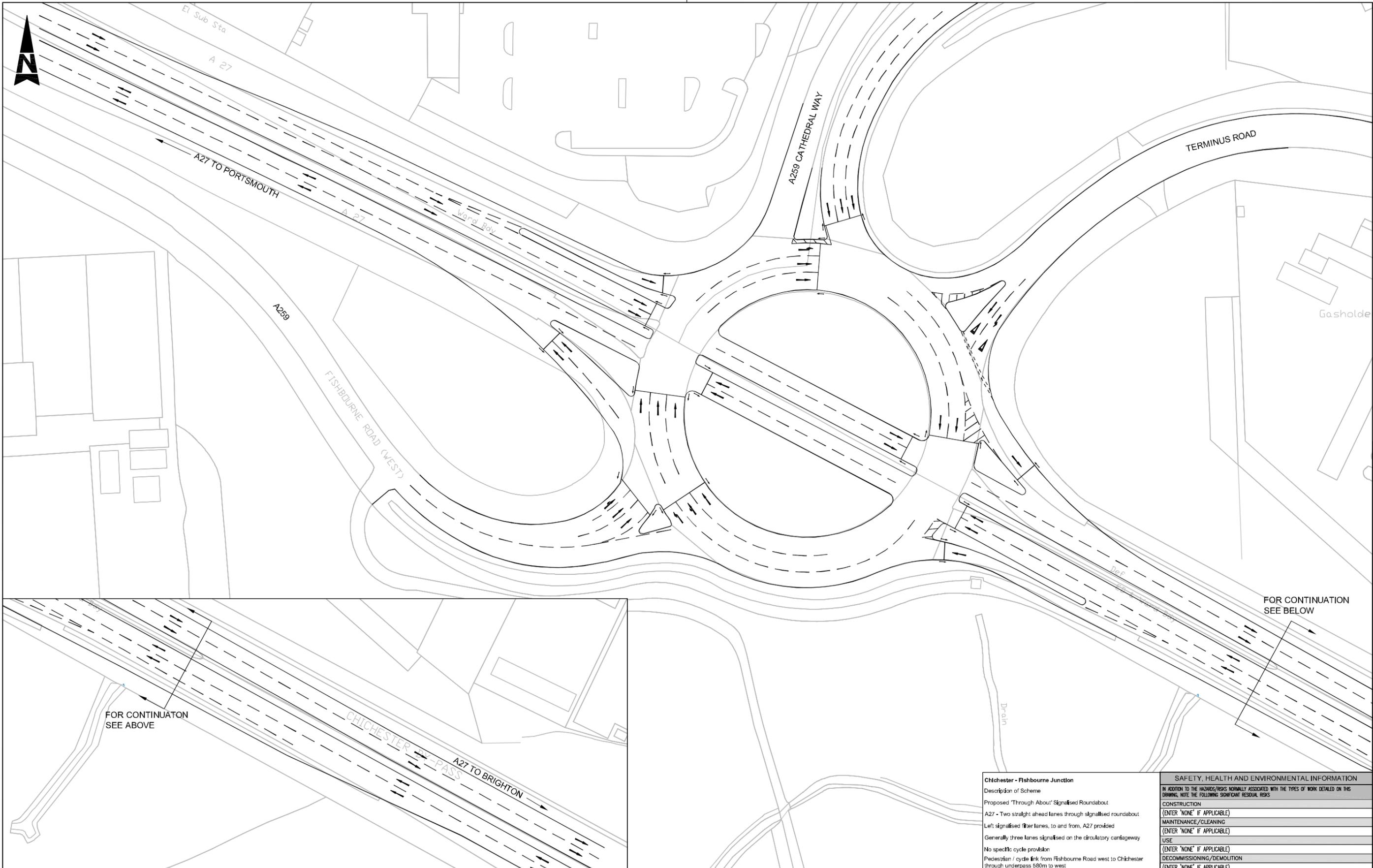
Green	Light Green	Green Accent 1 Lighter 40%	Yellow Accent 3 lighter 80%	Light Orange	Orange	Red
Large beneficial	Moderate beneficial	Slight beneficial	Neutral	Slight adverse	Moderate adverse	Large adverse

Notes on cost estimates:

1. Construction costs based on Spons rates for area of pavement adjusted for inflation for 2012.
2. Statutory undertakes costs based on 20% construction costs at this stage.
3. Land costs not included.
4. Preparation & Supervision costs not included.
5. Project risk costs not included.
6. If maximum cost is <10m low cost, 10-30m medium cost, 30m + high cost
7. All options have a 45% optimism bias.

Appendix H. Feasibility Designs

DO NOT SCALE



Chichester - Fishbourne Junction
 Description of Scheme
 Proposed 'Through About' Signalised Roundabout
 A27 - Two straight ahead lanes through signalised roundabout
 Left signalised filter lanes, to and from, A27 provided
 Generally three lanes signalised on the circulatory carriageway
 No specific cycle provision
 Pedestrian / cycle link from Fishbourne Road west to Chichester through underpass 580m to west

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION				
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS				
CONSTRUCTION				
[ENTER 'NONE' IF APPLICABLE]				
MAINTENANCE/CLEANING				
[ENTER 'NONE' IF APPLICABLE]				
USE				
[ENTER 'NONE' IF APPLICABLE]				
DECOMMISSIONING/DEMOLITION				
[ENTER 'NONE' IF APPLICABLE]				

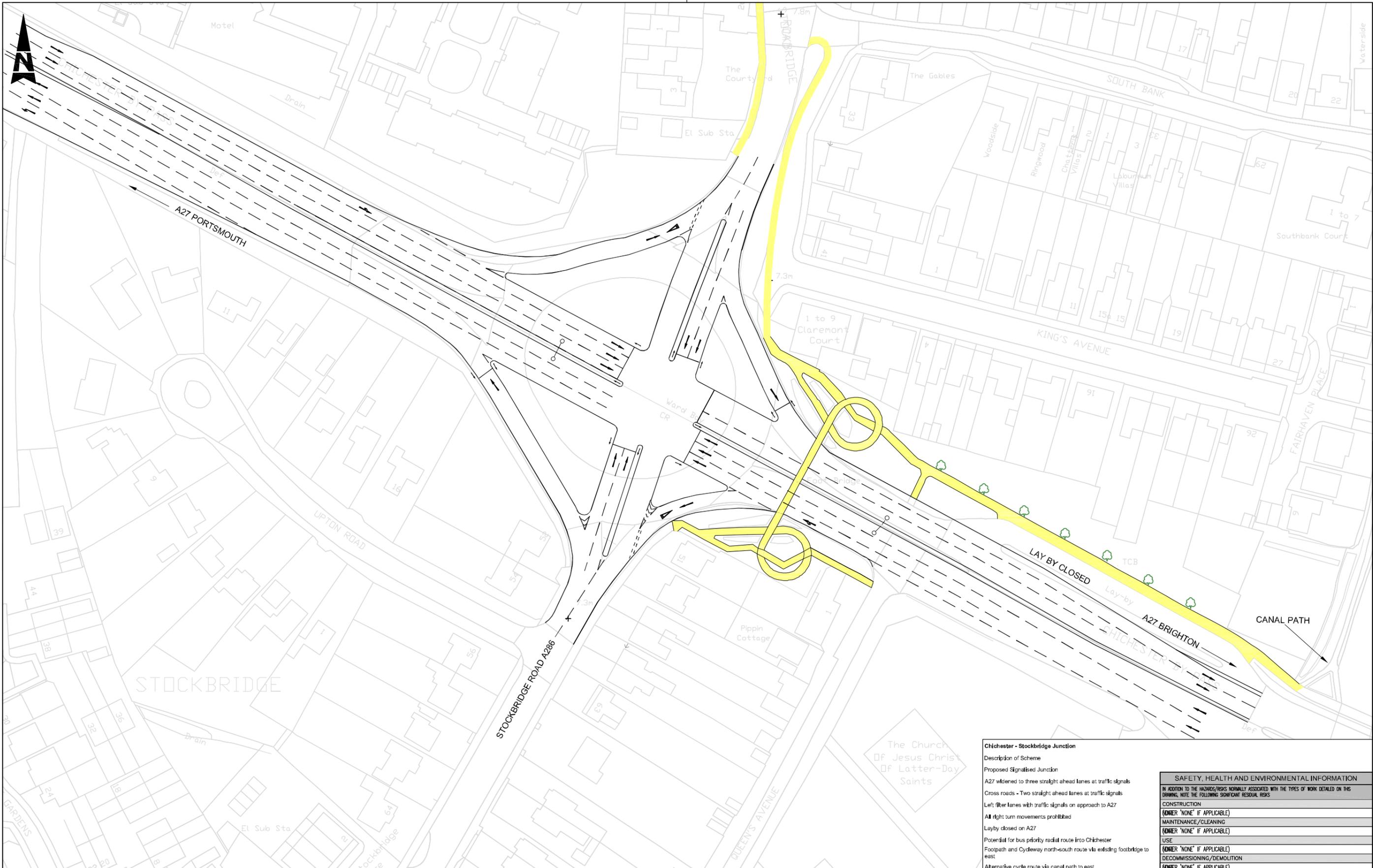
Stat	Rev	Purpose of Issue	Date	Auth	Rev	Description	By	Date	Chk'd	Auth
S2	P1	For Information	08/05/13	AB	P1	Initial Issue	MN	08/05/13	RM	AB

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Client	WEST SUSSEX COUNTY COUNCIL
Project	A27 ROUTE STRATEGY

Title					CHICHESTER - FISH BOURNE JUNCTION
Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised	
A3	1:1000	MN	RM	AB	
Status	Drawing Number	Date	Date	Date	Rev
S2	A27-ATK-ZZ-DR-D-101	15/04/13	07/05/13	08/05/13	P1

DO NOT SCALE



Notes:
 - Foot / Cycle way route

Stat	Rev	Purpose of Issue	Date	Auth	Rev	Description
S2	P1	For Information	07/05/13	AB	P1	Initial Issue

ATKINS
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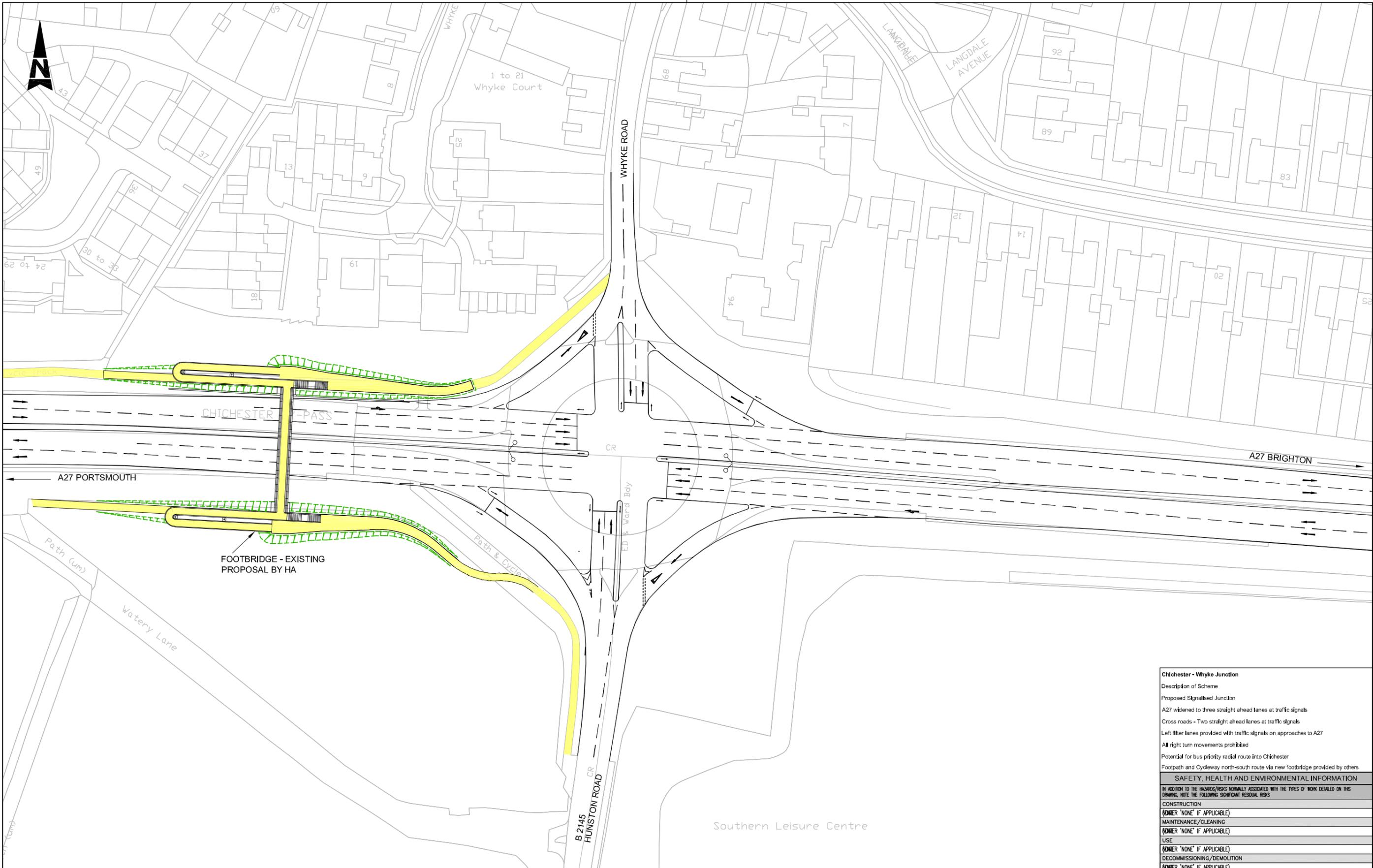
Client: WEST SUSSEX COUNTY COUNCIL
 Project: A27 ROUTE STRATEGY

Chichester - Stockbridge Junction
 Description of Scheme
 Proposed Signalised Junction
 A27 widened to three straight ahead lanes at traffic signals
 Cross roads - Two straight ahead lanes at traffic signals
 Left filter lanes with traffic signals on approach to A27
 All right turn movements prohibited
 Layby closed on A27
 Potential for bus priority radial route into Chichester
 Footpath and Cycleway north-south route via existing footbridge to east
 Alternative cycle route via canal path to east

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION			
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS			
CONSTRUCTION	(OWNER 'NONE' IF APPLICABLE)		
MAINTENANCE/CLEANING	(OWNER 'NONE' IF APPLICABLE)		
USE	(OWNER 'NONE' IF APPLICABLE)		
DECOMMISSIONING/DEMOLITION	(OWNER 'NONE' IF APPLICABLE)		

Title: CHICHESTER - STOCKBRIDGE JUNCTION			
Sheet Size	Original Scale	Designed/Drawn	Checked
A3	1:1000	MN	RM
Status	Drawing Number	Date	Date
S2	A27-ATK-ZZ-DR-D-102b	15/04/13	07/05/13
		Authorised	Rev
		AB	P1

DO NOT SCALE



Notes:
 [Yellow Box] - Foot / Cycle way route

Stat	Rev	Purpose of Issue	Date	Auth	Rev	Description
S2	P1	For Information	07/05/13	AB	P1	Initial Issue

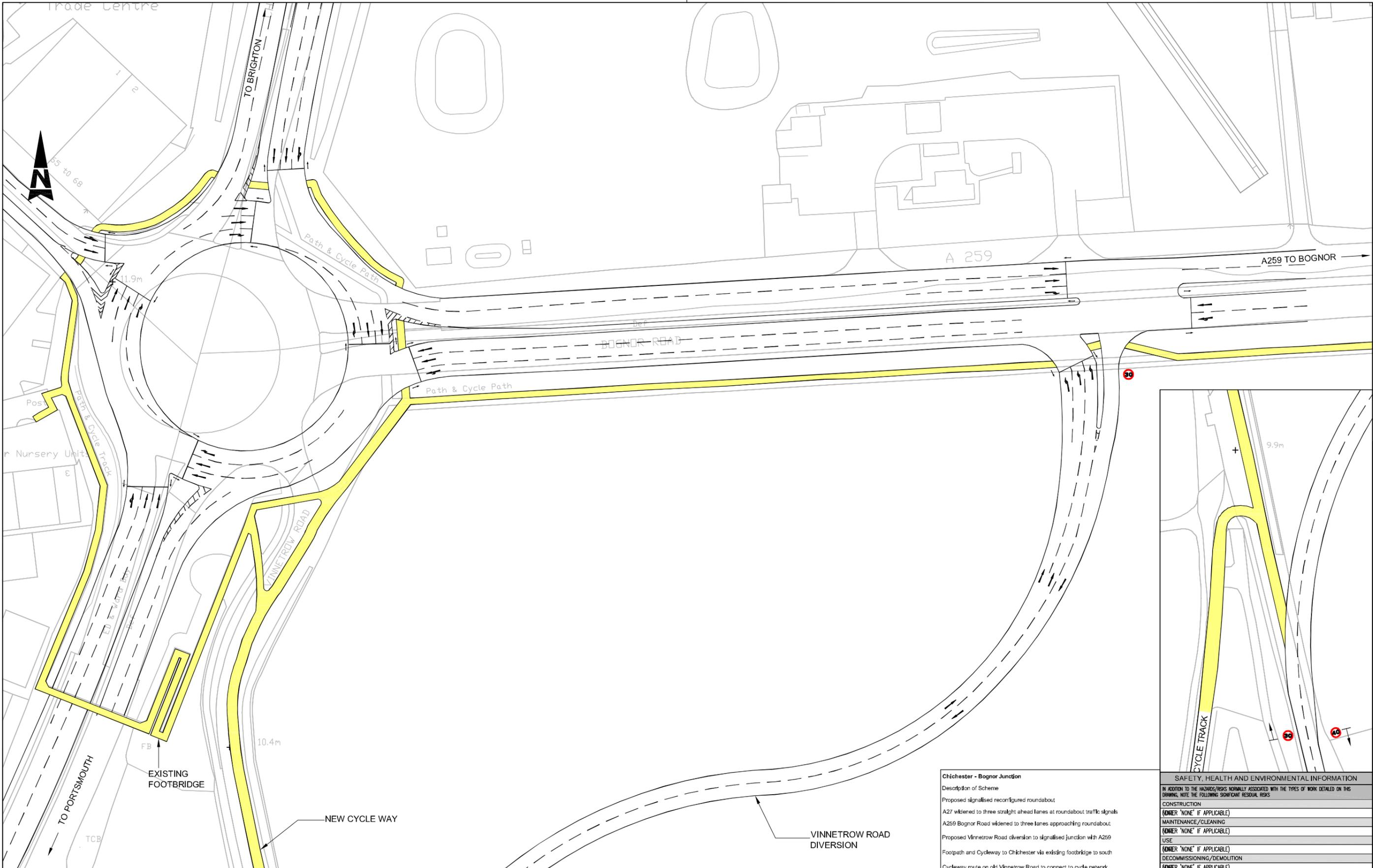
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Project	A27 ROUTE STRATEGY

Chichester - Whyke Junction				
Description of Scheme				
Proposed Signalled Junction				
A27 widened to three straight ahead lanes at traffic signals				
Cross roads - Two straight ahead lanes at traffic signals				
Left filter lanes provided with traffic signals on approaches to A27				
All right turn movements prohibited				
Potential for bus priority radial route into Chichester				
Footpath and Cycleway north-south route via new footbridge provided by others				
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION				
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS				
CONSTRUCTION				
[NONE 'NONE' IF APPLICABLE]				
MAINTENANCE/CLEANING				
[NONE 'NONE' IF APPLICABLE]				
USE				
[NONE 'NONE' IF APPLICABLE]				
DECOMMISSIONING/DEMOLITION				
[NONE 'NONE' IF APPLICABLE]				
Title		CHICHESTER - WHYKE JUNCTION		
Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A3	1:1000	MN	RM	AB
Status	Drawing Number	Date	Date	Date
S2	A27-ATK-ZZ-DR-D-103b	15/04/13	07/05/13	07/05/13
				Rev
				P1

DO NOT SCALE



Notes:
 - Foot / Cycle way route

Stat	Rev	Purpose of Issue	Date	Auth	Rev	Description
S2	P1	For Information	07/05/13	AB	P1	Initial Issue

