Regional Investment Programme

A27 Arundel

PCF Stage 1 - Traffic Forecasting Report

March 2017

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TRAFFIC FORECASTING REPORT - A27 ARUNDEL BYPASS

Highways England

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1.1 CONTEXT

1.1.1 The Roads Investment Strategy announcement on 1 December 2014 included a Bypass of Arundel

1.1.2 The starting point would be the previous preferred route subject to consultation with the National Park Authority, local government and the public on this and alternative options.

1.1.3 There are existing capacity constraints at Arundel due to the single carriageway section through Arundel, worsened by constrained capacity at the Ford Roundabout and Crossbush junctions.

- → The current demand exceeds the theoretical capacity of a single carriageway road in Arundel.
- → Future growth will result in the demand further exceeding capacity through Arundel, and this section of the A27 will act as a constraint to the planned growth in housing and employment in the corridor.
- → The A27 results in severance through the town of Arundel.

1.1.4 The A27 is a strategically important corridor on the south coast which is used by both long distance strategic traffic and local traffic alike. The Arundel section is one of a number of bottlenecks which causes delay and variable journey times due to the single carriageway alignment and the number of junctions. Table 1.1 presents a selection of Annual Average Daily Traffic (AADT) values for the study area taken from WebTRIS.

Table 1.1: AADT Values from WebTRIS for Study Area

LOCATION	2016 AADT
A27 North of Crossbush Roundabout - Northbound	14,676
A27 North of Crossbush Roundabout - Southbound	15,059
A27 between A284 near Arundel (east) and A280 - Eastbound	14,344
A27 between A280 and A284 near Arundel (east) - Westbound	13,869
A27 between A284 near Arundel (west) and A29 near Bognor Regis (east) - Westbound	13,338

1.1.5 Environmental constraints close to Arundel include, the presence of the South Downs National Park and ancient woodland, heritage assets such as Tortington Priory, and the sensitivity of the River Arun floodplain. In the vicinity there are designated a Site of Special Scientific Interest (SSSI) a Special Area of Conservation (SAC) and Biodiversity Action Plan (BAP) habitat.

1.1.6 The Road Investment Strategy (RIS) for the period 2015-2021, published in 2014 and is referred to as 'RIS 1', comprises a long term vision for England's motorways and trunk roads. It specifies those locations that are to be the subject of technical study and which should, as a result, be improved through a programme of investment.

1.1.7 The A27 in the vicinity of Arundel was identified by RIS 1 as an area for investment (referred to as 'A27 Arundel Bypass').

1.1.8 Highways England has commissioned WSP | Parsons Brinckerhoff to undertake a technical assessment of the A27 around Arundel, and to consider in detail the various technical issues associated with improving these sections of the A27. The assessment has been undertaken in line with the *Project Control Framework* (PCF) operated by Highways England. Specifically, the assessment is at PCF Stage 1; 'Option Identification'. This is the stage where:

- Options are identified to be taken to public consultation
- Options are assessed in terms of environmental impact, traffic forecasts and economic benefits
- Cost estimates are carried out.

1.1.9 A Traffic Data Collection Report, which provides an overview and initial analysis of the traffic data collected for the development of the OD matrix for the model (v1.2.0), was submitted to TAME on 29 June 2016 and has subsequently been agreed and signed off.

1.1.10 Primary data collected throughout the 2015 surveys were used for the purpose of model development and calibration and provides an overview of the existing conditions. This predominantly related to the RSI and non-RSI link counts. Table 1.2 and Table 1.3 outline the data that was utilised during the base year model development.

Table 1.2: RSI Calibration Link Counts (Interview Direction) - All User Classes

Survey Ref	Site Description	AM Average (Veh's)	IP Average (Veh's)	PM Average (VEH's)
RSI 1	*A27 Arundel Road - Site 1*	977	876	901
RSI 2	*A27 Old Shoreham Road - Site 2*	1,513	1,297	1,391
RSI 3	*A259 Crookthorn Lane - Site 3*	866	690	768
RSI 4	*A259 Brighton Road - Site 4*	712	696	882
RSI 5	*A29 N Whiteways Lodge Roundabout - Site 5*	377	379	585
RSI 6	*A280 Long Furlong - Site 6*	516	484	896
RSI 7	*A24 Findon Road - Site 7*	859	831	938
RSI 8	*A283 Steyning Road - Site 8*	912	703	982
RSI 10	*B2139 Whiteways Lodge Roundabout - Site 10*	369	277	398