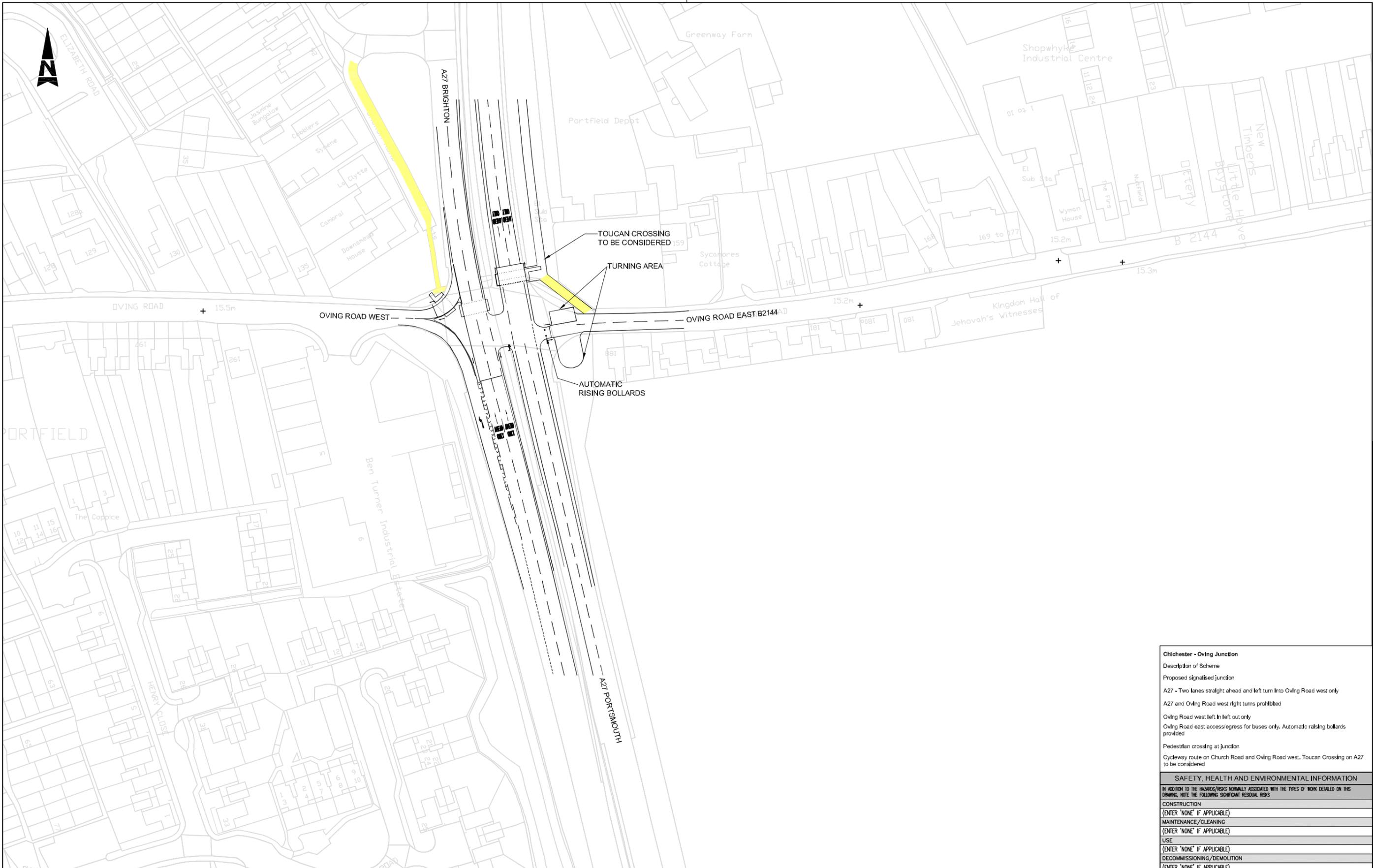
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Chichester - Bognor Junction	
Description of Scheme	
Proposed signalised reconfigured roundabout	
A27 widened to three straight ahead lanes at roundabout traffic signals	
A259 Bognor Road widened to three lanes approaching roundabout	
Proposed Vinnetrow Road diversion to signalised junction with A259	
Footpath and Cycleway to Chichester via existing footbridge to south	
Cycleway route on old Vinnetrow Road to connect to cycle network	
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SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION				
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CONSTRUCTION	(OWNER 'NONE' IF APPLICABLE)			
MAINTENANCE/CLEANING	(OWNER 'NONE' IF APPLICABLE)			
USE	(OWNER 'NONE' IF APPLICABLE)			
DECOMMISSIONING/DEMOLITION	(OWNER 'NONE' IF APPLICABLE)			
Title				
CHICHESTER - BOGNOR ROAD JUNCTION				
Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A3	1:1000	MN	RM	AB
Status	Drawing Number	Date	Date	Date
S2	A27-ATK-ZZ-DR-D-104b	15/04/13	07/05/13	07/05/13
				Rev
				P1

DO NOT SCALE



Notes:

- Foot / Cycle way route
- Pedestrian Crossing

Stat	Rev	Purpose of Issue	Date	Auth	Rev	Description	By	Date	Chk'd	Auth
S2	P1	For Information	07/05/13	AB	P1	Initial Issue	MN	07/05/13	RM	AB

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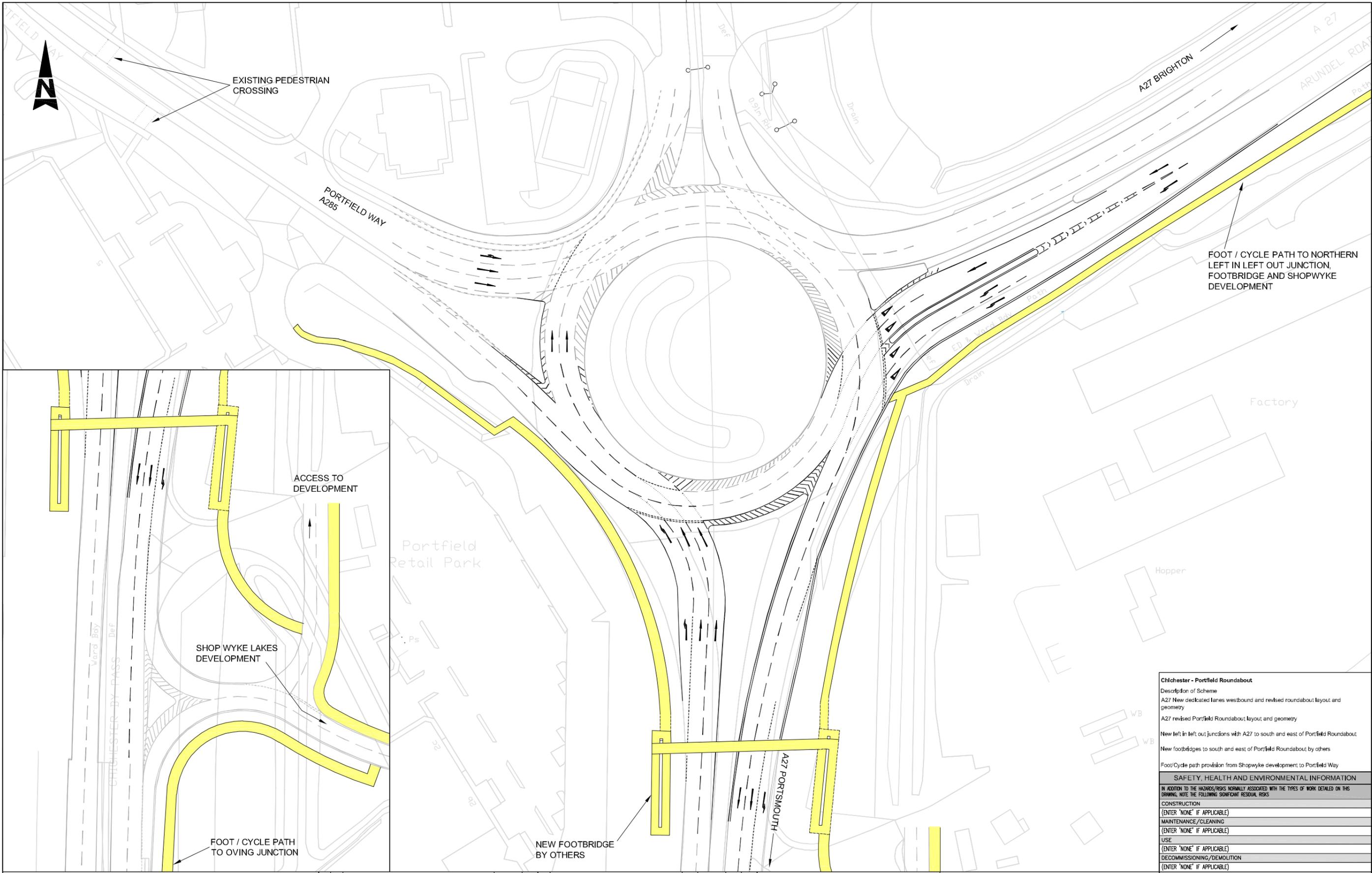
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A27 ROUTE STRATEGY

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A3	1:1000	MN	RM	AB
Status	Drawing Number	Date	Date	Date
S2	A27-ATK-ZZ-DR-D-105	15/04/13	07/05/13	07/05/13

Chichester - Oving Junction				
Description of Scheme				
Proposed signalised junction				
A27 - Two lanes straight ahead and left turn into Oving Road west only				
A27 and Oving Road west right turns prohibited				
Oving Road west left, in left out only				
Oving Road east access/egress for buses only. Automatic raising bollards provided				
Pedestrian crossing at junction				
Cycleway route on Church Road and Oving Road west. Toucan Crossing on A27 to be considered				
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION				
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS				
CONSTRUCTION				
[ENTER 'NONE' IF APPLICABLE]				
MAINTENANCE/CLEANING				
[ENTER 'NONE' IF APPLICABLE]				
USE				
[ENTER 'NONE' IF APPLICABLE]				
DECOMMISSIONING/DEMOLITION				
[ENTER 'NONE' IF APPLICABLE]				
Title				
CHICHESTER - OIVING ROAD JUNCTION				

DO NOT SCALE



Notes:
 - Foot / Cycle way route

Stat	Rev	Purpose of Issue	Date	Auth	Rev	Description
S2	P1	For Information	07/05/13	AB	P1	Initial Issue

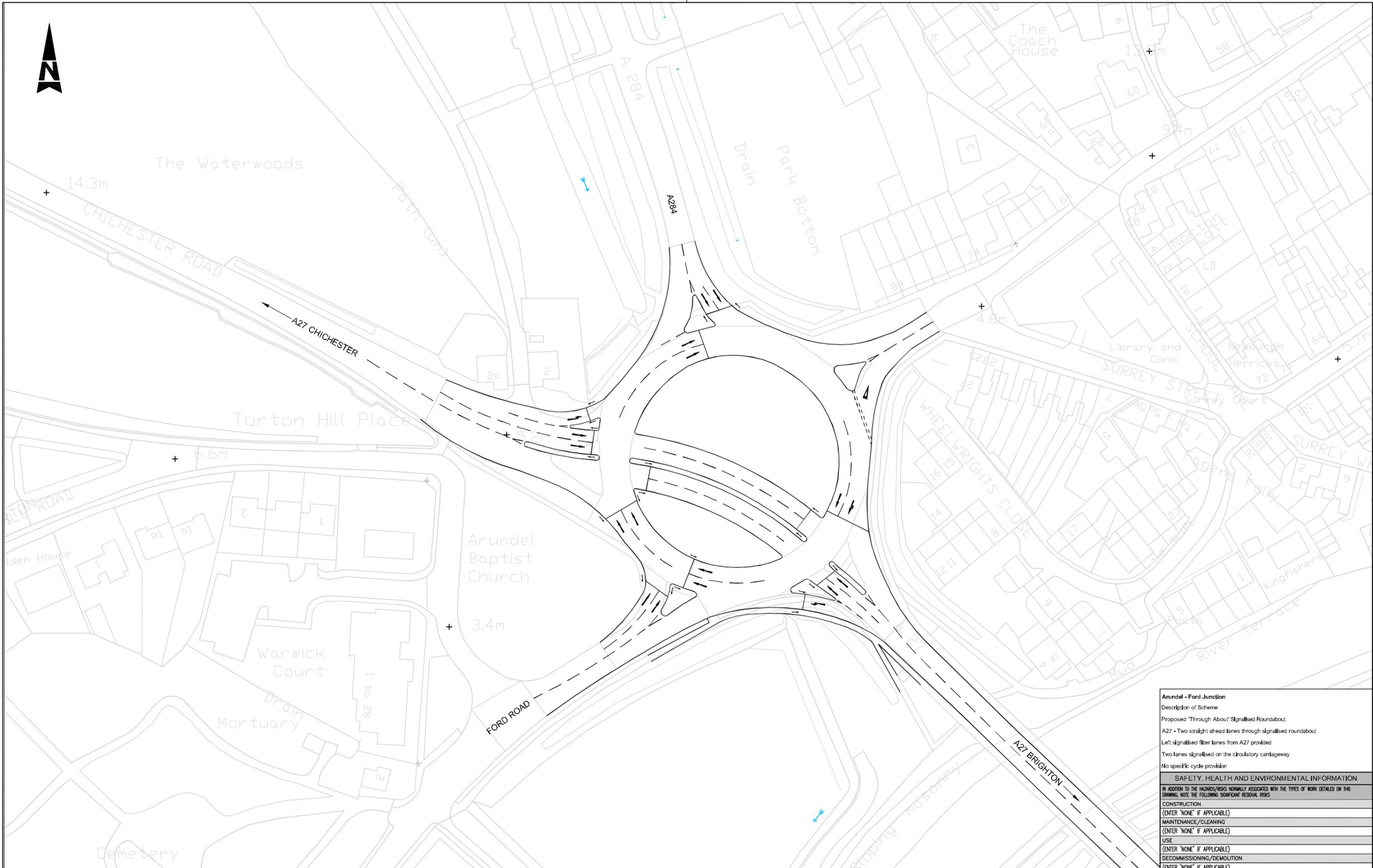
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Chichester - Portfield Roundabout				
Description of Scheme				
A27 New dedicated lanes westbound and revised roundabout layout and geometry				
A27 revised Portfield Roundabout; layout and geometry				
New left in left out junctions with A27 to south and east of Portfield Roundabout				
New footbridges to south and east of Portfield Roundabout; by others				
Foot/Cycle path provision from Shopwyke development to Portfield Way				
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION				
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS				
CONSTRUCTION				
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MAINTENANCE/CLEANING				
[ENTER 'NONE' IF APPLICABLE]				
USE				
[ENTER 'NONE' IF APPLICABLE]				
DECOMMISSIONING/DEMOLITION				
[ENTER 'NONE' IF APPLICABLE]				
Title CHICHESTER - PORTFIELD ROUNDABOUT				
Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A3	1:1000	MN	RM	AB
Status	Drawing Number	Date	Date	Date
S2	A27-ATK-ZZ-DR-D-106	15/04/13	07/03/13	07/05/13
Rev				
				P1

DO NOT SCALE

A3



Arundel - Ford Junction				
Description of Scheme				
Proposed 'Through About' Signalised Roundabout				
A27 - Two straight ahead lanes through signalised roundabout				
Left signalised filter lanes from A27 provided				
Two lanes signalised on the circulatory carriageway				
No specific cycle provision				
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION				
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS				
CONSTRUCTION				
[ENTER 'NONE' IF APPLICABLE]				
MAINTENANCE/CLEANING				
[ENTER 'NONE' IF APPLICABLE]				
USE				
[ENTER 'NONE' IF APPLICABLE]				
DECOMMISSIONING/DEMOLITION				
[ENTER 'NONE' IF APPLICABLE]				

Stat	Rev	Purpose of Issue	Date	Auth	Rev	Description
S2	P1	For Information	07/05/13	AB	P1	Initial Issue

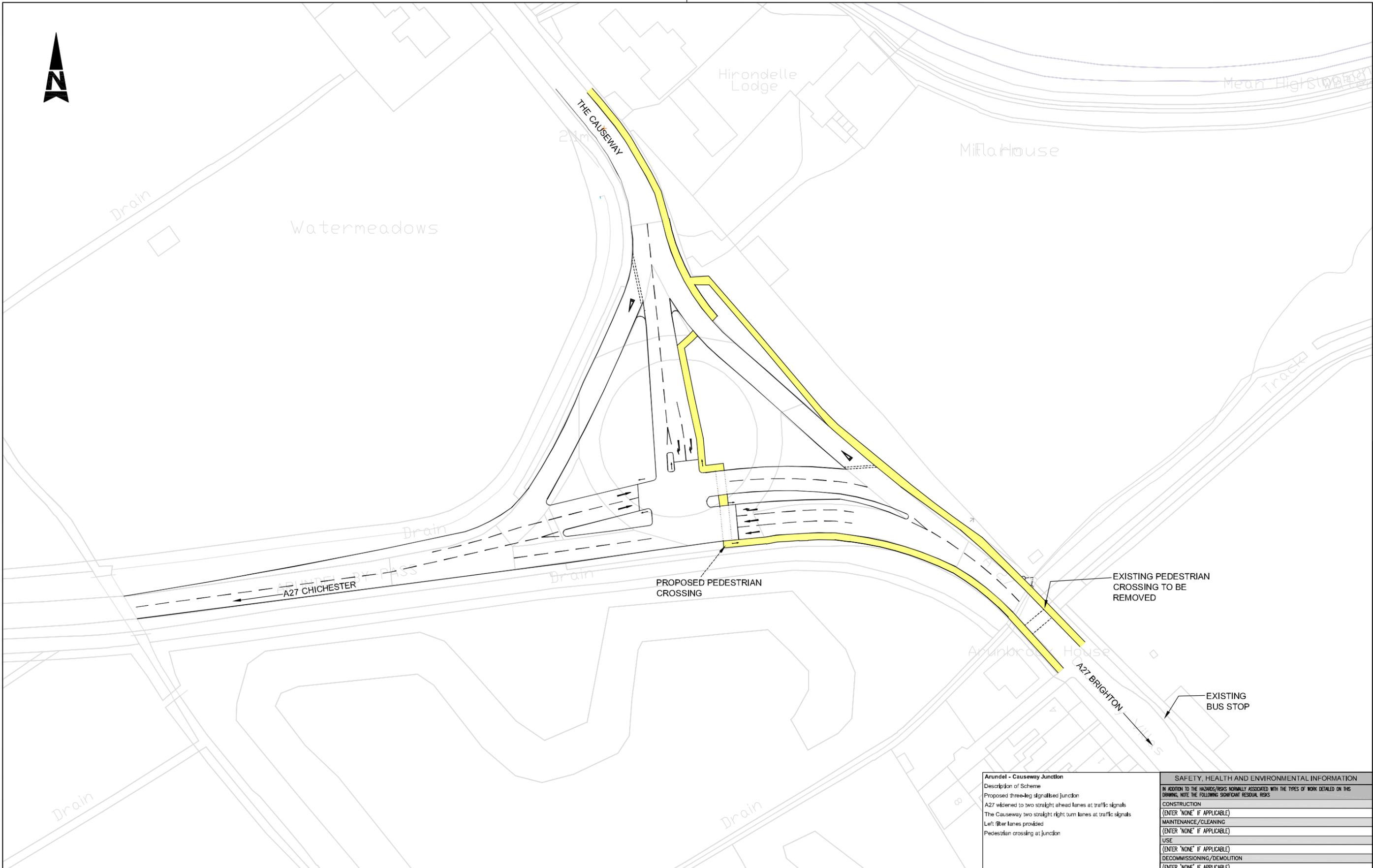
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Title				
ARUNDEL - FORD ROAD JUNCTION				
Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A3	1:1000	MN	RM	TRA
Status	Drawing Number	Date	Date	Date
S2	A27-ATK-ZZ-DR-D-107	15/04/13	07/05/13	07/05/13
Rev				
				P1

DO NOT SCALE



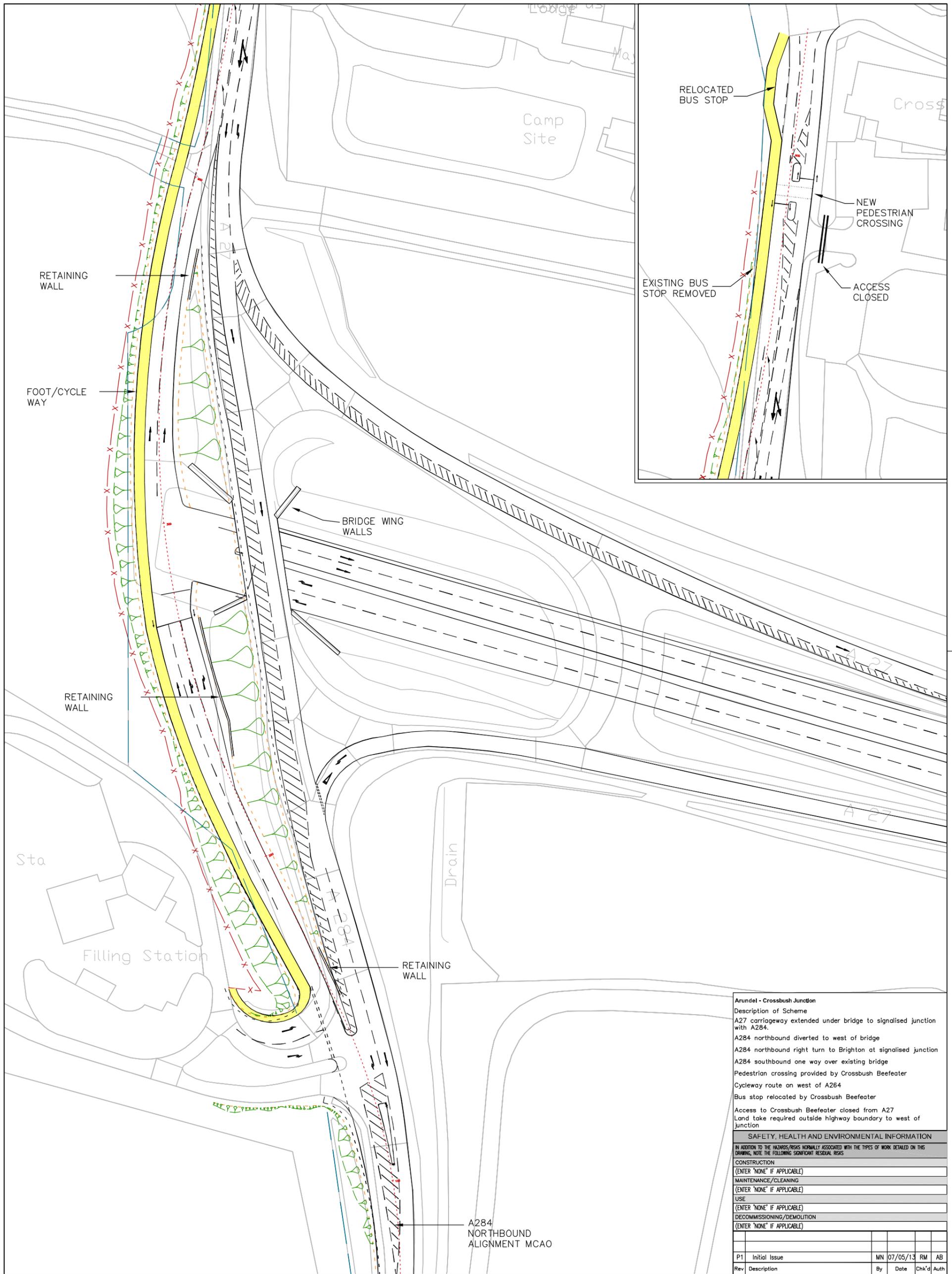
Notes:
 - Foot / Cycle way route

Stat	Rev	Purpose of Issue	Date	Auth	Rev	Description	By	Date	Chk'd	Auth
S2	P1	For Information	07/05/13	AB	P1	Initial Issue	MN	07/05/13	RM	AB

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SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION				
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CONSTRUCTION [ENTER 'NONE' IF APPLICABLE]				
MAINTENANCE/CLEANING [ENTER 'NONE' IF APPLICABLE]				
USE [ENTER 'NONE' IF APPLICABLE]				
DECOMMISSIONING/DEMOLITION [ENTER 'NONE' IF APPLICABLE]				
Title ARUNDEL - CAUSEWAY JUNCTION				
Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A3	1:1000	MN	RM	AB
Status	Drawing Number	Date	Date	Date
S2	A27-ATK-ZZ-DR-D-108	15/04/13	07/05/13	07/05/13
Rev				
				P1



Arundel - Crossbush Junction
 Description of Scheme
 A27 carriageway extended under bridge to signalised junction with A284.
 A284 northbound diverted to west of bridge
 A284 northbound right turn to Brighton at signalised junction
 A284 southbound one way over existing bridge
 Pedestrian crossing provided by Crossbush Beefeater
 Cycleway route on west of A264
 Bus stop relocated by Crossbush Beefeater
 Access to Crossbush Beefeater closed from A27
 Land take required outside highway boundary to west of junction

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
 IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS

CONSTRUCTION	(ENTER 'NONE' IF APPLICABLE)
MAINTENANCE/CLEANING	(ENTER 'NONE' IF APPLICABLE)
USE	(ENTER 'NONE' IF APPLICABLE)
DECOMMISSIONING/DEMOLITION	(ENTER 'NONE' IF APPLICABLE)

P1	Initial Issue	MN	07/05/13	RM	AB
Rev	Description	By	Date	Chk'd	Auth

Notes:

- Foot / Cycle way route
- Existing highway boundary
- New highway boundary

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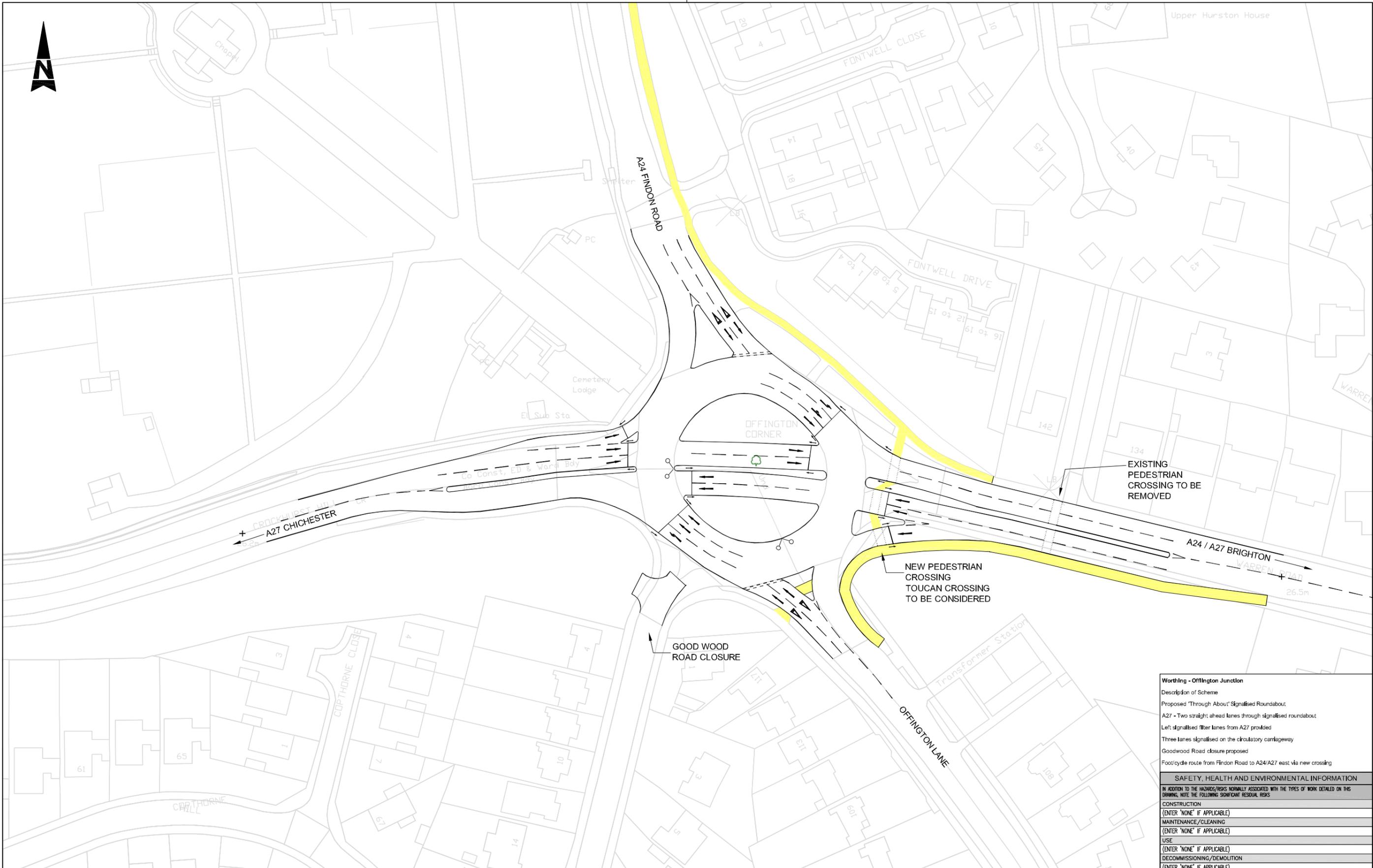
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Title
ARUNDEL - CROSSBUSH JUNCTION

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A3	1:1000	MN	RM	AB
Status	Drawing Number	Date	Date	Date
S2	A27-ATK-ZZ-DR-D-109	30/04/13	07/05/13	07/05/13

DO NOT SCALE



Notes:
 - Foot / Cycle way route

Stat	Rev	Purpose of Issue	Date	Auth	Rev	Description
S2	P1	For Information	07/05/13	AB	P1	Initial Issue

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A27 ROUTE STRATEGY

Worthing - Offington Junction
 Description of Scheme
 Proposed 'Through About' Signalised Roundabout
 A27 - Two straight ahead lanes through signalised roundabout
 Left signalised filter lanes from A27 provided
 Three lanes signalised on the circulatory carriageway
 Goodwood Road closure proposed
 Foot/cycle route from Findon Road to A24/A27 east via new crossing

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
 IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS

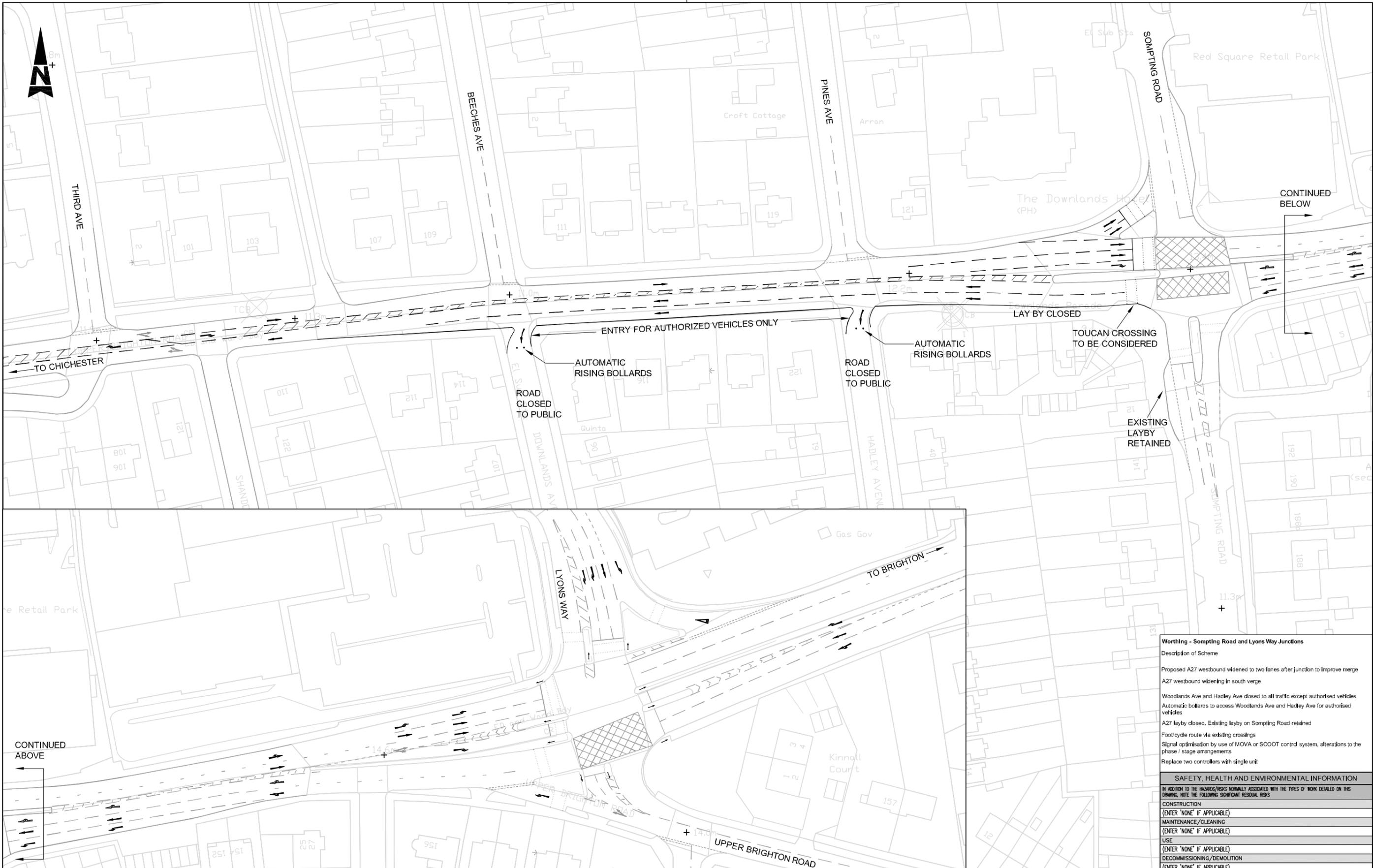
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 USE
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 DECOMMISSIONING/DEMOLITION
 [ENTER 'NONE' IF APPLICABLE]

Title
WORTHING - OFFINGTON JUNCTION

Sheet Size	Original Scale	Designed/Drawn	Checked	Authorised
A3	1:1000	MN	RM	AB
Status	Drawing Number	Date	Date	Date
S2	A27-ATK-ZZ-DR-D-110	15/04/13	07/05/13	07/05/13

DO NOT SCALE

A3



Notes:
 - Existing pedestrian crossing

Stat	Rev	Purpose of Issue	Date	Auth	Rev	Description
S2	P1	For Information	07/05/13	AB	P1	Initial Issue
Stat	Rev	Purpose of Issue	By	Date	Chk'd	Auth

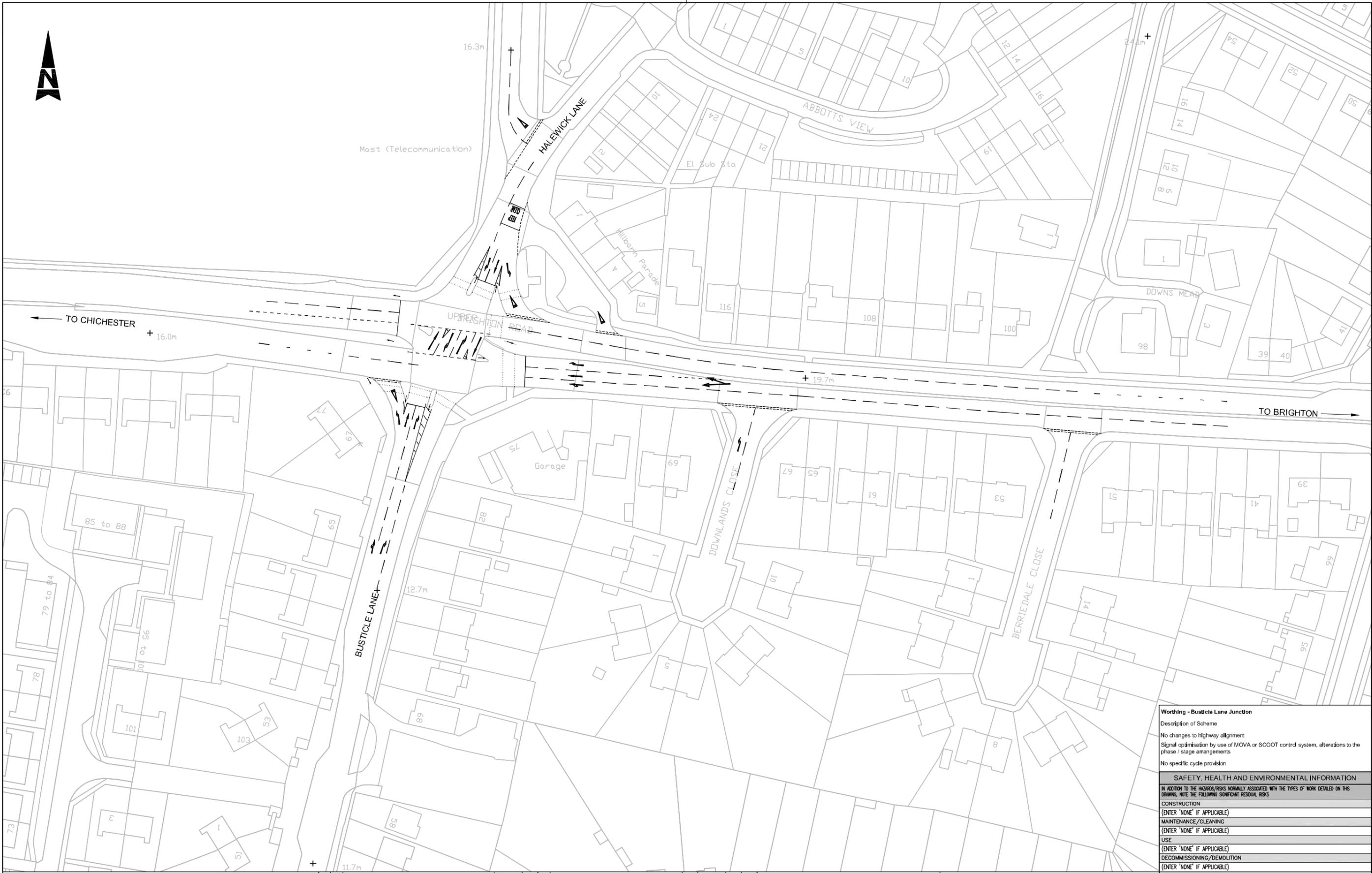
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Worthing - Sompting Road and Lyons Way Junctions Description of Scheme Proposed A27 westbound widened to two lanes after junction to improve merge A27 westbound widening in south verge Woodlands Ave and Hadley Ave closed to all traffic except authorised vehicles Automatic bollards to access Woodlands Ave and Hadley Ave for authorised vehicles A27 layby closed, Existing layby on Sompting Road retained Foot/cycle route via existing crossings Signal optimisation by use of MOVA or SCOOT control system, alterations to the phase / stage arrangements Replace two controllers with single unit				
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS				
CONSTRUCTION [ENTER 'NONE' IF APPLICABLE]				
MAINTENANCE/CLEANING [ENTER 'NONE' IF APPLICABLE]				
USE [ENTER 'NONE' IF APPLICABLE]				
DECOMMISSIONING/DEMOLITION [ENTER 'NONE' IF APPLICABLE]				
Title WORTHING LYONS WAY AND SOMPTING ROAD JUNCTION		Sheet Size Original Scale A3 1:1000		
Status Drawing Number S2 A27-ATK-ZZ-DR-D-112		Designed/Drawn MN 15/04/13 Checked RM 07/05/13 Authorised AB 07/05/13		
Rev P1		Date 07/05/13		

DO NOT SCALE

A3



Notes:
 - Existing informal pedestrian crossing

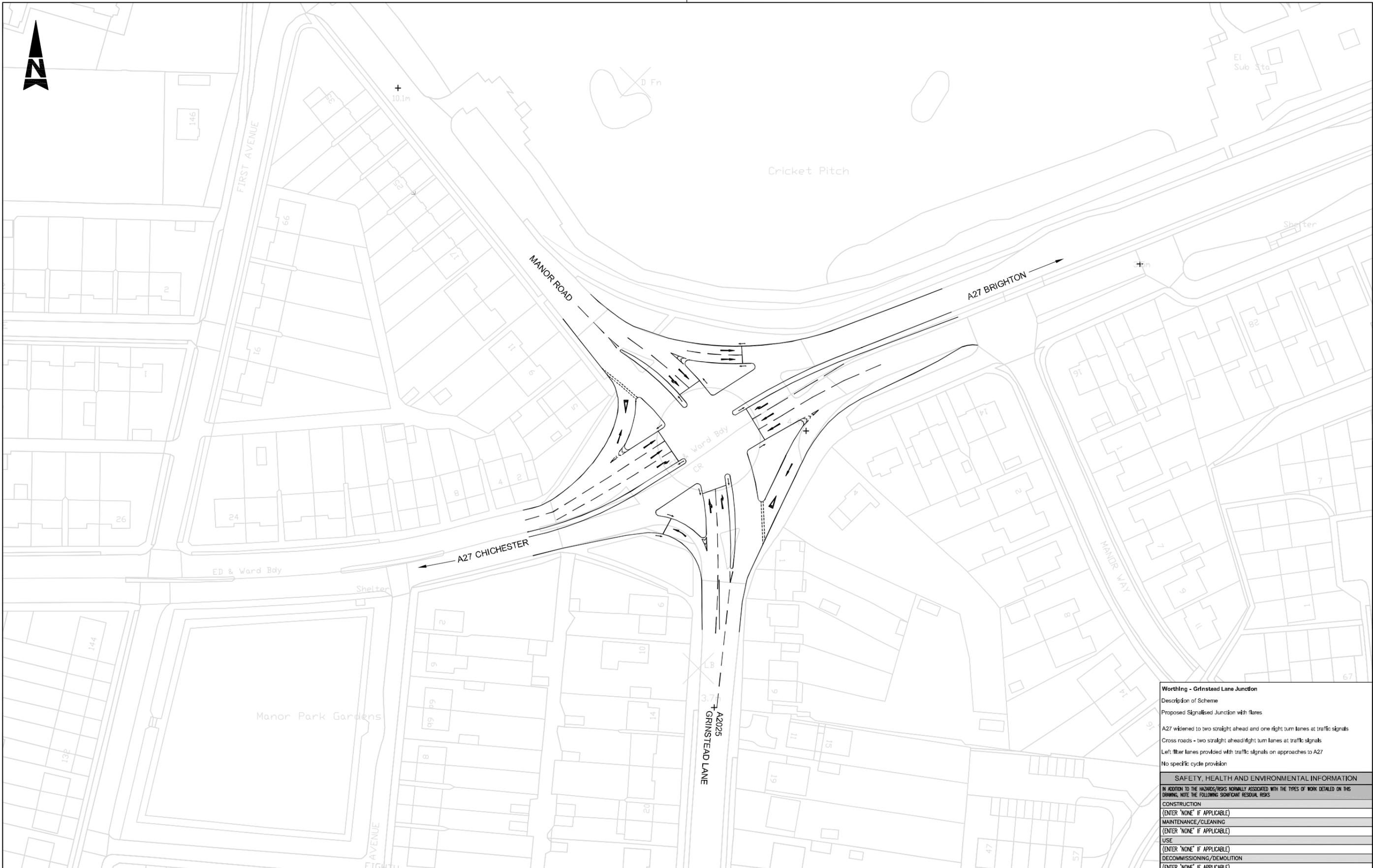
Stat	Rev	Purpose of Issue	Date	Auth	Rev	Description
S2	P1	For Information			P1	Initial Issue