Table 1.3: RSI Calibration Link Counts (Non-Interview Direction) - All User Classes

Survey Ref	Site Description	AM Average (Veh's)	IP Average (Veh's)	PM Average (VEH's)
RSI 1	*A27 Arundel Road - Site 1*	1,075	911	1,079
RSI 2	*A27 Old Shoreham Road - Site 2*	1,913	1,576	1,854
RSI 3	*A259 Crookthorn Lane - Site 3*	670	764	1,047
RSI 4	*A259 Brighton Road - Site 4*	782	628	765
RSI 5	*A29 N Whiteways Lodge Roundabout - Site 5*	527	310	426
RSI 6	*A280 Long Furlong - Site 6*	744	485	547
RSI 7	*A24 Findon Road - Site 7*	936	802	825
RSI 8	*A283 Steyning Road - Site 8*	1,039	832	1,122
RSI 10	*B2139 Whiteways Lodge Roundabout - Site 10*	348	254	369

1.1.11 The existing traffic conditions along the scheme sections are also presented in the Local Model Validation Report[1] (LMVR). The LMVR[1] summarises all aspects of the development and validation of the base year model and demonstrate that the model has been calibrated and validated to a level compliant with its intended use for future year demand forecasting and demonstrate it is fit for purposed; further details are presented in Section 2.3.

1.1.12 Details and a plan of the study area are presented in the LMVR[1]. Transport Appraisal Guidance (TAG) advises in Unit M1-1 (January 2014) that models should be based in the current or a 'recent' year, generally taken to be within the last five years. TAME Advice note 1 v1.0 (June 2015) also states that matrices with supporting survey data within a model should be no longer than 10 years old for the assessment of RIS1 schemes up to PCF Stage 1.

1.1.13 The WSCTM trip matrices for the base model are primarily based on roadside interview (RSI) data recorded in 2000-2009. The model was updated to 2015 for Highways England to appraise the A27 Arundel scheme, following a comprehensive data collection and modelling exercise to provide up to date origin-destination data from RSIs. The base model was calibrated and validated, which is detailed in the LMVR.

[1] Local Model Validation Report – A27 Arundel Bypass by Highways England, January 2017

1.1.14 A single traffic forecasting exercise has been undertaken to assess the options for improvements to sections of the A27 Arundel Bypass. This Traffic Forecasting Report describes the methodology and results of the forecasting transport model for the A27 Arundel Bypass scheme. The report has been prepared using the following guidance:

- WebTAG Unit M3.1 – Highway Assignment Modelling (2014)
- TAME Advice Note 1 v1.0
- TAG Unit M4 'Forecasting and Uncertainty'
- COBA User Manual.

1.2 STATEMENT OF SCHEME OBJECTIVES

1.2.1 The objectives of the A27 Arundel Bypass scheme is detailed in the respective Client Scheme Requirement documents and are summarised below. The scheme seeks to deliver the following objectives:

- To enhance the capacity, connectivity, and the resilience provided by the A27 route within the West Sussex Coastal Area and the wider coastal region. This will contribute positively to the economy of Arundel and strengthen the local and regional economic base, as well as facilitate housing allocations within Local Plans. Also to minimise disruption to traffic and to business during the implementation of any scheme.
- To improve the safety and personal security of travellers along the Arundel sections of the A27 route for all road users including vulnerable road users.
- To improve road safety and reduce dis-benefits to communities and vulnerable road users on the wider local road network that is caused by traffic avoiding congestion on the A27.
- To reduce the community severance caused by the A27 through Arundel, and to improve links between local communities, including for vulnerable road users. Also to provide better access to local services and facilities and to the South Downs National Park (SDNP), particularly for more sustainable modes of transport.
- To deliver a high standard of design for any A27 improvement that reflects the character of the route and the quality of the surrounding landscape, minimises the adverse environmental impact of new construction, improves air quality, and supports the following:
  - planning for climate change
  - working in harmony with the environment to conserve natural resources and encourage bio-diversity
  - protecting and enhancing countryside and historic and archaeological environments
  - reducing air and noise pollution
- To recognise that any improvement would have a significant impact on the SDNP, and have regard to the purposes and special qualities of the National Park that the SDNP authority is seeking to preserve in designing and evaluating improvement options.