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Worthing - Busticle Lane Junction	
Description of Scheme	
No changes to Highway alignment Signal optimisation by use of MOVA or SCOOT control system, alterations to the phase / stage arrangements No specific cycle provision	
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS	
CONSTRUCTION	[ENTER 'NONE' IF APPLICABLE]
MAINTENANCE/CLEANING	[ENTER 'NONE' IF APPLICABLE]
USE	[ENTER 'NONE' IF APPLICABLE]
DECOMMISSIONING/DEMOLITION	[ENTER 'NONE' IF APPLICABLE]
Title	WORTHING - BUSTICLE LANE JUNCTION
Sheet Size	A3
Original Scale	1:1000
Designed/Drawn	MN
Checked	RM
Authorised	AB
Date	15/04/13
Date	21/05/13
Date	21/05/13
Status	S2
Drawing Number	A27-ATK-ZZ-DR-D-113
Rev	P1

DO NOT SCALE



Worthing - Grinstead Lane Junction
 Description of Scheme
 Proposed Signalised Junction with flares
 A27 widened to two straight ahead and one right turn lanes at traffic signals
 Cross roads - two straight ahead/right turn lanes at traffic signals
 Left filter lanes provided with traffic signals on approaches to A27
 No specific cycle provision

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS	
CONSTRUCTION	[ENTER 'NONE' IF APPLICABLE]
MAINTENANCE/CLEANING	[ENTER 'NONE' IF APPLICABLE]
USE	[ENTER 'NONE' IF APPLICABLE]
DECOMMISSIONING/DEMOLITION	[ENTER 'NONE' IF APPLICABLE]

Stat	Rev	Purpose of Issue	Date	Auth	Rev	Description
S2	P1	For Information	07/05/13	AB	P1	Initial Issue

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Title	
WORTHING - GRINSTEAD LANE JUNCTION	
Sheet Size	Original Scale
A3	1:1000
Status	Drawing Number
S2	A27-ATK-ZZ-DR-D-114
Authorised	Rev
AB	P1
Date 15/04/13	Date 07/05/13
Date 07/05/13	Date 07/05/13

Appendix I. Breakdown of Cost Estimates for Preferred Package

A27 Route Strategy Scheme Costs				
1	Construction costs based on Spons rates for area of pavement adjusted for inflation for 2012 (includes estimates for site clearance; fencing/safety fencing; drainage; kerbs & footways/cycleways; signs & markings; street lighting)			
2	Statutory undertakes costs based on 20% base construction costs at this stage			
3	9% Preparation & 12% Supervision costs not included			
4	20% Project risk costs included			
5	All options have a 45% optimism bias			
		rate £	area	Cost
1.0	Fishbourne Hamburger Junction			
	Roadworks construction cost based on pavement area	400	4150	1660000
	Landscaping and noise/visual mitigation			30000
	Signalised Junction £40k + £10k/stop line signals	14	10000	180000
	Prelims incl TM			748000
	Base costs 2012			2618000
	Utility diversions 20% of base costs			523600
	Land costs not known. Additional land required appears to be within highway boundary			0
	Total			3141600
	plus 45% optimism bias			1413720
	plus 9% preparation			282744
	plus 12% supervision			376992
	plus 20% risk			628320
	Total cost £m			5.84
2.0	Stockbridge Signalised Junction (restricted access)			
2.1	Signalised Junction restricted access.			
	Roadworks construction cost based on pavement area	400	4180	1672000
	Landscaping and noise/visual mitigation			30000
	Signalised Junction £20k + £10k/stop line signals	6	10000	80000
	Footbridge (existing retained)	0	0	0
	Prelims incl TM			712800
	Base costs 2012			2494800
	Utility diversions 20% of base costs			498960
	Land costs not known. Additional land required appears to be within highway boundary			0
	Total			2993760
	plus 45% optimism bias			1347192
	plus 9% preparation			269438
	plus 12% supervision			359251
	plus 20% risk			598752
	Total cost £m			5.57

3.0	Whyke Signalised Junction (restricted access)			
3.1	Signalised Junction restricted access. (Jacobs 2009 £2.04m)			
	Roadworks construction cost based on pavement area	400	3960	1584000
	Landscaping and noise/visual mitigation			30000
	Signalised Junction £20k + £10k/stop line signals	6	10000	80000
	Footbridge. Provided by others	0		0
	Prelims incl TM			677600
	Base costs 2012			2371600
	Utility diversions 20% of const costs			474320
	Land costs not known. Additional land required appears to be within highway boundary			0
	Total			2845920
	plus 45% optimism bias			1280664
	plus 9% preparation			256133
	plus 12% supervision			341510
	plus 20% risk			569184
	Total cost £m			5.29
4.0	Bognor Road Signalised Roundabout			
	Roadworks construction cost based on pavement area	400	5290	2116000
	Landscaping and noise/visual mitigation			30000
	Signalised Roundabout £20k + £10k/stop line signals	8	10000	100000
	Existing footbridge retained			
	Prelims incl TM			898400
	Base costs 2012			3144400
	Utility diversions 20% of const costs			628880
	Land costs not known. Additional land required appears to be within highway boundary			0
	Total			3773280
	plus 45% optimism bias			1697976
	plus 9% preparation			339595
	plus 12% supervision			452794
	plus 20% risk			754656
	Total cost £m			7.02
4.4	Vinnetrow diversion and signalised junction with A259			
	Roadworks cost based on pavement area	350	3065	1072750
	Landscaping and noise/visual mitigation			10000
	Signalised Junction £10k/stop line signals	3	10000	30000
	Prelims incl TM			445100
	Base costs 2012			1557850
	Utility diversions 20% of const costs			311570
	Land required outside highway boundary. Costs by others			0
	Total			1869420
	plus 45% optimism bias			841239
	plus 9% preparation			168248
	plus 12% supervision			224330
	plus 20% risk			373884
	Total cost £m			3.48

5.0	Oving Sigalised Junction (restriced access) - Works by Shopwyke development			
5.1	Changes to movement in junction.			
	Roadworks construction cost - Roadmarking signs etc			30000
	Landscaping and noise/visual mitigation			10000
	Automatic bollards			15000
	Signalised Junction £20k + £10k/stop line signals	4	10000	60000
	Prelims incl TM			46000
	Base costs 2012			115000
	Utility diversions 10% of const costs			11500
	Land costs not known. Additional land required appears to be within highway boundary			0
	Total			126500
	plus 45% optimism bias			56925
	plus 9% preparation			11385
	plus 12% supervision			15180
	plus 20% risk			25300
	Total cost £m			0.24
6.0	Portfield Roundabout Improvements, South LILO Access and Footbridge - Works by Shopwyke development			
	Roadworks construction cost based on pavement area + kerbing + roadmarking (works to 30m from edge of A27 carriageway)	400	535	254000
	Cycleways	52	1635	85020
	Landscaping and noise/visual mitigation			30000
	Footbridge £1770/m2 deck + £50000 for ramps	1770	104	234080
	Prelims incl TM			241240
	Base costs 2012			844340
	Utility diversions 20% of const costs			168868
	Land costs not known. Additional land required outside highway boundary acquired by others			0
	Total			1013208
	plus 45% optimism bias			455944
	plus 9% preparation			91189
	plus 12% supervision			121585
	plus 20% risk			202642
	Total cost £m			1.88

Note: Supervision and preparation assumptions are taken from the standard tuba economic file and are sourced from the COBA manual (DMRB Volume 13): 13.1.2.7 – The Preparation of Cost Data for Use in COBA. Supervision costs are those associated with the cost of site staff and testing of materials. Preparation costs include Consulting Engineers'/Agent Authorities fees, actual costs of pursuing alternative routes (if any) in the early stages of the scheme, Public Consultation, Public Inquiry and the cost of any surveys carried out during scheme preparation.

Operating costs

The scheme costs assume the installation of the signals. Operation costs include the annual cost of signal maintenance for all of the proposed junction changes as follows:

- Maintenance assumes an annual cost of £1000 per stop line, which includes least two heads per stop line and some allowance for repeaters/phasing heads and Toucan crossings plus other associated equipment;
- The maintenance costs have been considered in the appraisal for 60 years; and
- Above ground traffic signals have a life of approx 20 years, but interim replacement has been excluded from the appraisal due to the complex nature of contracts involved.

No deduction has been made for the discontinuing the maintenance of existing signal heads.

Appendix J. Preferred Package Traffic Model Outputs

J.1. Model Network Summary Statistics

J.1.1. Chichester

Table below contains a summary of the junction performance in SATURN. Note, SATURN is average peak hour, whilst LinSig / ARCADY make an assumption about average peak hour.

Table J-1 Overall network performance – Chichester

Do-Nothing	Matrix Total (Pcu's / hr)	Average Speed (km / h)		Delay (pcu hours)		Vehicle Kilometres		Delay / vehicle (minutes)	
		This Time Period	Next Time Period	This Time Period	Next Time Period	This Time Period	Next Time Period	This Time Period	Next Time Period
Network-Wide	143159	72	28	12111	3113	4665704	174212	5.075	1.304
A27 Corridor - Whole	143159	38	31	2040	679	151491.0	33646.1	0.855	0.284
A27 Corridor - Chichester	143159	39	32	376	69	29945.0	3615.2	0.157	0.029
Preferred Package	Matrix Total (Pcu's / hr)	Average Speed (km / h)		Delay (pcu hours)		Vehicle Kilometres		Delay / vehicle (minutes)	
		This Time Period	Next Time Period	This Time Period	Next Time Period	This Time Period	Next Time Period	This Time Period	Next Time Period
Network-Wide	143159	73	28	11475	3077	4680137	155627	4.809	1.289
A27 Corridor - Whole	143159	45	30	1820	717	188166.0	33884.9	0.762	0.301
A27 Corridor - Chichester	143159	50	51	268	24	33923.7	2932.3	0.112	0.010

Along the whole A27 corridor there is a significant improvement in average speed from 38 km per hour to 45 km per hour.

Total delay and delay per vehicle on the whole A27 corridor and within the Chichester section reduces by around a third.

The vehicle kilometres on the network increase across the wider network, as well as the study and local network in Chichester. Across the network it increases by 3%, across the study area 24% and across Chichester by 13%.

J.2. Arundel

Table J-2 Overall network performance - Arundel

Do-Nothing	Matrix Total (Pcu's / hr)	Average Speed (km / h)		Delay (pcu hours)		Vehicle Kilometres		Delay / vehicle (minutes)	
		This Time Period	Next Time Period	This Time Period	Next Time Period	This Time Period	Next Time Period	This Time Period	Next Time Period
Network-Wide	143159	72	28	12111	3113	4665704	174212	5.075	1.304
A27 Corridor - Whole	143159	38	31	2040	679	151491.0	33646.1	0.855	0.284
A27 Corridor - Arundel	143159	18.4	13.3	325	151	8985	2670	0.136	0.063
Preferred Package	Matrix Total (Pcu's / hr)	Average Speed (km / h)		Delay (pcu hours)		Vehicle Kilometres		Delay / vehicle (minutes)	
		This Time Period	Next Time Period	This Time Period	Next Time Period	This Time Period	Next Time Period	This Time Period	Next Time Period
Network-Wide	143159	73	28	11475	3077	4680137	155627	4.809	1.289
A27 Corridor - Whole	143159	45	30	1820	717	188166.0	33884.9	0.762	0.301
A27 Corridor - Arundel	143159	18	12	396	168	10317	2552	0.166	0.070

Despite clear improvements at each junction across the A27 corridor at Arundel average speed actually decreases slightly. This is due to increased flows, particularly between Crossbush and Causeway at the single lane carriageway section and also movements clashing with turning movements to the side road at Crossbush Lane increases. As a result overall delay increases slightly from 477 pcu hours to 564 pcu hours.

The vehicle kilometres on the network increase across the wider network, as well as the study and local network in Arundel. Across the network it increases by 3%, across the study area 24% and across Arundel by 15%.

J.3. Worthing

The table below shows the percentage change in the sum of modelled flow at the key A27 junctions in Worthing

Table J-3 Overall network performance – Worthing

Do-Nothing	Matrix Total (Pcu's / hr)	Average Speed (km / h)		Delay (pcu hours)		Vehicle Kilometres		Delay / vehicle (minutes)	
		This Time Period	Next Time Period	This Time Period	Next Time Period	This Time Period	Next Time Period	This Time Period	Next Time Period
Network-Wide	143159	72	28	12111	3113	4665704	174212	5.075	1.304
A27 Corridor - Whole	143159	38	31	2040	679	151491.0	33646.1	0.855	0.284
A27 Corridor - Worthing	143159	25	17	744	220	30609.9	5199.2	0.311	0.092
Preferred Package	Matrix Total (Pcu's / hr)	Average Speed (km / h)		Delay (pcu hours)		Vehicle Kilometres		Delay / vehicle (minutes)	
		This Time Period	Next Time Period	This Time Period	Next Time Period	This Time Period	Next Time Period	This Time Period	Next Time Period
Network-Wide	143159	73	28	11475	3077	4680137	155627	4.809	1.289
A27 Corridor - Whole	143159	45	30	1820	717	188166.0	33884.9	0.762	0.301
A27 Corridor - Worthing	143159	44	45	371	39	43986.3	4918.6	0.155	0.016

Across the A27 corridor at Worthing there is a significant improvement in average speeds from 24 km per hour to 44 km per hour. Total delay reduces by over half.

The vehicle kilometres on the network increase across the wider network, as well as the study and local network in Worthing. Across the network it increases by 3%, across the study area 24% and across Worthing by 44%.

J.4. Junction Model Summary Results

J.4.1. Chichester Junction Summary Results

J.4.1.1. Fishbourne Junction

The junction modelling results for Fishbourne Junction are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

There are potential blocking back problems at this junction if capacity is exceeded.

Table J-1 Junction performance – Fishbourne

Fishbourne	Arm	Do Minimum	Preferred Package
Volume / Over Capacity		130%	90%
Eastbound average delay (seconds)	A27 Chichester By-pass West	185	19
Westbound average delay (seconds)	A27 Chichester By-pass East	37	28
Inbound average delay (seconds)	A259 Fishbourne Road	264	100
Outbound average delay (seconds)	A259 Cathedral Way	5	95
Terminus Road average delay (seconds)	Terminus Road	1,144	4
Eastbound total delay (PCU Hours)	A27 Chichester By-pass West	136	16
Westbound total delay (PCU Hours)	A27 Chichester By-pass East	25	23
Inbound total delay (PCU Hours)	A259 Fishbourne Road	131	24
Outbound total delay (PCU Hours)	A259 Cathedral Way	1	10
Terminus Road total delay (PCU Hours)	Terminus Road	268	0
Eastbound demand flow (PCU's per hour)	A27 Chichester By-pass West	1,758	3,383
Westbound demand flow (PCU's per hour)	A27 Chichester By-pass East	1,641	3,174
Inbound demand flow (PCU's per hour)	A259 Fishbourne Road	1,191	717
Outbound demand flow (PCU's per hour)	A259 Cathedral Way	708	380
Terminus Road demand flow (PCU's per hour)	Terminus Road	563	117

In the absence of intervention, the junction is expected to operate above capacity, with significant delays. The results from the Do Minimum show that the junction operates above capacity (130%). Eastbound traffic on the A27 experience significant delays of around three minutes. Also traffic travelling across the A27 into Chichester along the A259 experiences average delays of four and a half minutes.

The preferred package of a Hamburger junction with Terminus Road retained offers significant improvements to Eastbound traffic with delays down to 19 seconds and inbound movements reducing from over 4 minutes delay to just over one and a half minutes, although with some increase in delay for traffic leaving Chichester. Traffic flows east and westbound increase significantly. Overall by 2026 the junction is expected to perform just within capacity at 90%.

J.4.2. Stockbridge Roundabout

The junction modelling results for Stockbridge Junction are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

Table J-2 Junction performance – Stockbridge

Stockbridge	Arm	Do Minimum	Preferred Package
Volume / Over Capacity		129%	76%
Eastbound average delay (seconds)	A27 Chichester By-pass West	292	23
Westbound average delay (seconds)	A27 Chichester By-pass East	131	25
Inbound average delay (seconds)	Stockbridge Road South	16	24
Outbound average delay (seconds)	A286 Stockbridge Road North	8	48
Eastbound total delay (PCU Hours)	A27 Chichester By-pass West	256	19
Westbound total delay (PCU Hours)	A27 Chichester By-pass East	96	16
Inbound total delay (PCU Hours)	Stockbridge Road South	5	8
Outbound total delay (PCU Hours)	A286 Stockbridge Road North	1	11
Eastbound demand flow (PCU's per hour)	A27 Chichester By-pass West	2,107	2,648
Westbound demand flow (PCU's per hour)	A27 Chichester By-pass East	1,756	2,907
Inbound demand flow (PCU's per hour)	Stockbridge Road South	809	1,074
Outbound demand flow (PCU's per hour)	A286 Stockbridge Road North	241	436

The results from the Do Minimum show that the junction operates above capacity (129%). Strategic traffic on the A27 corridor experiences significant delays, with average delay of five minutes eastbound and just over two minutes westbound. Traffic travelling across the A27 into and out of Chichester along the A286 experiences minor delays of quarter of a minute inbound and a few seconds outbound.

The preferred package of a signalised junction with left and straight over only movements improves conditions for east and westbound traffic significant to just 23 and 25 seconds respectively. There is a slight increase in delay for traffic leaving Chichester to 48 seconds. Traffic Westbound increases most significantly but also noticeably Eastbound. Overall by 2026 the junction is expected to operate well within design capacity at 76%.

J.4.3. Whyke Roundabout

The junction modelling results for Whyke Junction are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

Table J-3 Junction performance – Whyke

Whyke	Arm	Do Minimum	Preferred Package
Volume / Over Capacity		130%	68%
Eastbound average delay (seconds)	A27 Chichester By-pass West	24	20
Westbound average delay (seconds)	A27 Chichester By-pass East	46	20
Inbound average delay (seconds)	B2145 Whyke Road South	250	43
Outbound average delay (seconds)	Whyke Road North	91	41
Eastbound total delay (PCU Hours)	A27 Chichester By-pass West	14	15
Westbound total delay (PCU Hours)	A27 Chichester By-pass East	26	14

Inbound total delay (PCU Hours)	B2145 Whyke Road South	154	6
Outbound total delay (PCU Hours)	Whyke Road North	7	5
Eastbound demand flow (PCU's per hour)	A27 Chichester By-pass West	1,431	2,592
Westbound demand flow (PCU's per hour)	A27 Chichester By-pass East	1,343	2,630
Inbound demand flow (PCU's per hour)	B2145 Whyke Road South	1,480	841
Outbound demand flow (PCU's per hour)	Whyke Road North	188	400

The results from the Do Minimum show that the junction operates above capacity (130%). Strategic traffic on the A27 corridor experiences some delays, with average delay of three quarters of a minute eastbound and half a minute westbound. Traffic travelling across the A27 into and out of Chichester along Whyke Road and the B2145 experiences significant delays of four minutes inbound and one and a half minutes outbound.

The preferred package of a signalised junction with left and straight over movements only allowed most noticeably improves conditions for inbound traffic whilst reducing delays on all other movements. Traffic flows east and westbound are expected to increase significantly. Overall the junction in 2026 is expected to operate well within design capacity at 68%.

J.4.4. Bognor Roundabout

The junction modelling results for Bognor Roundabout are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

There are potential blocking back problems at this junction if capacity is exceeded.

Table J-4 Junction performance – Bognor Roundabout

Bognor	Arm	Do Minimum	Preferred Package
Volume / Over Capacity		123%	71%
Eastbound average delay (seconds)	A27 Chichester By-Pass South	164	16
Westbound average delay (seconds)	A27 Chichester By-Pass North	15	56
Inbound average delay (seconds)	A259 Bognor Road East)	172	61
Outbound average delay (seconds)	A259 Bognor Road West	6	76
Eastbound total delay (PCU Hours)	A27 Chichester By-Pass South	95	12
Westbound total delay (PCU Hours)	A27 Chichester By-Pass North	7	17
Inbound total delay (PCU Hours)	A259 Bognor Road East total delay (PCU Hours)	99	16
Outbound total delay (PCU Hours)	A259 Bognor Road West	1	14
Eastbound demand flow (PCU's per hour)	A27 Chichester By-Pass South	1386	2557
Westbound demand flow (PCU's per hour)	A27 Chichester By-Pass North	1155	1115
Inbound demand flow (PCU's per hour)	A259 Bognor Road East	1373	1872
Outbound demand flow (PCU's per hour)	A259 Bognor Road West	389	400

The results from the Do Minimum show that the junction operates above capacity (123%). Strategic traffic on the A27 corridor experiences some delays, particularly eastbound with delays just under three minutes. Traffic travelling across the A27 into Chichester along the A259 Bognor Road experiences delays of just under three minutes compared to just a few seconds outbound.

The preferred scenario of a signalised roundabout and diverting Vinnetrow Road to a new junction on the Bognor Road reduces the most significant delays EB to 16 seconds and inbound to a minute. Westbound movements though have increased delays to 1 minute and traffic leaving Chichester to 76 seconds. Traffic flows are expected to increase significantly eastbound but also noticeably inbound. Overall the junction in 2026 is expected to operate well within design capacity at 71%.