1.3 DESCRIPTION OF SCHEME

1.3.1 Five of the ten scheme options for Arundel have been prioritised and taken forward to public consultation and economic assessment. The following section will present all the prioritised scheme options and will provide the results of the PCF Stage 1 assessment.

1.3.2 As this study has progressed through PCF Stage 1, it has become apparent that some options are better suited to delivering the objectives listed in Section 1.2, and that some options are not suitable to be taken forward to economic assessment. The full list of options that were considered within PCF Stage 1 is detailed below, with the options that have been taken forward to economic assessment identified.

Arundel Scheme Proposals

1.3.3 PCF Stage 1 of the Arundel improvements study has given consideration to 10 options. Details for each option are provided below:

- **Option 0A –** Junction improvements only to Crossbush Junction, Causeway roundabout, and Ford Road roundabout.
- **Option 0B –** A narrowed urban D2UAP[2] corridor along the existing A27 alignment, in addition to the improvements at Crossbush Junction, Causeway roundabout, and Ford Road roundabout.
- **Option 0BA –** A narrowed urban D2UAP corridor along the existing A27 alignment, in addition to the improvements at Crossbush Junction, Causeway roundabout, and Ford Road roundabout. Supplemented by a short offline section past Arundel Railway Station, with the current road becoming a local off-slip/ on slip from the short new offline dual carriageway.
- **Option 1 -** D2UAP widening on current existing alignment, then offline D2AP[3] to tie into Crossbush Junction, incorporating the route suggested by WSCC – an online, then offline improvement, running west to east.
- **Option 2 –** D2AP bypass with reduced visual impact by having the route lower in the valley. Option 2 is an offline route from the existing A27 alignment, approximately 4.4km in length commencing from a new interchange adjacent to The White Horse Public House, to the west of Arundel, on the existing A27 Chichester Road. The alignment then turns toward the south to run adjacent to Tortington Lane and then south-eastward. The alignment continues in a south east direction to cross the River Arun, and then turns northwards to run adjacent to the existing A27 Arundel Bypass. This alignment then continues on to cross over the Arun Valley Railway and ties into the existing A27 to form a new grade separated interchange at Crossbush Junction. Option 2 will incorporate the standard D2AP corridor along its entire length.
- **Option 3 -** An offline D2AP route bypassing the existing A27 alignment. This alignment continues in a south east direction through ancient woodland at Tortington Common, to create four new under-bridges at Old Scotland Lane, Binsted Lane, Tortington Lane, and Ford Road. The alignment then turns eastwards to create two new over-bridges at the River Arun and Arun Valley Railway. The proposed alignment then ties into the existing A27 to form a new grade separated interchange at Crossbush Junction. Option 3 will incorporate the standard D2AP corridor along its entire length.

[2] Dual Carriageway two lane urban all purpose
[3] Dual Carriageway rural all purpose

- **Option 4 –** An offline D2AP route that commences further west than the previously mentioned options to minimise impacts on existing ancient woodland and the newly formed SDNP. The alignment continues in a south east direction adjacent to the border of the SDNP and will create four new under-bridges at Binsted Lane (north), Old Scotland Lane, Binsted Lane (south), and Ford Road. The alignment then continues east, similar to Option 3 above, and will create two new over-bridges at the River Arun and Arun Valley Railway. The proposed alignment then ties into the existing A27 to form a new grade separated interchange at Crossbush Junction. Option 4 will incorporate the standard D2AP corridor along its entire length.
- **Option 5 –** An offline D2AP[4] route that runs north of Tortington Priory, allowing for the shortest possible distance over the floodplain, then intersects the ancient woodland. The alignment then continues east, similar to Option 3 above, and will create two new over-bridges at the River Arun and Arun Valley Railway. The proposed alignment then ties into the existing A27 to form a new grade separated interchange at Crossbush Junction.
- **Option 5A –** An offline D2AP route that is a combination of Option 3 and Option 5 alignments, avoiding SDNP ancient woodland areas to the west and passing south of the Guest Houses on Priory Lane along Ford Road, joining with the existing A27 dual carriageway at Crossbush and a new grade separated junction near Binsted Lane.
- **Option 5B –** An offline D2AP route starting at Crossbush Junction, forming a new grade separated interchange with the existing A27 dual carriageway, running west, south of Arundel town, across the Arun floodplain between Tortington Priory and Tortington village. It bypasses the ancient woodland areas, running between Binsted and Walberton, to join the existing A27 dual carriageway north of the Hilton Hotel and Avisford Park Golf Course, west of the existing junction with Mill Road/Tye Lane.

1.3.4 As a result of the PCF Stage 1 design, traffic modelling, and environmental appraisal, five of these options have not been taken forward to economic assessment. The options that have been taken forward for traffic forecasting and economic assessment are:

- Option 0A
- Option 1
- Option 3
- Option 5A
- Option 5B.

1.3.5 Figure 1 outlines the study area and the location of the options for Arundel.

1.4 PURPOSE OF THIS REPORT

1.4.1 The purpose of the Traffic Forecasting Report is to demonstrate that the forecasting procedure undertaken using the SATURN model is in accordance with Highways England's Major Projects – Project Control Framework (PCF).

1.4.2 This report describes the process undertaken in preparing the model for use in the forecasting of future traffic conditions on the A27 with the 'with' and 'without' scheme scenarios. The model forecasts will provide the data required for economic and environmental appraisal of the scheme at PCF Stage 1. The model will provide the basis for Highways England to decide whether the schemes offer sufficient value for money to take them forward to PCF Stage 2.

[4] Dual carriageway two lane rural all purpose

1.4.3 This report presents the details of the methodology used in the development for both the “with” and “without” scheme scenarios. The aim is to demonstrate that the forecast model has been developed to represent projected changes in both travel demand and network supply.

1.4.4 The report follows the structure recommended in Highways England’s PCF, and is divided into the following chapters;

- Chapter 2: Summary of Previous Work
- Chapter 3: The Uncertainty Log and Forecast Years
- Chapter 4: Reference Case Forecast Demand and Supply
- Chapter 5: Demand Forecast
- Chapter 6: Assignment Results for Economic Assessment
- Chapter 7: Summary and Conclusion.

2 SUMMARY OF PREVIOUS WORK

2.1 MODELLED TIME PERIODS AND NETWORK STRUCTURE

2.1.1 Owing to the proximity of these two locations, a single base year model has been prepared to validate both schemes, as agreed with Highways England's Traffic Appraisal Modelling and Economics (TAME) Division and described in the Appraisal Specification Report (ASR)for the A27 Arundel (HE551523_WSP-PB_A27A_P002_ASR)

2.1.2 It was agreed with West Sussex County Council (WSCC) that the West Sussex County Traffic Model (WSCTM) model network would be used to appraise the A27 Arundel Bypass. The network was cordoned to the study area for the two schemes, and has been revised and updated by WSP | Parsons Brinckerhoff to determine the benefits of the A27 Arundel Bypass scheme:

2.1.3 A plan illustrating the geographical coverage of the model is presented in Appendix I-1. Fully calibrated and validated base year models have been developed for the following time periods:

- AM Peak Period (07:00 – 10:00)
- Inter Peak Period (10:00 – 16:00)
- PM Peak Period (16:00 – 19:00).

2.1.4 Origin-destination and trip purpose data for these periods were utilised throughout the model development process to make best use of the RSI survey data and maintain translation to the forecasting and economics stage of the assessment.

2.1.5 The core simulation coverage of the cordoned traffic model relates to 'Inset B' outlined in Appendix I-1. The extent of this detailed study area includes key links and junctions. This is representative of the geographical area of the two schemes being assessed as well as the periphery defined within 'Inset A' in Appendix I-2. This includes coverage of Arundel

2.1.6 The SATURN highway network consists of the trunk roads and other key routes providing links into the study area. These consist of the:

- A27
- A284
- A29
- A24
- A280
- A283
- A259

2.1.7 SATURN Version 11.3.12U was used to develop the 2015 base year model.

2.2 SPECIFICATION AND JUSTIFICATION OF DEMAND SEGMENTATION

2.2.1 The trip matrices were segmented in accordance with the trip purposes identified and surveyed throughout the road side interviews. These consisted of the following trip purposes:

- Home Based Work
- Home Based Employers' Business
- Home Based Other
- Non-Home Based Employers' Business
- Non-Home Based other.

2.2.2 The segments outlined above were collected for Cars and Light Goods Vehicles (LGV), whilst Heavy Goods Vehicles (HGV) were aggregated in to a single purpose. LGV trip purposes were further aggregated in to 'Personal' and 'Business' use for compliance in TUBA during the scheme economics stage of the assessment.