J.4.5. Oving Road Junction

The junction modelling results for Oving Road are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

Table J-5 Junction performance – Oving Road

Oving		Do Minimum	Preferred Package
Volume / Over Capacity		121%	49%
Eastbound average delay (seconds)	A27 Chichester By-pass South	12	6
Westbound average delay (seconds)	A27 Chichester By-pass North	12	5
Inbound average delay (seconds)	B2144 Oving Road East	203	0*
Outbound average delay (seconds)	B2144 Oving Road West	394	39*
Eastbound total delay (PCU Hours)	A27 Chichester By-pass South	4	3
Westbound total delay (PCU Hours)	A27 Chichester By-pass North	4	2
Inbound total delay (PCU Hours)	B2144 Oving Road East	17	0*
Outbound total delay (PCU Hours)	B2144 Oving Road West	36	2*
Eastbound demand flow (PCU's per hour)	A27 Chichester By-pass South	1238	1538
Westbound demand flow (PCU's per hour)	A27 Chichester By-pass North	1280	1114
Inbound demand flow (PCU's per hour)	B2144 Oving Road East	304	0*
Outbound demand flow (PCU's per hour)	B2144 Oving Road West	332	173*

*Left movements

The results from the Do Minimum show that the junction operates over capacity (121%). Strategic traffic on the A27 corridor experiences minimal delays, of 12 seconds in each direction. Traffic travelling across the A27 into and out of Chichester along Shopwhyke Road and Oving Road experiences delays of over three minutes inbound and six and a half minutes outbound.

The preferred package of restricting straight over and right-turn movements removes inbound and outbound delays and improves conditions for strategic East and Westbound traffic. Traffic flows eastbound increase whilst those with restrictions inbound and outbound decrease. Overall the junction in 2026 is expected to have improved so that it is operating within design capacity at 49%.

J.4.6. Portfield Roundabout

The junction modelling results for Portfield Roundabout are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

Table J-6 Junction performance – Portfield Roundabout

Portfield	Arm	Do Minimum	Preferred Package
Volume / Over Capacity		86%	90%
Eastbound average delay (seconds)	A27 Chichester By-pass South	7	10
Westbound average delay (seconds)	A27 Arundel Road	7	5
Inbound average delay (seconds)	A285 Portfield Way	4	1
Outbound average delay (seconds)	Chichester By-Pass North	3	0
Eastbound total delay (PCU Hours)	A27 Chichester By-pass South	4	5
Westbound total delay (PCU Hours)	A27 Arundel Road	5	5
Inbound total delay (PCU Hours)	A285 Portfield Way	1	1
Outbound total delay (PCU Hours)	Chichester By-Pass North	0	0
Eastbound demand flow (PCU's per hour)	A27 Chichester By-pass South	1,342	1,283
Westbound demand flow (PCU's per hour)	A27 Arundel Road	1,789	2,409
Inbound demand flow (PCU's per hour)	A285 Portfield Way	411	494
Outbound demand flow (PCU's per hour)	Chichester By-Pass North	236	306

The results from the Do Minimum show that the junction operates under capacity (86%). Strategic traffic on the A27 corridor and inbound and outbound traffic experience minimal average delays, a few seconds in all directions.

The preferred package which includes a revised layout and additional eastbound lane with new left in/left out junctions on the A27 either side of Portfield roundabout in relation to the Shopwhyke Lakes development has minimal impact on the operation of the junction.

J.5. Arundel Junction Summary Results

J.5.1. Crossbush Junction

The junction modelling results for Crossbush Junction are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

Table J-7 Junction performance – Crossbush Junction

Crossbush	Arm	Do Minimum	Preferred Package
Volume / Over Capacity		141%	91%
Eastbound average delay (seconds)	A27 North Left turn	12	7
Westbound average delay (seconds)	A27 East to A27 North	344	27

Inbound average delay (seconds)	A284 Lyminster Road South	13	67
Outbound average delay (seconds)	A27 North to A284 Lyminster Road	25	1
Eastbound total delay (PCU Hours)	A27 North Left turn	6	4
Westbound total delay (PCU Hours)	A27 East to A27 North	231	15
Inbound total delay (PCU Hours)	A284 Lyminster Road South	5	17
Outbound total delay (PCU Hours)	A27 North to A284 Lyminster Road	6	0
Eastbound demand flow (PCU's per hour)	A27 North Left turn	1,654	2,338
Westbound demand flow (PCU's per hour)	A27 East to A27 North	1,342	2,281
Inbound demand flow (PCU's per hour)	A284 Lyminster Road South	983	918
Outbound demand flow (PCU's per hour)	A27 North to A284 Lyminster Road	(101 included in E/B)	(243 included in E/B)

The results from the Do Minimum show that the junction operates over capacity (141%). The main delay is to Westbound traffic of approaching 7 minutes.

The preferred package which reroutes westbound traffic under the current overbridge has largely removed the Westbound delay to 27 seconds. Traffic coming into Arundel from Littlehampton does experience increased delays to around a minute. East and westbound traffic flows increase significantly. Overall by 2026 the junction is expected to operate just within design capacity at 91%.

J.5.2. Causeway Roundabout

The junction modelling results for Causeway Roundabout are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

Table J-8 Junction performance – Causeway Roundabout

Causeway	Arm	Do Minimum	Preferred Package
Volume / Over Capacity		190%	81%
Eastbound average delay (seconds)	A27 Arundel By-pass West	22	40
Westbound average delay (seconds)	A27 The Causeway East	945	27
Outbound average delay (seconds)	The Causeway North	22	36
Eastbound total delay (PCU Hours)	A27 Arundel By-pass West	16	17
Westbound total delay (PCU Hours)	A27 The Causeway East	529	11
Outbound total delay (PCU Hours)	The Causeway North	0	1
Eastbound demand flow (PCU's per hour)	A27 Arundel By-pass West	1,676	1,850
Westbound demand flow (PCU's per hour)	A27 The Causeway East	1,343	1,518
Outbound demand flow (PCU's per hour)	The Causeway North	153	146

The results from the Do Minimum show that the junction operates over capacity (190%). Westbound strategic traffic on the A27 corridor is expected to experience heavy delays, with the model estimating an average of 15 minutes, which would include a risk of traffic queues interfering with the operation of Crossbush junction.

The preferred package of a signalised junction incorporating the existing crossing on Causeway largely removes westbound delays with minor increases for other movements. East and westbound traffic flows increase slightly. Overall in 2026 the junction is expected to operate within design capacity at 81%.

J.5.3. Ford Roundabout

The junction modelling results for Ford Roundabout are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

There are potential blocking back problems at this junction if capacity is exceeded.

Table J-9 Junction performance – Ford Roundabout

Ford	Arm	Do Minimum	Preferred Package
Volume / Over Capacity		143%	78%
Eastbound average delay (seconds)	A27 Arundel By-pass West	406	11
Westbound average delay (seconds)	A27 Arundel By-Pass East	458	16
Inbound average delay (seconds)	Ford Road	40	66
Outbound average delay (seconds)	Maltravers Street	37	88
A284 average delay (seconds)	A284 only	26	36.4
Eastbound total delay (PCU Hours)	A27 Arundel By-pass West	208	5
Westbound total delay (PCU Hours)	A27 Arundel By-Pass East	248	7
Inbound total delay (PCU Hours)	Ford Road	8	7
Outbound total delay (PCU Hours)	Maltravers Street	4	5
A284 total delay (PCU Hours)	A284 only	4	0.4
Eastbound demand flow (PCU's per hour)	A27 Arundel By-pass West	1228	1623
Westbound demand flow (PCU's per hour)	A27 Arundel By-Pass East	1300	1540
Inbound demand flow (PCU's per hour)	Ford Road	288	288
Outbound demand flow (PCU's per hour)	Maltravers Street	250	116
A284 demand Flow (PCU's per hour)	A284 only	323	37

The Do Minimum scenario is to deliver the layout improvements identified in the bid for Pinch Point Funding. The junction is estimated to operate over capacity at 143%. Movements on the A27 are estimated to be delayed by between six and eight minutes.

The preferred package of a Hamburger junction removes the delay for east and westbound traffic but does have a slight adverse impact on the inbound and outbound movements incurring delays of up to one and a half minutes. Eastbound traffic flow increases most significantly. Overall the junction improves to operate under design capacity at 78%.

J.6. Worthing Junction Summary Results

J.6.1. Offington Corner

The junction modelling results for Offington Corner are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

There are potential blocking back problems at this junction if capacity is exceeded.

Table J-10 Junction performance – Offington Corner

Offington	Arm	Do Minimum	Preferred Package
Volume / Over Capacity		137%	89%
Eastbound average delay (seconds)	A27 Crockhurst Hill West	16	34
Westbound average delay (seconds)	A27 Warren Road East	42	43
Northbound average delay (seconds)	A2031 Offington Lane South	312	57
Southbound average delay (seconds)	A24 Findon Road North	314	74
Eastbound total delay (PCU Hours)	A27 Crockhurst Hill West	6	20
Westbound total delay (PCU Hours)	A27 Warren Road East	23	28
Northbound total delay (PCU Hours)	A2031 Offington Lane South	23	28
Southbound total delay (PCU Hours)	A24 Findon Road North	145	30
Eastbound demand flow (PCU's per hour)	A27 Crockhurst Hill West	941	2,002
Westbound demand flow (PCU's per hour)	A27 Warren Road East	1,353	2,626
Northbound demand flow (PCU's per hour)	A2031 Offington Lane South	741	1,085
Southbound demand flow (PCU's per hour)	A24 Findon Road North	1,112	1,222

The results from the Do Minimum show that the junction is estimated to operate over capacity (137%). Strategic traffic on the A27 corridor experiences an average delay of three quarters of a minute westbound and quarter of a minute eastbound. Delays for traffic moving north and south across the A27 are forecast to be in excess of five minutes.

The preferred package of a Hamburger junction with Goodwood Road closed offers significant improvements to local traffic reducing delays to around one minute with minor increases to average east and westbound movements. There are significant increases to traffic flows east and westbound. Overall the junction in 2026 is expected to operate just within design capacity at 89%.

J.6.2. Grove Lodge Roundabout

The junction modelling results for Grove Lodge Roundabout are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

There are potential blocking back problems at this junction if capacity is exceeded. .

Table J-11 Junction performance – Grove Lodge

Grove Lodge		Do Minimum	Preferred Package
Volume / Over Capacity		145%	95%
Eastbound average delay (seconds)	A27 Warren Road	43	38
Westbound average delay (seconds)	A27 Upper Brighton Road	368	34

Northbound average delay (seconds)	A24 Broadwater St West	150	81
Southbound average delay (seconds)	Hill Barn Lane Left	38	183
Eastbound total delay (PCU Hours)	A27 Warren Road	14	25
Westbound total delay (PCU Hours)	A27 Upper Brighton Road	237	26
Northbound total delay (PCU Hours)	A24 Broadwater St West	75	10*
Southbound total delay (PCU Hours)	Hill Barn Lane Left	10*	10*
Eastbound demand flow (PCU's per hour)	A27 Warren Road	1,519	2,430
Westbound demand flow (PCU's per hour)	A27 Upper Brighton Road	2,052	3,128
Northbound demand flow (PCU's per hour)	A24 Broadwater St West	1,659	1,208
Southbound demand flow (PCU's per hour) (from Hill Barn lane)	Hill Barn Lane Left	10*	10*

* Low flows of 10 pcu's assumed where link not included in model or low flow reported.

The results from the Do Minimum show that the junction is estimated to operate over capacity (145%). Westbound strategic traffic on the A27 corridor experiences a significant delay of six minutes and northbound traffic out of Worthing two and a half minutes.

The preferred package of a Hamburger junction reduces the westbound delay to around half a minute and nearly halves the Northbound delay whilst there is an increase in the Southbound delay for up to 3 minutes. The Grove Lodge design has incorporated the designs related to the local college and housing development which improves pedestrian movements and increases cycle times, Traffic flows east and westbound increase significantly. Overall the junction performance improves and operates at about design capacity.

J.6.3. Lyons Farm / Sompting Road

The junction modelling results for Lyons Farm / Sompting Road are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

Table J-12 Junction performance – Lyons Farm / Sompting Road

Lyons Farm / Sompting Road		Do Minimum	Preferred Package
Volume / Over Capacity		98%	89%
Eastbound average delay (seconds)	A27 Upper Brighton Road West	50	28
Westbound average delay (seconds)	A27 Sompting By-Pass East	449	29
Northbound average delay (seconds)	Sompting Road South / Upper Brighton Road South	18	55
Southbound average delay (seconds)	Sompting Road North / Lyons Farm Exit	0	1
Eastbound total delay (PCU Hours)	A27 Upper Brighton Road West	34	23
Westbound total delay (PCU Hours)	A27 Sompting By-Pass East	289	24
Northbound total delay (PCU Hours)	Sompting Road South / Upper Brighton Road South	2	7
Southbound total delay (PCU Hours)	Sompting Road North / Lyons Farm Exit	0	0
Eastbound demand flow (PCU's per hour)	A27 Upper Brighton Road West	2,420	2,918
Westbound demand flow (PCU's per hour)	A27 Sompting By-Pass East	2,318	2,962
Northbound demand flow (PCU's per hour)	Sompting Road South / Upper Brighton Road	290	412

hour)	South		
Southbound demand flow (PCU's per hour)	Sompting Road North / Lyons Farm Exit	0	69

The results from the Do Minimum show that the combined junctions are estimated to operate over capacity (98%). Strategic traffic on the A27 corridor experiences an average delay of in excess of seven minutes westbound, and nearly a minute eastbound.

The preferred proposal to optimise signals and implement traffic merging improvements Westbound from Sompting Road practically removes the westbound delay with a slight adverse impact on northbound movements. There are slight traffic flow increases. Overall the junction performance improves slightly operating just under design capacity at 89%.

J.6.4. Busticle Lane

The junction modelling results for Busticle Lane are shown in the table below. Delay figures are for the approach and crossing of the junction as far as the exit.

Table J-13 Junction performance – Busticle Lane

Busticle Lane	Arm	Do Minimum	Preferred Package
Volume / Over Capacity		115%	67%
Eastbound average delay (seconds)	A27 Upper Brighton Road West	226	4
Westbound average delay (seconds)	A27 Upper Brighton Road East	156	20
Northbound average delay (seconds)	Busticle Lane	35	42
Southbound average delay (seconds)	Halewick Lane	50	63
Eastbound total delay (PCU Hours)	A27 Upper Brighton Road West	131	2
Westbound total delay (PCU Hours)	A27 Upper Brighton Road East	72	9
Northbound total delay (PCU Hours)	Busticle Lane	2	2
Southbound total delay (PCU Hours)	Halewick Lane	0	1
Eastbound demand flow (PCU's per hour)	A27 Upper Brighton Road West	1,022	2,043
Westbound demand flow (PCU's per hour)	A27 Upper Brighton Road East	836	1,672
Northbound demand flow (PCU's per hour)	Busticle Lane	481	484
Southbound demand flow (PCU's per hour)	Halewick Lane	34	37

The results from the Do Minimum show that the combined junctions are estimated to operate over capacity (115%). Strategic traffic on the A27 corridor experiences an average delay of in excess of just under four minutes westbound and two and a half minutes eastbound. Northbound traffic across the A27 has delays of approximately 35 seconds, and southbound traffic 50 seconds. Without intervention, the traffic at the junction will experience moderate delays, particularly for east-west traffic on the A27.

The preferred package of optimising the traffic signals reduces delays for East and Westbound traffic with minor increases for north and southbound movements. Traffic flows have increase significant east and westbound. Overall the junction in 2026 is expected to operate well within design capacity at 67%.

J.6.5. Northing Lancing Roundabout

The junction modelling results for North Lancing Roundabout are shown in the table below.

Table J-14 Junction performance – North Lancing Roundabout

North Lancing		Do Minimum	Preferred Package
Volume / Over Capacity		122%	90%
Eastbound average delay (seconds)	A27 Upper Brighton Road	201	17
Westbound average delay (seconds)	Old Shoreham Road	5	11
Northbound average delay (seconds)	Grinstead Lane	28	36
Southbound average delay (seconds)	Manor Road	7	27
Eastbound total delay (PCU Hours)	A27 Upper Brighton Road	1	12
Westbound total delay (PCU Hours)	Old Shoreham Road	158	7
Northbound total delay (PCU Hours)	Grinstead Lane	7	7
Southbound total delay (PCU Hours)	Manor Road	2	1
Eastbound demand flow (PCU's per hour)	A27 Upper Brighton Road	728	2,475
Westbound demand flow (PCU's per hour)	Old Shoreham Road	2,834	2,280
Northbound demand flow (PCU's per hour)	Grinstead Lane	831	666
Southbound demand flow (PCU's per hour)	Manor Road	651	140

The results from the Do Minimum show that the combined junctions are estimated to operate above capacity (122%). Strategic traffic on the A27 corridor experiences minimal delays eastbound and over three minutes Eastbound. Northbound traffic across the A27 has delays of approximately half a minute and southbound traffic has minimal delays. Without intervention, the traffic at the junction will experience delay, particularly for east-west traffic on the A27.

The preferred package of a signalised junction with additional flaring at exits removes the delay eastbound with a slight increase to north and southbound traffic. Scenario 1 proposal is to convert to a signalised junction with flared entries and exits. Traffic flow eastbound increases significantly. Overall in 2026 the junction is expected to operate just under design capacity at 90%.

J.7. LinSig Limitation: Stacking Capacities

A limitation with LinSig that has been identified is the blocking back issue on roundabout links. LinSig has limitations in predicting queues blocking back on circulatory links. The modelled scenarios where this issue occurs have been identified and are noted in the table below. Where the queues (measured in PCU's) exceed PCU capacity then further delays will occur on preceding links. The table identifies the stacking capacity on the roundabout links and the maximum circulatory queue reported by LinSig.

Table J-15 Maximum Potential Queues from LinSig

	Stacking Capacity @ circulatory (pcu)	Preferred Package (circulatory queue) pcu	Junction Blocking Back
Fishbourne Rbt	7	38	√
Bognor Rbt	7	23	√

	Stacking Capacity @ circulatory (pcu)	Preferred Package (circulatory queue) pcu	Junction Blocking Back
Ford Rbt	6	10	√
Offington Rbt	7	29	√
Grove Lodge Rbt	12	26	√

The table shows that the biggest potential impacts on the results is at Fishbourne Roundabout, and that Bognor, Offington and Grove Lodge could also have blocking back issues.

The local model indicates there is potential for blocking back of queues through the roundabout junction. This could affect the preceding link. The worst case scenario is expected to be an additional 31 pcu's beyond the design stacking capacity.

Appendix K. Preferred Package Detailed Appraisal Summary Table

Table K-1 Assessment of the Options: Chichester

Criteria	Do Minimum Scenario	Chichester Preferred Package	
<p>Intervention objective: Improve journey times and journey time reliability for strategic (longer distance traffic) on the A27.....</p> <p><i>Average journey time taken from Saturn</i></p> <p><i>Average A27 speed taken from Saturn</i> See Appendices B and C for further information.</p>	Degree of junction saturation (% Flow / Capacity)		
	Fishbourne	130%	Ch.Fish.4b = 90% (Moderate beneficial)
	Stockbridge	129%	Ch.Stock.1b = 76% (Large beneficial)
	Whyke	130%	Ch. Why.1b = 68% (Large beneficial)
	Bognor Rd	123%	Ch.Bgr.4 = 71% (Large beneficial)
	Oving Rd	121%	Ch.Oving.1 = 49% (Large beneficial)
	Portfield	86%	Ch.Port.3a = 90% (Neutral)
	All Junctions (Journey Time)		All Junctions: Moderate beneficial
	WB = 29 mins; EB = 22 mins.		WB = 18 mins; EB = 18 mins.
	Average A27 speed		Large beneficial
38 km/hr		50 km/hr	
<p>Intervention objective: whilst ensuring the dual function of the A27 as a longer distance strategic route and a local access route is maintained <i>Based on delay by arm from from Arcady (DoMin) and Linsig and supporting evidence from Saturn plots.</i> See Appendix B for further information....</p>	Fishbourne (Delay by arm)		
	EB = 185s; WB = 37s; IB = 264s; OB = 5s Most significant delays: EB (though traffic) and IB (local).		EB = 19s; WB = 28s; IB =100 s; OB = 95s EB delay largely removed; Some adverse impact on outbound movements.
	Stockbridge (Delay by arm)		Ch.Stock.1b: Large beneficial
	EB = 292s; WB = 131s; IB = 16s; OB = 8s Most significant delays: EB and WB (through traffic).		EB = 23s; WB = 25s; IB = 24s; OB = 48s EB and WB delays largely removed with some adverse impact to outbound movements.
	Whyke (Delay by arm)		Ch. Why.1b: Moderate beneficial
	EB = 24s; WB = 46s; IB = 250s; OB = 91s Most significant delays: IB and OB (local traffic).		EB = 20s; WB = 20s; IB = 43s; OB = 41s All delays reduced to under a minute.
	Bognor Rd (Delay by arm)		Ch.Bgr.4: Moderate beneficial
	EB = 164s; WB = 15s; IB = 172s; OB = 6s Most significant delays: EB (though traffic) and IB (local).		EB = 16s; WB = 56s; IB = 61s; OB = 76s Large delays EB and IB are reduced. Some adverse impact on WB and OB but of only to around one minute.
	Oving Rd (Delay by arm)		Ch.Oving.1: Slight beneficial
	EB = 12s; WB = 12s; IB = 203s; OB = 394s Most significant delays: IB and OB (local traffic).		EB = 6s; WB = 5s; IB = 0s (left only) OB = 39s (left only)
Portfield (Delay by arm)		Ch.Port.3a: Neutral	
EB = 7s; WB = 7s; IB = 3s; (N Chi Bypass); OB = 4s (Portfield Way) Minimal delay on all arms.		EB =10 s; WB =5 s; IB = 1s; OB = 0s	

Criteria	Do Minimum Scenario	Chichester Preferred Package
<p>Intervention objectives: Improve access by private and public transport to key employment and regeneration areas within Coastal West Sussex, including Chichester, Worthing and key regeneration areas such as Bognor Regis and Littlehampton. Enable proposed housing, employment and retail growth to take place within Coastal West Sussex without undue congestion. <i>Based on overall network performance statistics from Saturn</i></p>	<p>N/A</p> <p>N/A</p> <p>Chichester A27 Corridor Statistics: Average Speed (km / h): 38 Vehicle Kilometres: 33,560 Total Delay (PCU Hours): 445 PCU-Hrs Delay per veh: 11 secs</p>	<p>Moderate Beneficial</p> <p>Public transport – Bus movements across at Fishbourne, Stockbridge, Whyke and Bognor Junctions have improved under proposed arrangements. Further bus priority considered unnecessary at these junctions. General access – Increase in journey speed on the A27, vehicle kilometres declines. Total delay on the A27 in Chichester reduces. Chichester A27 Corridor Statistics: Average Speed (km / h): 50 Vehicle Kilometres: 36,856 Total Delay: 292 PCU-Hrs; Delay per veh km: 7 secs</p>
<p>Intervention objective: Improve connectivity to/from the Manhood Peninsula (including Selsey and the Witterings).</p>	<p>N/A</p>	<p>Slight adverse</p> <p>Reduction in large inbound delays at Whyke and slight increase at Stockbridge. Flows decrease around the junctions on links to and from the Manhood Peninsula as a result of banned right turns.</p>
<p>Fit with wider transport and government objectives</p>	<p>N/A</p> <p>-</p>	<p>Large beneficial</p> <p>Improvements to the A27 and complementary public transport improvements at Chichester, Arundel and Worthing are identified as a high priority in the LTP3.</p>
<p>Impact on long term aspirations for the route</p>	<p>N/A</p> <p>-</p>	<p>Moderate beneficial</p> <p>Does not adversely affect longer term aspiration for flyovers at Fishbourne and Bognor Road junctions. Diversion of Vinnetrow Road onto Bognor Road is beneficial in terms of providing a flyover at Bognor Road junction in the longer-term.</p>
<p>Impact on other junctions - Any evidence of delays being moved from one junction to another, or to other parts of the corridor (e.g. Arundel or Worthing)?</p>	<p>N/A</p> <p>N/A</p>	<p>Slight adverse</p> <p>Turning restrictions at Stockbridge, Whyke and Oving will lead to traffic either routing to alternative junction or making u-turns Fishbourne / Bognor. No adverse impact identified in Worthing or Arundel.</p>
<p>Monetised estimate of journey time and operating cost benefits (From TUBA). Present Value of Benefits, 2010 prices discounted to 2010.</p>	<p>N/A</p>	<p>Large beneficial</p> <p>N/A – Overall cost benefit of 5.0 for all schemes. Proportion of cost in Chichester 53% Benefits from model outputs are estimated to be worth £308m over a 60 year period. WEI Study indicates further £31m-£62m worth of benefits over 60 years.</p>
<p>Qualitative assessment of housing</p>	<p>N/A</p>	<p>Slight Beneficial</p>

Criteria	Do Minimum Scenario	Chichester Preferred Package
development and wider economic impacts, based on existing evidence and professional judgement (where appropriate) (Source: CWS Employment and Infrastructure Strategy)	-	Employment: Bognor Road Junction improvements identified as essential for development at Old MOD site, Chichester. Bognor Road improvements desirable and improvements at Portfield / Oving likely to be essential to support development at Land at Barnfield Drive (500 plus retail jobs) and Old Tarmac Site. Housing: 100 units at Barratt Site, Donnington will increase pressure on Stockbridge Junction. Other sites identified that will increase pressure on A27 junctions and require upgrades are: Tangmere (500-1100 units), North East of City (1500 units), West of Chichester (500-1500 units) and Shopwhyke Lakes (600 units). DaSTS (2010) identified improvements at Fishbourne, Whyke and Oving Road as critical to housing delivery.
Carbon	N/A -	Slight Beneficial Overall delays reduced as percentage of journey time from 52% to 41%. Carbon Benefits = £0.8m for all schemes on A27.
Local environment – noise and air quality impacts: Change in vehicle km on A27 in Chichester used as a proxy for noise and air quality impacts.	N/A -	Slight Beneficial Change in vehicle km on A27: 10%, although total delay reduced so should be slight improvement in air quality and noise.
Local environment – natural environment, heritage and landscape and the urban environment	N/A -	Moderate adverse Slight adverse impact on historical heritage at Bognor Road junction: diversion of Vinnetrow Road could impact on archaeological site (cropmark rings). In addition, there is potential for unrecorded sites to be discovered, particularly Iron Age and Roman remains. Listed buildings may be visually impacted. Some loss of arable land.
Accident Impacts	N/A -	Moderate beneficial Ch.Fish.4b – benefits in separating traffic flows. (Slight beneficial) Ch.Stock.1b – benefits from banned right turns. (slight beneficial) Ch.Why.1b – benefits from banned right turns. (Slight beneficial) Ch.Bgr.4 – may have benefits for lane changing accidents. (slight beneficial) Ch.Oving.1 - if current accidents due to failure to conform accidents at traffic signals could reduce. (Moderate beneficial) Ch.Port.3a – depends upon whether pedestrians use footbridge. (slight beneficial)
Assessment of Impact on Severance	N/A -	Slight beneficial Ch.Fish.4b – Pedestrian crossing north-south through signals may cause delays to through traffic. (No change) Ch.Stock.1b – Jacobs proposed new footbridge. Advised not to introduce additional cycle/pedestrian crossing arrangements. (Slight beneficial) Ch.Why.1b – As above. (Slight beneficial)

Criteria	Do Minimum Scenario	Chichester Preferred Package
		<p>Ch.Bgr.4 – Existing A27 footbridge retained. (No change)</p> <p>Ch.Oving.1 - With restricted movements at junction opportunity to improve at grade pedestrian and cycle crossings. (Moderate beneficial)</p> <p>Ch.Port.3a – Improvements proposed for pedestrians (Slight beneficial).</p>
Social and Distributional Impacts	N/A	Slight beneficial
	-	<p>There are areas of income deprivation and older people identified around Stockbridge and Fishbourne Junctions.</p> <p>Generally reductions in delay will improve access and the economy. Slight Beneficial</p> <p>At Fishbourne residents would benefit from reduced congestion. Moderate Beneficial</p> <p>At Stockbridge residents would benefit from reduced delay on A27 but could be impacted by banned right turn, increase delay on local links and longer journeys. Neutral</p>
Affordability (Cost – 2012 prices including optimism bias, undiscounted)	N/A	Moderate adverse
<p><i>See notes below.</i></p> <p><i>Does not include land costs, preparation or supervision costs or project risks.</i></p>	-	<p>Ch.Fish.4 – £5.8 million</p> <p>Ch.Stock.1b – £5.6 million</p> <p>Ch.Why.1b – £5.3 million</p> <p>Ch.Bog.4 – £10.5 million</p> <p>Ch.Oving.1 – £0.2 million</p> <p>Ch.Port.3a – £4.2 million</p> <p>Total cost at feasibility design: £31.6m</p> <p>Costs for Oving and Portfield expected to be met by developers. Potential £10m from Chichester District Council from Developer Contributions.</p>
Public / Stakeholder Acceptability	N/A	Slight Beneficial
	-	<p><i>(Source: Chichester Area and A27 Transport Proposals Public Consultation Report, 2005)</i></p> <p>Public consultation: 93% of respondents said A27 junctions needed to be improved.</p> <p>Options in the scenarios considered:</p> <p>Ch.Stock.1 44% agreed, 41% disagreed – potential concern over banned movements</p> <p>Ch.Why.1 42% agreed, 40% disagreed – potential concern over banned movements</p> <p>Ch.Oving.1 45% agreed, 35% disagreed – potential concern over banned movements</p> <p>– potential concern over banned movements</p> <p>Ch.Port.3 – new lane W/B 70% agreed, 10% disagreed</p>

Criteria	Do Minimum Scenario	Chichester Preferred Package
Practical Feasibility	N/A	Moderate adverse - Potential for substantial issues.
	-	<p>Ch.Fish.4b – Some potential issues. Hamburger design within highway land; but dedicated left turns are outside highway boundary and may require stats diversions.</p> <p>Ch.Stock.1b - No significant issues. Changes appear to be within highway boundary.</p> <p>Ch.Why.1b - No significant issues. Changes appear to be within highway boundary.</p> <p>Ch.Bog.4 - Some potential issues. Roundabout to be realigned and slip roads outside of highway boundary. Vinnetrov Rd diversion requires land-take.</p> <p>Ch.Oving.1 - No significant issues. Changes appear to be within highway boundary.</p> <p>Ch.Port.3a - No significant issues. Changes appear to be within highway boundary.</p> <p>All schemes considered deliverable within the short term, with implementation planned from 2015.</p> <p>Some improvements (Portfield and Oving) dependent on development.</p> <p>Notable risks on this project:</p> <p>Implementation in short term requiring effective management approach</p> <p>Funding likely to be straightforward with risk in planning and agreeing financing loans.</p>

Scale:

Green	Light Green	Green Accent 1 Lighter 40%	Yellow Accent 3 lighter 80%	Light Orange	Orange	Red
Large beneficial	Moderate beneficial	Slight beneficial	Neutral	Slight adverse	Moderate adverse	Large adverse

Notes on cost estimates:

1. Construction costs based on Spons rates for area of pavement adjusted for inflation for 2012.
2. Statutory undertakes costs based on 20% construction costs at this stage.
3. Land costs not included as assumed owned by WSCC.
4. 9% Preparation & 12% Supervision costs included.
5. 20% Project risk costs included.
6. All options have a 45% optimism bias.

Table K-2 Assessment of the Options: Arundel

Criteria	Do Minimum	Arundel Preferred Package	
<p>Intervention objective: Improve journey times and journey time reliability for strategic (longer distance traffic) on the A27.....</p> <p><i>Average journey time taken from Saturn</i></p> <p><i>Average A27 speed taken from Saturn</i> <i>See Appendices B and C for further information.</i></p>	Degree of junction saturation (% Flow / Capacity)		
	Crossbush	141%	Ar.CB.8 = 91% (Moderate beneficial)
	Causeway	190%	Ar.Caus.2 = 81% (Large beneficial)
	Ford	143%	Ar.Ford.2 = 78% (Large beneficial)
	All Junctions (Journey Time)		All Junctions: Neutral
	WB =22 min; EB = 16 min.		WB = 25 min; EB = 14 min.
<p>Intervention objective: whilst ensuring the dual function of the A27 as a longer distance strategic route and a local access route is maintained</p> <p><i>Based on delay by arm from from Arcady (DoMin) and Linsig, and supporting evidence from Saturn plots.</i> <i>See Appendix C for further information....</i></p>	Crossbush (Delay by arm)		
	EB = 12s; WB = 344s; IB= 13s OB = 25s Most significant delays: WB (through traffic).		Ar.CB.8: Large beneficial EB = 7s; WB = 27s; IB = 67s OB = 1s WB delay largely removed; slight adverse effects on IB traffic with around a minute delay.
	Casueway (Delay by arm)		Ar.Caus.2 Moderate beneficial
	EB = 22s; WB = 945s; OB = 22s Most significant delays are to WB traffic.		EB = 40s; WB = 27s; OB = 36s WB delay mostly removed. Minor increase in EB and OB delay.
	Ford (Delay by arm)		Ar.Ford.2: Moderate beneficial
	EB = 406s; WB = 458s; IB = 40s; OB = 37s Most significant delays: EB and WB (through traffic).		EB =11 s; WB =16 s; IB = 66s; OB = 88s Significant reduction in delays for through traffic. Slight adverse impact on IB and OB (local traffic)
<p>Intervention objectives: Improve access by private and public transport to key employment and regeneration areas within Coastal West Sussex, including Chichester, Worthing and key regeneration areas such as Bognor Regis and Littlehampton. Enable proposed housing, employment and retail growth to take place within Coastal West Sussex without undue congestion. <i>Based on overall network performance statistics from Saturn</i></p>	N/A		
	<p>N/A</p> <p>Arundel A27 Corridor Statistics: Average Speed (km / h): 17 km/hr Vehicle Kilometres: 11,656 Total Delay (PCU Hours): 476 PCU hrs Delay per vehicle km: 12 secs</p>		<p>Neutral</p> <p>Public transport – Bus access could be affected by slight adverse impacts of local inbound and outbound traffic but would benefit where interacting with strategic movements at junctions. General access – No change in overall journey speed on the A27 with slight increase in total delay on the A27 across Arundel due to interaction within model with side road between Crossbush and Chichester. Arundel A27 Corridor Statistics: Average Speed (km / h): 16 km/hr Vehicle Kilometres: 12,869 Total Delay (PCU Hours): 563 PCU hrs Delay per vehicle km: 14 secs</p>

Criteria	Do Minimum	Arundel Preferred Package
Intervention objective: Improve connectivity to/from the Manhood Peninsula (including Selsey and the Witterings).	N/A	N/A
Fit with wider transport and government objectives	N/A	Large beneficial
	-	Improvements to the A27 and complementary public transport improvements at Chichester, Arundel and Worthing are identified as a high priority in the LTP3.
Impact on long term aspirations for the route	N/A	Moderate beneficial
	-	Does not adversely affect longer term aspiration for Arundel Bypass. Some improvements at Crossbush would be demolished to build eastern end of a potential bypass
Impact on other junctions - Any evidence of delays being moved from one junction to another, or to other parts of the corridor (e.g. Arundel or Worthing)?	N/A	Neutral
	N/A	No adverse impact on Chichester or Worthing identified. SATURN identifies increase in west bound flow between Causeway and Crossbush causing delay on single lane section and impacts on side road junction at Crossbush Lane. Situation at junctions improved overall though. Also potentially some increase in flows along London Road in Arundel as traffic tries to avoid Ford junction.
Monetised estimate of journey time and operating cost benefits (From TUBA). Present Value of Benefits, 2010 prices discounted to 2010.	N/A	Large beneficial
		Overall cost benefit of 5.0 for all schemes. Proportion of cost in Arundel 26%. Benefits from model outputs are estimated to be worth £308m over a 60 year period. WEI Study indicates further £31m-£62m worth of benefits over 60 years.
Qualitative assessment of housing development and wider economic impacts, based on existing evidence and professional judgement (where appropriate) (Source: CWS Employment and Infrastructure Strategy)	N/A	Slight Beneficial
	-	Employment: Improvements at Crossbush junction would improve access to St Martins Littlehampton (50 jobs) and Wick Site (500 jobs) and are therefore desirable. It may also increase interest in the development at West Bank of River Arun (400 jobs). Housing: 1,000 units identified at West Bank of River Arun delivered after 2015 may require completion of Lyminster Bypass / Crossbush improvement Improvements to Ford Junction (bid for Pinchpoint funding) supports several development sites, anticipated to create 10,400 jobs, and several residential developments, anticipated to create 8,400 homes by 2020. To start 2013 and end 2015. (source: HA website – note consistency with above) Crossbush: Proposals for 2000 new homes at Littlehampton have recently been approved, along with plans to upgrade the A284. This will result in more traffic coming up from the South Coast, some of which will wish to turn right. This will exacerbate the above problem. (source: Crossbush Junction Study)
Carbon	N/A	Neutral

Criteria	Do Minimum	Arundel Preferred Package
	-	Overall delays little change as percentage of journey time from 55% to 52%. Carbon Benefits = £0.8m for all schemes on A27.
Local environment – noise and air quality impacts: Change in vehicle km on A27 in Arundel used as a proxy for noise and air quality impacts.	N/A	Slight Adverse
	-	Change in vehicle km on A27: 10%, No significant change in overall travel time delays.
Local environment – natural environment, heritage and landscape and the urban environment (See Appendix D for further information)	N/A	Neutral
	-	Schemes involve minimal changes to the footprint of the junctions concerned, and minimal loss of habitat. All options are at-grade and have minimal impact on landscape / townscape.
Accident Impacts	N/A	Neutral
	-	A4.CB.8 – +1 potentially +2 depending upon location of nose-to-tail collisions. (Slight beneficial). Ar.Caus.2 – could create nose-to-tail collisions (Slight adverse). Ar.Ford.2 – roundabout has relatively good safety record – hamburger could add conflicts (Slight adverse).
Assessment of Impact on Severance	N/A	Neutral
	-	A4.CB.8 – Pedestrian movements considered. Ar.Caus.2 – Pedestrian crossing to be relocated within the signalised junction or closer to the railway station. Ar.Ford.2 – Signalisation provides opportunity to improve facilities for pedestrians and cyclists, but potentially to a lesser extent than Scenario 2 due to more complex arrangement.
Social and Distributional Impacts	N/A	Moderate Beneficial
	-	There are areas of income deprivation and older people identified around the Ford junction area Generally reductions in delay will improve access and the economy. Moderate Beneficial Ford – Moderate Beneficial
Affordability (Cost – 2012 prices including optimism bias, undiscounted) See notes below.	N/A	Moderate cost
	-	A4.CB.8 – £5.94 million. Ar.Caus.2 - £2.79 million. Ar.Ford.2 - £3.00 million. Estimated Cost at Feasibility Stage = £11.7m
Public / Stakeholder Acceptability	N/A	Moderate beneficial
	-	Anticipated that none of the options would attract significant opposition from the public / stakeholders. A4.CB.8 potentially more popular than other options for Crossbush, as improvement is more tangible / visible.

Criteria	Do Minimum	Arundel Preferred Package
Practical Feasibility	N/A	Slight adverse – Some potential issues
	-	<p>A4.CB.8 – Some potential issues with vertical alignments, utilities and landtake.</p> <p>Ar.Caus.2 – No significant issues. Changes assumed to be within highway boundary.</p> <p>Ar.Ford.2 – No significant issues. Changes assumed to be within highway boundary.</p> <p>All schemes considered deliverable within the short term, with implementation planned from 2015.</p> <p>Notable risks on this project: Implementation in short term requiring effective management approach Funding likely to be straightforward with risk in planning and agreeing financing loans.</p>

Scale:

Green	Light Green	Green Accent 1 Lighter 40%	Yellow Accent 3 lighter 80%	Light Orange	Orange	Red
Large beneficial	Moderate beneficial	Slight beneficial	Neutral	Slight adverse	Moderate adverse	Large adverse

Notes on cost estimates:

1. Construction costs based on Spons rates for area of pavement adjusted for inflation for 2012.
2. Statutory undertakes costs based on 20% construction costs at this stage.
3. Land costs not included as assumed owned by WSCC, other than at Crossbush where assumed estimate included.
4. 9% Preparation & 12% Supervision costs included.
5. 20% Project risk costs included.
6. All options have a 45% optimism bias.

Table K-3 Assessment of the Options: Worthing

Criteria	Do Minimum	Worthing Preferred Package	
<p>Intervention objective: Improve journey times and journey time reliability for strategic (longer distance traffic) on the A27.....</p> <p><i>Average journey time taken from Saturn</i></p> <p><i>Average A27 speed taken from Saturn</i> <i>See Appendices B and C for further information.</i></p>	Degree of junction saturation (% Flow / Capacity)		
	Offington	137%	Wo.Off.3 = 89% (Slight beneficial)
	Grove Lodge	145%	Wo.Gro.3 = 95% (Slight beneficial)
	Lyons Farm / Sompting Road	98%	Wo.LFSR.3 = 89% (Slight beneficial)
	Busticle Lane	115%	Wo.BL.1 = 67% (Large beneficial)
	North Lancing Roundabout	122%	Wo.NL.2 = 90% (Slight beneficial)
	All Junctions (Journey Time)		All Junctions: Moderate beneficial
	WB = 39 min; EB = 47min.		WB = 29 min; EB = 29 min.
	Average A27 speed		Large beneficial
	24 km/hr		44 km/hr
<p>Intervention objective: whilst ensuring the dual function of the A27 as a longer distance strategic route and a local access route is maintained</p> <p><i>Based on delay by arm from from Arcady (DoMin) and Linsig (Scen 1-3), and supporting evidence from Saturn plots.</i> <i>See Appendix C for further information....</i></p>	Offington (Delay by arm)		
	EB = 16s; WB = 42s; NB = 312s; SB = 314s Most significant delays for local traffic.		EB = 34s; WB = 43s; NB = 57s; SB = 74s Minor increases for strategic traffic with significant improvements on the North and South bound movements.
	Grove Lodge (Delay by arm)		Wo.Gro.3: Moderate beneficial
	EB = 43s; WB = 368s; NB = 150s; SB = 38s Most significant delays: WB (through traffic).and NB (local traffic).		EB = 38s; WB = 34s; NB = 81s; SB=183s WB delay mostly removed, NB reduced, SB increases, partly as a result of incorporating additional pedestrian crossing movements.
	Lyons Farm / Sompting Road (Delay by arm)		Wo.LFSR.3: Moderate beneficial
	EB = 50s; WB = 449s; NB = 18s; SB = 0s Most significant delays: WB (through traffic) and some delays to EB traffic.		EB = 28s; WB = 29s; NB = 55s; SB = 1s WB (through traffic) delays largely removed, additional delay to NB (local) traffic.
	Busticle Lane (Delay by arm)		Wo.BL.1: Moderate beneficial
	EB = 226s; WB = 156s; NB = 35s; SB = 50s Most significant delays: EB and WB (through traffic), with some delays SB (local traffic)		EB =4 s; WB = 20s; NB =42 s; SB = 63s Significant reduction in delays EB and WB (through traffic), slight increase in delay for NB and SB (local) traffic

Criteria	Do Minimum	Worthing Preferred Package
	North Lancing (Delay by arm)	Wo.NL.2: Moderate beneficial
	EB = 201s; WB = 5s; NB = 28s; SB = 7s Most significant delays WB (through traffic) with some delay NB (local traffic)	EB = 17s; WB = 11s; NB = 36s; SB = 27s Significant reduction in delays WB (through traffic) with a slight increase in delay both NB and SB (local traffic)
Intervention objectives: Improve access by private and public transport to key employment and regeneration areas within Coastal West Sussex, including Chichester, Worthing and key regeneration areas such as Bognor Regis and Littlehampton. Enable proposed housing, employment and retail growth to take place within Coastal West Sussex without undue congestion. <i>Based on overall network performance statistics from Saturn</i>	N/A N/A Worthing A27 Corridor Statistics: Average Speed (km / h): 24 km/hr Vehicle Kilometres: 35,809 Total Delay (PCU Hours): 964 PCU hrs Delay per vehicle: 24 secs	Large beneficial Public transport – Potential provision of improved pedestrian access to rail station. General access – Increase in journey speed on the A27 and vehicle kilometres. Total delay and delay per vehicle reduces on the A27 in Worthing. Worthing A27 Corridor Statistics: Average Speed (km / h): 44 km/hr Vehicle Kilometres: 48,905 Total Delay (PCU Hours): 410 PCU hrs Delay per vehicle: 10 secs
Intervention objective: Improve connectivity to/from the Manhood Peninsula (including Selsey and the Witterings).	N/A	N/A
Fit with wider transport and government objectives	N/A -	Large beneficial Improvements to the A27 and complementary public transport improvements at Chichester, Arundel and Worthing are identified as a high priority in the LTP3.
Impact on long term aspirations for the route	N/A -	Neutral No impact on long term aspirations for route
Impact on other junctions - Any evidence of delays being moved from one junction to another, or to other parts of the corridor (e.g. Arundel or Chichester)?	N/A N/A	Neutral Hadley Avenue and Downlands Avenue to be closed at junction with A27 for safety reasons. Need to consider turning or access arrangements in more detail. Goodwood Road proposed to be closed at Offington. No adverse impacts identified in Arundel or Chichester. No adverse impacts identified on other junctions in Worthing.
Monetised estimate of journey time and operating cost benefits (From TUBA). Present Value of Benefits, 2010 prices discounted to 2010.	N/A	Large Beneficial Overall cost benefit of 5.6 for all schemes. Proportion of cost in Worthing 21% Benefits from model outputs are estimated to be worth £308m over a 60 year period. WEI Study indicates further £31m-£62m worth of benefits over 60 years.

<p>Qualitative assessment of housing development and wider economic impacts, based on existing evidence and professional judgement (where appropriate)</p> <p>(Source: CWS Employment and Infrastructure Strategy)</p>	<p>N/A</p> <p>-</p>	<p>Slight Beneficial</p> <p>Employment: Site at Teville Gate (500 plus jobs), pressure on Grove Lodge Roundabout identified as an obstacle to delivery.</p> <p>Housing: 1,000 units at Teville Gate / Durrington will increase pressure on A27 junctions in Worthing.</p> <p>North Lancing: Improved access to Shoreham Airport essential. Improved access to Shoreham Harbour Regeneration and Shoreham Cement Works desirable. (CWS DaSTS Study Report)</p>
<p>Carbon</p>	<p>N/A</p> <p>-</p>	<p>Moderate Beneficial</p> <p>Overall delays reduced as percentage of journey time from 55% to 32%. Carbon Benefits = £0.8m for all schemes on A27.</p>
<p>Local environment – noise and air quality impacts: Change in vehicle km on A27 in Arundel used as a proxy for noise and air quality impacts.</p>	<p>N/A</p> <p>-</p>	<p>Slight Beneficial</p> <p>Change in vehicle km on A27: 37% although total delay reduced so should be slight improvement in air quality and noise.</p>
<p>Local environment – natural environment, heritage and landscape and the urban environment</p> <p>(See Appendix D for further information)</p>	<p>N/A</p> <p>-</p>	<p>Slight adverse</p> <p>Some loss of established trees associated with conversion of Grove Lodge Roundabout to a Hamburger Junction.</p>
<p>Accident Impacts</p>	<p>N/A</p> <p>-</p>	<p>Slight beneficial</p> <p>Wo.Off.3 – small roundabout to make a ‘Hamburger’; benefits less arms on roundabout (Neutral).</p> <p>Wo.Gro.3 – relatively good safety record at present. Hamburger roundabout could add more conflict points (slight adverse)</p> <p>Wo.LTSR.3 – may reduce nose-to-tail collisions (moderate beneficial)</p> <p>Wo.BL.1 – right-turns main problem unlikely to be reduced (slight adverse)</p> <p>Wo.NL.2 – may benefit failure to give way and nose-to-tail accidents. (Moderate beneficial)</p>
<p>Assessment of Impact on Severance</p>	<p>N/A</p> <p>-</p>	<p>Moderate beneficial</p> <p>Wo.Off.3 – Will combine at grade crossings with design.</p> <p>Wo.Gro.3 – Will incorporate crossing arrangements in line with new proposals where possible.</p> <p>Wo.LTSR.3 – No change.</p> <p>Wo.BL.1 – No change.</p> <p>Wo.NL.2 – Possible to provide at-grade footway crossing at signals.</p>
<p>Social and Distributional Impacts</p>	<p>N/A</p> <p>-</p>	<p>Moderate Beneficial</p> <p>There are areas of income deprivation identified around the whole section of the A27 in Worthing</p> <p>Generally reductions in delay will improve access and the economy. Moderate Beneficial</p>

Affordability (Cost – 2012 prices including optimism bias, undiscounted) <i>See notes below.</i>	N/A	Slight adverse
	-	Wo.Off.6 – £2.79 million Wo.Gro.3 – £3.50 million Wo.LTSR.3 – £0.56 million Wo.BL.1 – £0.12 million Wo.NL.2 – £2.59 million Maximum cost = £9.6m
Public / Stakeholder Acceptability	N/A	Moderate beneficial
	-	Anticipated that none of the options would attract significant opposition from the public / stakeholders.
Practical Feasibility	N/A	Slight adverse - Some potential issues.
	-	Wo.Off.3 – Some potential issues. Dedicated left turns outside highway boundary. May require stats diversions. Hamburger within highway land. Wo.Gro.3 – Some potential issues. Exit left turns widening required. Hamburger within highway land. Possible stats diversions. Wo.LTSR.3 – No significant issues. Changes within highway boundary. Wo.BL.1 – No significant issues. Wo.NL.2 – Some potential issues. Flares possibly outside highway land. Possible stats diversions. All schemes considered deliverable within the short term, with implementation planned from 2015. Notable risks on this project: Implementation in short term requiring effective management approach Funding likely to be straightforward with risk in planning and agreeing financing loans..

Scale:

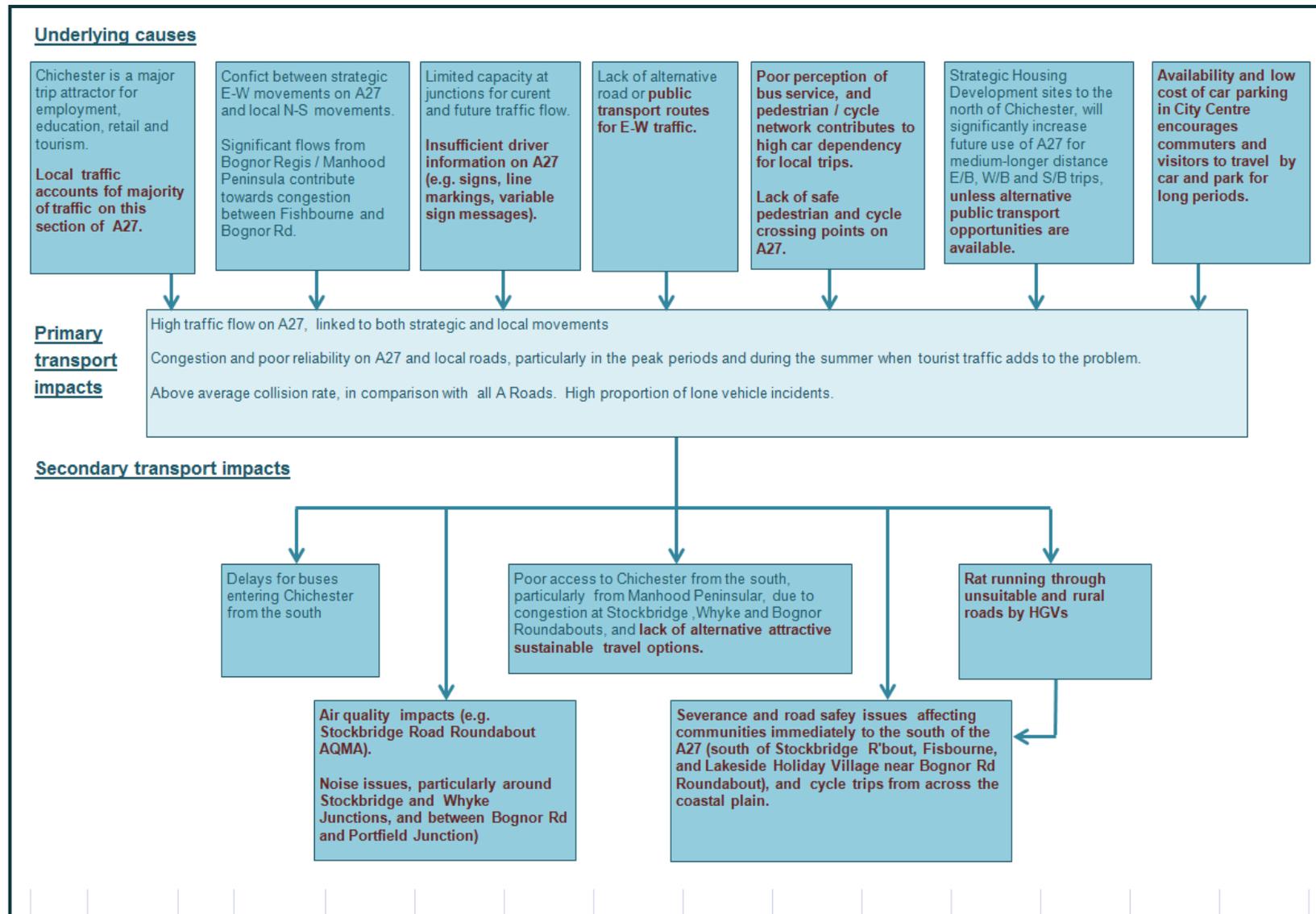
Green	Light Green	Green Accent 1 Lighter 40%	Yellow Accent 3 lighter 80%	Light Orange	Orange	Red
Large beneficial	Moderate beneficial	Slight beneficial	Neutral	Slight adverse	Moderate adverse	Large adverse

Notes on cost estimates:

1. Construction costs based on Spons rates for area of pavement adjusted for inflation for 2012.
2. Statutory undertakes costs based on 20% construction costs at this stage.
3. Land costs not included as assumed owned by WSCC.
4. 9% Preparation & 12% Supervision costs included.
5. 20% Project risk costs included.
6. All options have a 45% optimism bias.

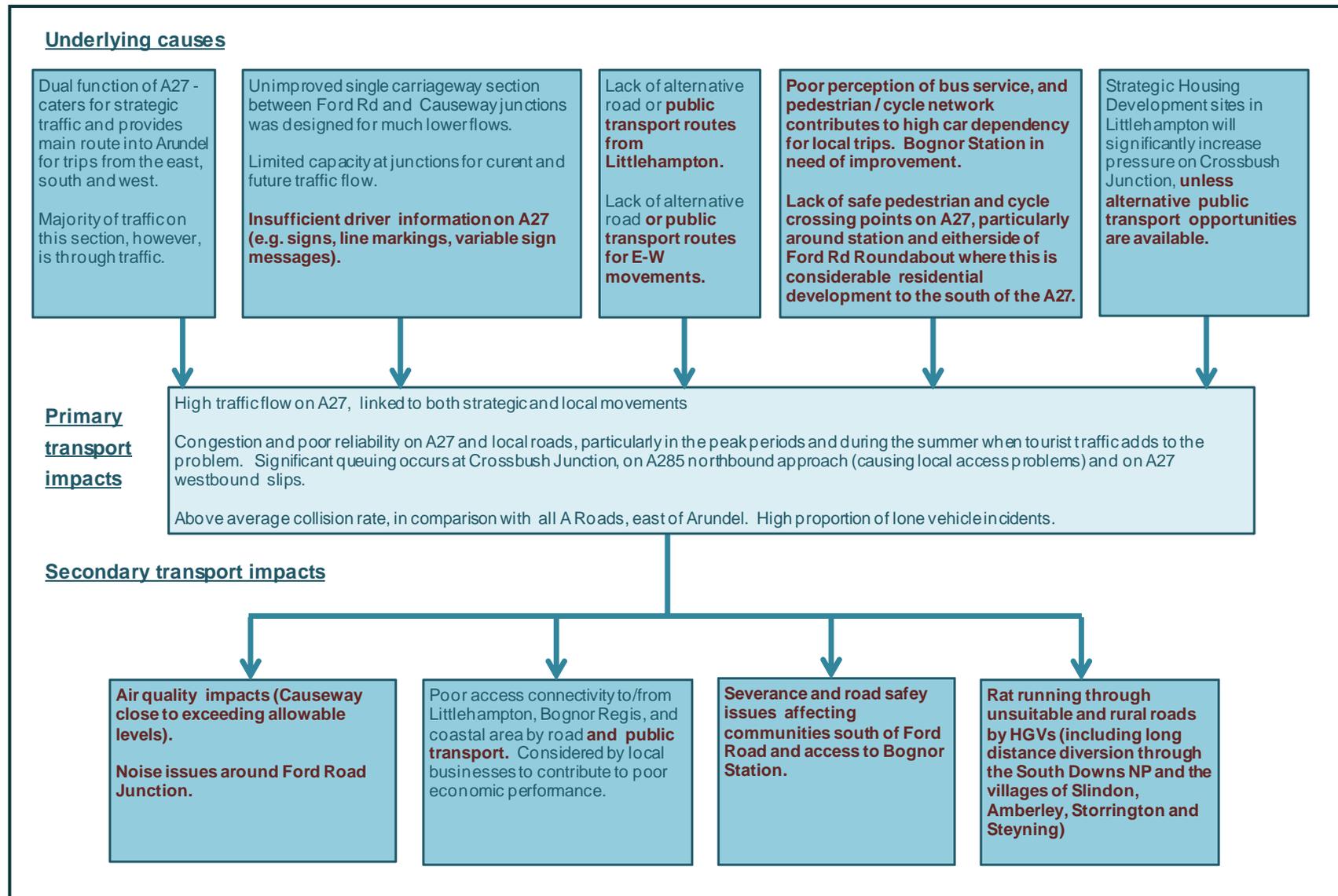
Appendix L. Role of Complementary Measures

Figure L-1 Chichester – Role of complementary measures in addressing challenges, opportunities and underlying causes



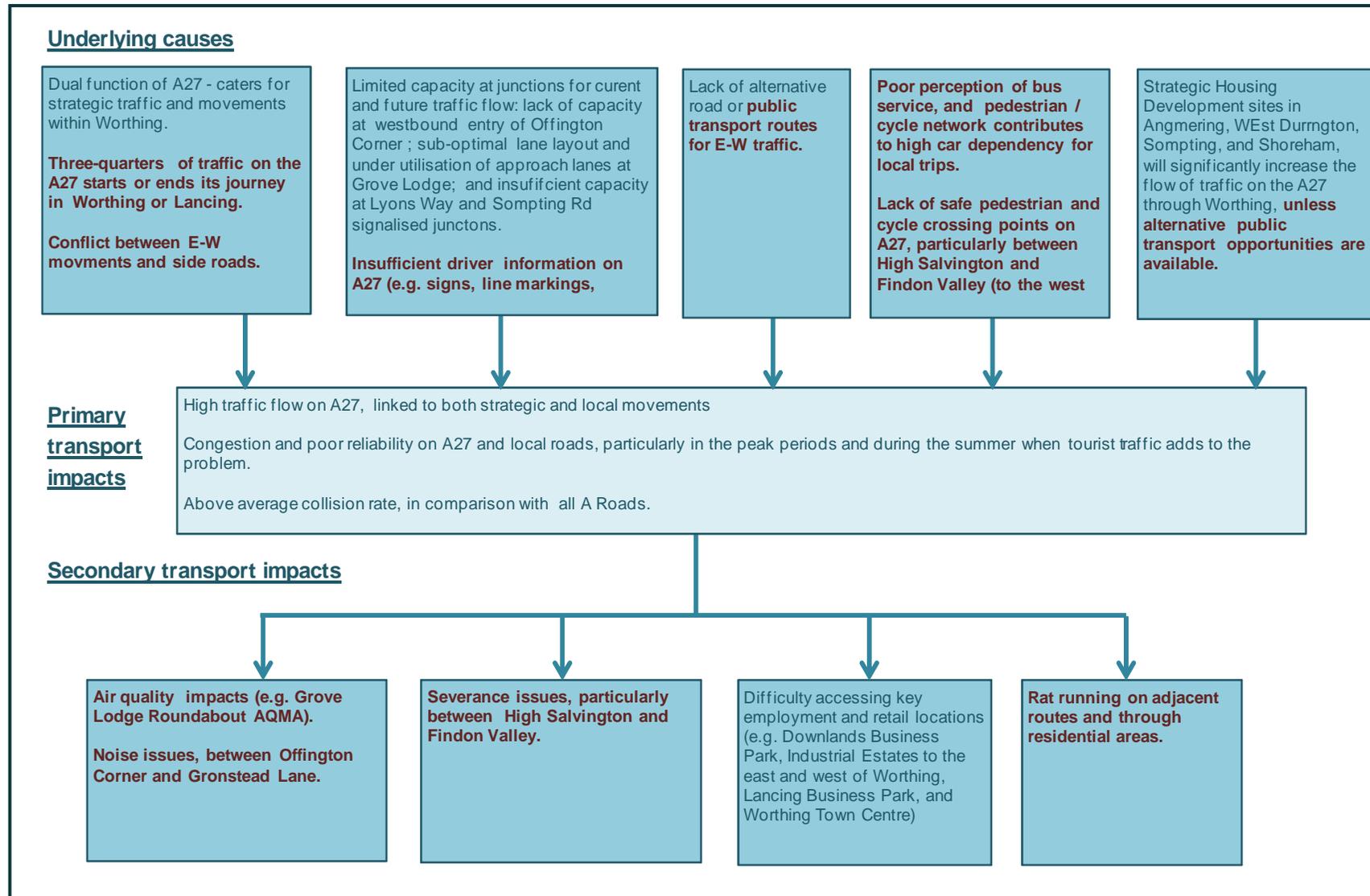
Issues to be addressed by complementary measures are highlighted in red.

Figure L-2 Arundel – Role of complementary measures in addressing challenges, opportunities and underlying causes



Issues to be addressed by complementary measures are highlighted in red.

Figure L-3 Worthing – Role of complementary measures in addressing challenges, opportunities and underlying causes



Issues to be addressed by complementary measures are highlighted in red.

Appendix M. Wider Economic Impact Study

July 2013

A27 Economic Impact Study Report

Leo Eyles

Albion Economics

Chapter 1 Introduction

Economic Impact Task

Atkins is assisting West Sussex County Council to model and appraise a number of on-line highway improvements for the A27 trunk road which runs east-west through the County. The following junctions have been examined and outline schemes developed for costing, modelling and appraisal:

Chichester

- Fishbourne junction (A27/A259)
- Stockbridge junction (A27/A286)
- Whyke junction (A27/B2145)
- Bognor Road junction (A27/A259)
- Oving Road junction (A27/B2144)
- Portfield junction (A27/A285)

Arundel

- Ford Road junction (A27/A284)
- Causeway junction (A27/Queens St)
- Crossbush junction (A27/A284)

Worthing/Lancing

- Offington Corner (A27/A24)
- Grove Lodge (A27/A24)
- Lyons Farm (W & E)
- Busticle Lane
- Grinstead Lane (A27/A2025)

As part of developing the broader case for the schemes, the County wish to be appraised of the potential wider economic impacts that the A27 scheme investments could unlock. This paper sets out an approach to this task at a strategic level.

Approach

A fully robust quantified approach would require a Land Use Interaction Model (LUTI) and this is highlighted in DfT guidance on Regeneration Reports [WebTAG 3.5.8](#). However, it is understood that a high-level analysis is required at this stage. Therefore a pragmatic approach has been employed which addresses the same principles as WebTAG analysis, as follows:

Development Opportunities

The hypothesis tested is that where accessibility can be improved, in the form of reduced congestion and/or additional capacity, this would permit additional development to come forward, or come forward more quickly. This is set out in Chapter 2.

GVA Impacts

Chapter 3 contains an analysis of GVA impacts over time which could result from construction of the preferred package of A27 junction improvements.

Chapter 2 Development Opportunities

Introduction

A consideration of development opportunities in the vicinity of the A27 is set out in this Chapter. The hypothesis tested is that where accessibility can be improved, in the form of reduced congestion and/or additional capacity, this would permit additional development to come forward, or come forward more quickly. In particular, the work considers the evidence for:

- Additional employment opportunities
- Evidence that existing jobs may be safeguarded
- Additional housing units

Worthing/Lancing

The tranche of junctions under consideration here lies within the boundaries of Adur District Council (Grinstead Lane, North Lancing and Busticle Lane, Sompting) or Worthing Borough Council (Lyons farm, Grove Lodge and Offington Corner). Worthing and Adur have an agreement to collaborate and share resources but their statutory planning powers remain independent.

Discussions were held with planning officers at Worthing/Adur to understand development plans and their relationship with the A27. A review of current planning documents has also informed this analysis.

The Worthing Core Strategy¹ identifies the role the A27 plays within the Borough:

“...like most urban environments, the town is characterised by areas of heavy road congestion, especially during the morning and evening peaks. This is especially prevalent around the northern edge of the town, where the A27 provides Worthing's only long distance through route.” (p 17).

“Furthermore, congestion and unreliable journey times have a negative impact on air quality and hinders inward investment and growth.” (p 28).

The Strategic Objectives identified for Worthing within the Core Framework include:

- Delivering a Sustainable Economy, including outcomes:
 - Economic development in the borough will contribute towards meeting the regional jobs growth targets
- Meet Worthing's Housing Needs, including outcomes:
 - delivering 4,000 additional dwellings by 2026 (net);
 - securing a high quality strategic development (West Durrington) and supporting infrastructure;
- Improve Accessibility, including outcomes:
 - levels of accessibility and connectivity within the borough and to other regions are improved
 - investment in transport infrastructure assists in the delivery of regeneration aims

¹ Worthing Adopted Core Strategy. April 2011.

As highlighted by the Core Strategy and confirmed by planning officers, the major development opportunity in Worthing is at **West Durrington**. This would abut the A27 but would not have a direct access on to the Trunk Road. As a more sustainable solution, the internal road network would feed towards the town centre and towards public transport such as Goring station, approximately 2km away. Nevertheless, traffic looking to travel beyond the town will require use of the A27. Traffic travelling west or north would use Titmore Lane to access the A27/A280 junction, which currently operates under capacity and is not subject to review in this A27 work. Eastbound, however, traffic would load to the Offington Corner (A27/A24) or Grove Lodge (A27/A24) junction.

West Durrington is planned to secure an additional 700 housing units, with potential for a further 375 units as part of a potential future development area (PFDA).

Worthing College is in the process of relocating (September 2013 opening) to **The Warren at Hill Barn Lane** on the site recently vacated by Aviva insurance company. This has an access directly on to the A27 at the Grove Lodge roundabout. Worthing College has 200+ jobs, but this replaces a peak of 1,200 jobs on this site when Aviva (and formerly Norwich Union) was here prior to 2009. Discussions with Economic Development officers at Worthing has highlighted that egress issues were problematic from the site for Aviva, but that rationalisation of posts in Norfolk was the main motivation for relocation.

Decoy Farm is a former landfill site and current civic amenity (waste) site with a total size of 7.7 hectares. It is cited as an Area of Change in the Core Strategy². New development on the site could add to the overall supply of small industrial units as well as other employment sectors such as vehicular storage, larger warehousing, open storage and general industrial. Redevelopment opportunities could include the relocation of the existing bus depot at Marine Parade. There is evidence that there is unmet demand for larger, high quality freehold B2 units³.

In an effort to improve access to the eastern industrial estates and Decoy Farm, consideration has previously been given to the construction of an East Worthing Access Road (EWAR). However, on cost and environmental grounds, this has not been progressed and there is no expectation that this can be delivered in the short to medium term. Traffic seeking access to the trunk road network would have to use the very busy Lyons Farm junction of the A27.

There are other important constraints to development at Decoy Farm, including contamination and flooding risk. Improvements to the Lyons Farm junction might be classified as a necessary but not sufficient condition for new development and jobs.

In **Adur**, the (draft) Adur Local Plan (2012)⁴ identifies a number of relevant Key Issues, including:

- The need to facilitate the regeneration of Adur
- The need to improve infrastructure
- The need to meet identified housing needs

² Op Cit p 70.

³ Ibid.

⁴ Draft Adur Local Plan 2012, Adur District Council

- The need to address road congestion and related pollution – air and noise - whilst improving the existing transport network

New Monks Farm is identified in the Plan as the largest green field opportunity for new housing, with an allocation of between 450 and 600 units and up to 10,000 square metres of appropriate employment generating uses. This is situated south of and abutting the A27 between the Sussex Pad and Grinstead Lane junctions. The development would require a new A27 junction to facilitate the full scale of development, although it would also ‘face’ west in access terms. Traffic seeking access to the trunk road network westwards would need to pass through the Grinstead Lane junction at North Lancing.

Development at the **Sompting Fringe** is identified as having capacity to cater for between 250 and 420 housing units. This represents part of the local green gap between Adur and Worthing. *“Traffic from this site will have to pass through the congested North Lancing roundabout to travel east on the A27⁵.”* The nearest junction, however, is at Busticle Lane.

The site adjacent to and abutting the A27 at **Sompting North**, just west of Busticle Lane, is also identified as having capacity for 210 housing units. The Highways Agency will not support an additional access onto the A27 from this site and it can be surmised that access to the trunk road network would need to be via the congested Busticle Lane junction.

Arun

The three Arundel junctions under review all lie within Arun District. The Draft Arun Local Plan was published in April 2013⁶. Arun’s Economic Strategy includes:

- Encourage the level and rate of new investment, particularly in high growth sectors – focusing on new enterprises and inward investment;
- Maintain and improve the area’s infrastructure, facilities and physical environment;
- Maintain and improve transport networks across the District and wider area⁷.

“...economic growth and employment sites planned for Bognor Regis and Littlehampton will also need to be supported by good north-south linkages which will improve the District's connectivity to the A27⁸.”

Littlehampton has secured planning consent for the development of housing, employment and other land at Courtwick and North Littlehampton. The employment land provision is essential to address the objectives of employment and enterprise growth in Arun. The Strategic Allocations here total 3 Ha of employment land, 1,260 houses at North Littlehampton and a further 500 at Courtwick. Each of these will need to access the trunk road network at the Crossbush junction of the A27. However,

⁵ Op cit pp 54-55.

⁶ Local Plan (Summer 2013) Publication version of the Local Plan replacing all previous versions. Arun District Council. April 2013.

⁷ Op cit p71

⁸ Op cit p 215

since these developments have secured planning permission it is not possible to state categorically that they rely on the proposed Crossbush improvements.

Other strategic development proposals in Arun do not impact directly on the A27 junctions under review, although they will articulate the location of expected traffic growth inherent within the traffic modelling work undertaken by Atkins.

Chichester

Discussions were held with planning officers at Chichester District Council to understand development plans and their relationship with the A27. A review of studies and current planning documents has also informed this analysis.

Detailed work reported in March 2013⁹ to understand the relationship between Local Plan development proposals and the requirements to enhance capacity. This work identifies four key strategic housing development sites:

At **Tangmere**, development of between 800 and 1,600 new homes is envisaged adjacent to the A27 at the junction with the A285, east of Chichester. This is not one of the junctions under consideration, but traffic travelling west would impose additional pressure upon the Chichester bypass junctions under review.

At **Westhampnett**, on the north eastern edge of Chichester, there is a strategic allocation of between 500 and 1,400 houses. Traffic from here would access the trunk road network at the Portfield (Sainsbury's) junction on the eastern edge of the Chichester bypass.

Land **West of Chichester** has an allocation of between 500 and 1,600 units. The first phase (500) would be to the north of the plot. The access point to the A27 would be at the Fishbourne Junction via Cathedral Way.

Additionally, a strategic allocation at **Shopwyke** for 600 homes is proceeding with a planning application having been lodged. The site is located abutting the A27 either side of the Portfield junction, with access perhaps also being via the Oving Road traffic light junction.

This work has involved the Highways Agency and so has a degree of consensus status. *"The Highways Agency has been part of the consultation process and has been involved in agreeing scenarios for the Local Plan transport assessment. This has included use of the Chichester Area Transport Model (CATM) to examine 2031 scenarios with and without the Local Plan allocations.... The CATM model results have indicated that further junction capacity along the A27 will be required in order to mitigate the impacts of the development scenarios."*¹⁰

It is anticipated that commercial and community development will come forward alongside each of the strategic housing sites, although the scale and nature of this is still to be finalised within the Chichester Local Plan. In order to provide a broad estimate of the employment potential that would

⁹ Chichester District Council – Local Plan Transport Study of Strategic Development Options and sustainable Transport Measures FINAL REPORT. Jacobs. March 2013

¹⁰ Highways Agency Position Statement on the Chichester Local Plan. Highways Agency. March 2013.

be associated with this development, an approach largely consistent with Jacobs' recent analysis¹¹ has been adopted. The key assumption is that each strategic site will include new employment floorspace to be developed at a ratio of 20 sq.m per dwelling (i.e. 1,000 dwellings would be accompanied by 20,000 sq.m employment floorspace).

In addition, an assumption has been adopted that there will be 1 job per 40 sq m of commercial development. This represents a mix of retail, office and business park usage. It is further assumed that 40% of these jobs would be transferred from elsewhere and that a local multiplier of 1.2 would reflect additional jobs created in the supply-chain and in the local economy through indirect and induced effects¹².

On this basis, it is estimated that the net new jobs potential from these strategic sites in Chichester would be in the range of between 860 and 1870 jobs.

¹¹ Op cit. pp 10-11.

¹² Assumptions informed by Additionality Guide, 3rd Edition. English Partnerships. 2008.

Chapter 3 GVA Impacts

Introduction

This section describes the mechanisms by which the preferred package improvements translate to economic gains. It also estimates these economic gains in GVA terms. The economic assessment is the main quantified component of appraisal for trunk road improvements, although of course other elements such as safety, environmental impact and distributional impact play an important part in decision making. The conventional economic assessment is reported as part of the appraisal of the preferred package¹³. However, some of the benefits included there do not contribute directly to productivity and GVA enhancements, in line with DfT WebTAG guidance¹⁴.

Scope of GVA Impacts

The following benefits can be included as productivity gains and therefore add to GVA and improve economic efficiency:

Time and cost savings in the course of work

This element of appraisal is based on the assumption that travel in the course of work is usually not productive in itself and reducing journey times – either in free-flow conditions or by reducing delay – frees up time for additional productive activity. When an individual saves one hour travelling time whilst in work, the appraisal values this time at the gross cost to the firm of the worker's time (ie hourly wages plus national insurance contributions and other labour related costs). This applies to those using freight vehicles, travelling by bus or by company or private cars in the course of business.

Table 1 below shows working time values which apply only to journeys made in the course of work. This excludes commuting journeys. The perceived value of working time is the value as perceived by the employer. The table below is reproduced from official DfT guidance¹⁵ on the values to be placed on time saved in the course of work.

Table 1 Values of Working Time per person (£ per hour 2010 prices)			
Vehicle Occupant	Resource Cost	Perceived Cost	Market Price
Car driver	28.35	28.35	33.74
Car passenger	20.31	20.31	24.17
LGV (driver or passenger)	10.92	10.92	13.00
OGV (driver or passenger)	10.92	10.92	13.00
PSV driver	10.92	10.92	13.00
PSV passenger	21.69	21.69	25.81
Taxi driver	10.48	10.48	12.47
Taxi/Minicab passenger	47.95	47.95	57.06
Rail passenger	39.65	39.65	47.18
Underground passenger	38.57	38.57	45.90
Walker	31.79	31.79	37.83
Cyclist	18.24	18.24	21.70
Motorcyclist	25.65	25.65	30.53

¹³ Preferred Package Appraisal Report D5. Atkins.

¹⁴ <http://www.dft.gov.uk/webtag/documents/expert/unit3.5.php>

¹⁵ http://www.dft.gov.uk/webtag/documents/expert/pdf/u3_5_6-vot-op-cost-120723.pdf Table 1

Average of all working persons	28.68	28.68	<u>34.12</u>
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The values of time used are at market prices and those shown are in 2010 prices for consistency purposes.

In addition, improvements in journey times and reductions in congestion lead to savings in vehicle operating costs – both fuel and non-fuel. These are efficiency improvements and count as improvements to GVA.

Imperfect Competition

Despite the above, what we really seek to measure by time savings in the course of work is the additional value to society of the additional activity the worker can now undertake instead of travelling. However, under the assumption of perfect competition these two values (hourly labour cost and marginal hourly productivity) are identical – so labour costs is a good approximation.

In reality this is not true. On average firms are able to charge more for their products and services than they cost to produce. This means that the value society places on the worker's output from one hour's additional work (ie the price of whatever the worker makes in one hour) is higher than the cost of the worker's time to the firm.

By valuing workers' saved time at the level of costs to the firm rather than the value to society, current transport appraisal underestimates the benefits of in-work travel time savings. It can be shown that these 'missing' benefits **equal about 10% of conventionally measured user benefits to freight and business travel.**

Labour Market Impacts

By reducing commuting journey times and the uncertainty of congestion, highway improvement schemes can broaden the range of job opportunities to workers and expand the labour market catchment for firms. For existing commuters, the time savings measured as part of conventional appraisal are decreed to accrue to the worker as increased leisure time. These do not therefore count towards productivity improvements or gain in GVA. However, there are two second-order impacts which can count towards productivity and GVA:

- **More people working** – the monetary costs of travelling to work reduce the financial gains from working while commuting time costs increase the personal costs. At the margin, some people will choose to take a job rather than not and this represents an economic gain.
- **More people working in more productive jobs** – some existing workers may use their time/money commuting budget to travel further to access better paid and more productive jobs.

Agglomeration Benefits

Agglomeration simply means the geographic clustering of firms and workers. Typically, firms are more productive when near other firms because they have access to a large variety of inputs to their activities. It is also often argued that proximity to other similar firms increases the chance of

acquiring new knowledge and building connections and networks which support or increase productivity.

Many firms are also more productive when they have access to a large labour market since this makes recruitment quicker and it is easier to find workers with the exact skills match that they are after. Evidence supports all of this by showing that a larger and more dense a location, its firms become more productive.

By bringing firms closer together in time terms, for example by reducing congestion, then *effective density* is improved. If transport is made cheaper or quicker, more firms and workers will be located within reach and productivity will increase. These agglomeration benefits are additional to those already captured in appraisal.

GVA Impacts of the preferred package of A27 Junction Improvements

This exercise is a high-level one and therefore the full modelling of all the GVA impacts has not been commissioned. To calculate all agglomeration and labour market impacts from first principles requires a multi-modal model and a detailed Land Use Interaction Model to estimate, for example, the changes in labour market behaviour which may result from the accessibility gains predicted by the traffic model.

Nevertheless, it is possible to fully calculate the most significant contribution to GVA which is time savings and operating cost savings for travel in the course of work, and to extend these in a fully compliant way to estimate the additional GVA through businesses operating under imperfect competition. High-level estimates can also be made of agglomeration and labour market impacts.

Time and cost savings in the course of work

The traffic modelling and TUBA economic analyses estimates the time savings to business users, both freight and business travel, to be as set out in Table 2 below:

	Time savings	Vehicle operating cost savings	Total GVA Impact
2016	£3.0m	£0.1m	£3.1m
2026	£3.5m	£0.2m	£3.7m
Present value over 60 Years	£161.3m	£5.5m	£166.8m

These impacts are in 2010 prices to be consistent with TUBA.

Imperfect Competition

In line with WebTAG¹⁶ the calculations for additional GVA impact lead to the following running total GVA impact (2010 prices), as shown in Table 3 below:

¹⁶ http://www.dft.gov.uk/webtag/documents/expert/pdf/U3_5_14-wider-impacts120723.pdf Table 2

	Time savings	Vehicle operating cost savings	Total GVA Impact
2016	£3.3m	£0.1m	£3.4m
2026	£3.9m	£0.2m	£4.1m
Present value over 60 Years	£177.4m	£6.1m	£183.5m

Labour Market Impacts and Agglomeration Benefits

As mentioned above, the modelling of these impacts is beyond the scope of this high-level exercise. However, it is possible to assess the evidence and drive a range of a 'broad-brush' estimate of these impacts. These should be treated with caution as they do not comply fully with WebTAG.

Functional Urban Regions (FURs)

WebTAG suggests that agglomeration impacts are most likely to occur within Functional Urban Regions (FURs)¹⁷. Each FUR is constructed by firstly defining a core and then identifying a corresponding commuting field (or hinterland) for that core. The core is defined by a minimum working population (of 60,000) together with a minimum job density (of 7 jobs per hectare) for a ward. This is to reflect the fact that agglomeration impacts are most significant for transport schemes located within, or near, large and dense employment centres¹⁸.

Within the districts that the A27 junctions under exam fall, the following applies:

- In **Adur**, the whole District lies within the hinterland of Brighton and Hove Functional Urban Region
- In **Worthing**, just the Selden ward lies within the hinterland of the Brighton and Hove FUR
- In **Chichester**, only the Fernhurst, Plaistow and Westbourne wards lie within the Portsmouth FUR hinterland
- No wards in **Arun** lie within a FUR

This is based on 2001 census data.

This indicates that outside of the 2 junctions within Adur, agglomeration benefits of improved accessibility are likely to be relatively weak. Furthermore, a significant part of the labour market impacts would accrue outside of West Sussex.

Benchmark Evidence

Aside from business and freight user benefits, remaining GVA impacts, known as Wider Economic Impacts (WEIs), are a relatively recent development in transport economic appraisal. Nevertheless, there is a body of case study evidence of calculating WEIs. This suggests that WEIs represent an addition of between 5% and 40% of conventional transport benefits.

¹⁷ http://www.dft.gov.uk/webtag/documents/project-manager/pdf/u2_8-wider-impacts-120723.pdf

¹⁸ Op cit p5.

For the A27 preferred package, business and freight benefits represent more than half of total conventional benefits. Imperfect competition benefits (one element of WEI) therefore represent more than 5% of total conventional benefits.

On the basis of the above evidence, a reasonable benchmark range for total WEIs would be between **10% and 20%** of conventional benefits. Applying this range would imply a total GVA impact as set out in Table 4 below:

	Business and Freight Benefits	Wider Economic Impacts	Total GVA Impact
2016	£3.1m	£0.6m - £1.1m	£3.7m - £4.2m
2026	£3.7m	£0.7m - £1.4m	£4.4m - £5.1m
Present value over 60 Years	£166.8m	£30.9m - £61.7m	£197.7m - £228.5m

For the avoidance of doubt, these GVA estimates are not additive to the transport benefits reported in the conventional appraisal.

Chapter 4 Findings

This Chapter brings together the findings from this exercise

Development Opportunities

There is anecdotal evidence that the A27 acts as a constraint on economic and development activity. Congestion and slow and unpredictable journey times make the corridor a less attractive place to live, work and do business.

More specifically, there are a number of strategic housing allocations close to the A27 junctions under review, and which will rely on capacity enhancements in order that planning permission and/or implementation can be secured. Table 5 below summarises these housing plans:

Location	Planning Authority	Scale of Development (units)	Relevant Junctions	A27
West Durrington	Worthing	700 - 1075	Offington Corner Grove Lodge	
New Monks Farm	Adur	450 - 600	Grinstead Lane	
Sompting Fringe	Adur	250 - 420	Busticle Lane Grinstead Lane	
North Sompting	Adur	210	Busticle Lane	
North Littlehampton	Arun	1260	Crossbush	
Courtwick	Arun	500	Crossbush	
Tangmere	Chichester	800 – 1,600	Portfield	
Westhampnett	Chichester	500 – 1,400	Portfield	
West of Chichester	Chichester	500 – 1,600	Fishbourne	
Shopwyke	Chichester	600	Portfield Oving Road	

There is less specific evidence of the extent of planned commercial development in the vicinity of the A27 junctions under review, nor of the scale of job opportunities these would unlock. Nevertheless, the following employment land allocations have been identified:

- 10,000m² at New Monks Farm, Lancing
- Decoy Farm, east Worthing – although this would require a new access road to the A27
- Mixed use plans alongside strategic housing allocations in Chichester.

Net additional job potential at the Chichester and Lancing sites would be in the broad range of between 1000 and 2000 jobs, although this is subject to significant uncertainty since land-use plans are not well developed for employment use, and this estimate relies on a number of assumptions.

GVA Impacts

A high-level estimate has been prepared of the GVA impacts of the proposed A27 preferred investment package, building on the traffic modelling and conventional appraisal work already undertaken. The following impacts are expected to add to productivity and economic activity:

- Time and cost savings in the course of work for both freight and business travel

- Additional benefits due to imperfect competition
- Labour market impacts, both workers moving to more productive jobs and a greater willingness to enter the job market
- Agglomeration benefits

In total, these benefits could be worth up to £228.5m across the 60 year economic life of the A27 investment schemes, although not all of this would accrue within the West Sussex boundaries. The GVA impacts are summarised in Table 6 below.

Table 6 GVA Impact Range of A27 Preferred Investment Package (2010 prices)

	Business and Freight Benefits	Wider Economic Impacts	Total GVA Impact
2016	£3.1m	£0.6m - £1.1m	£3.7m - £4.2m
2026	£3.7m	£0.7m - £1.4m	£4.4m - £5.1m
Present value over 60 Years	£166.8m	£30.9m - £61.7m	£197.7m - £228.5m

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