2.2.3 Table 2.1 portrays the overall structure of the demand matrix used through the assignment procedure.

Table 2.1: Matrix Structure (8 User Classes)

Vehicle Class	User Class	Abbreviation Used (Within SATURN)	Matrix Level
Car	Home Based Work	HBW	1
Car	Home Based Employers' Business	HBEB	2
Car	Home Based Other	HBO	3
Car	Non-Home Based Employers' Business	NHBEB	4
Car	Non-Home Based Other	NHBO	5
LGV	Personal (Home Based Work + Home Based Other + Non-Home Based Other)	LGV Personal	6
LGV	Business (Home Based Employers' Business + Non-Home Based Employers' Business)	LGV Business	7
HGV	All	HGV ALL	8

2.2.4 The resulting trip matrix consisted of 8 levels representing different trip purposes and 3 vehicle types (Cars, LGV and HGV).

2.3 VARIABLE DEMAND MODELLING

2.3.1 It was agreed with Highways England TAME that Variable Demand Modelling (VDM) would not be undertaken at PCF Stage 1. This will be undertaken at Stage 2 using the South East Regional Transport Model.

2.4 ASSIGNMENT TECHNIQUE AND GENERALISED COST PARAMETERS

2.4.1 The A27 SATURN (Version 11.3.12U) model uses a Wardrop equilibrium assignment technique and simulates congestion, queues, and delays. Using an equilibrium assignment allows the travel speed on each network link to be recalculated according to the level of traffic assigned, minimising the overall generalised cost of travel time (time and distance) between origin and destination zones.

2.4.2 As SATURN treats vehicles in Passenger Car Units (PCU) it was necessary to convert Heavy Good Vehicles (HGV) accordingly. Following from the above guidance, it is recommended that a value of '2.5' be used in converting HGV (vehicle units) to PCU whereas other vehicle classes remain constant (i.e. 1 vehicle unit = 1 PCU for Cars and LGV).

2.4.3 Generalised cost parameters for route assignment in pence per minute (PPM) and pence per kilometre (PPK) were calculated using:

- Values of time
- GDP growth rates, purpose splits and vehicle occupancies
- Vehicle operating costs recommended by the DfT for use in economic appraisals of transport projects in England.

2.4.4 The values for the last two points above were based on the July 2016 WebTAG databook tables and are consistent with the latest guidance contained within WebTAG Unit A1.3. The generalised costs for the 2015 base year model are provided in Table 2.2.

Table 2.2: 2015 Base Year Generalised Cost Parameters

Time Period	Cost	Cars – Commuting	Cars – In Work	Cars – Other	LGV	HGV
AM	PPM	19.50	29.08	13.44	20.48	20.74
	PPK	7.36	13.62	7.36	14.42	45.88
IP	PPM	19.82	29.80	14.31	20.48	20.74
	PPK	7.36	13.62	7.36	14.42	45.88
PM	PPM	19.57	29.50	14.07	20.482	20.74
	PPK	7.36	13.62	7.36	14.42	45.88

2.5 MODEL CALIBRATION AND VALIDATION

CALIBRATION

2.5.1 To provide confidence in the robustness and accuracy of the forecast models, a full audit process was undertaken to calibrate and validate the 2015 base year model in line with current guidance which is detailed in the LMVR[1].

2.5.2 A LMVR (Section 1.1.13) has been prepared which outlines the performance of the base model. The LMVR was issued to Highways England in January 2017.

2.5.1 Table 2.3 to Table 2.5 show the Calibration Link Flow results for the AM, Inter-Peak and PM modelled hours.

Table 2.3: AM Calibration Summary Results

Criteria	Number of Links	Pass		Pass Rate	
		Prior	Post	Prior	Post
RSI Links Flows < 700 veh/h	6	6	6	100%	100%
RSI Links Flows 700 - 2,700 veh/h	12	10	9	83%	75%
Turn Analysis Flows < 700 veh/h	175	131	144	75%	82%
Turn Analysis Flows 700 - 2,700 veh/h	57	23	33	44%	58%

Table 2.4: Inter-Peak Calibration Summary Results

Criteria	Number of Links	Pass		Pass Rate	
		Prior	Post	Prior	Post
RSI Links Flows < 700 veh/h	9	7	8	78%	89%
RSI Links Flows 700 - 2,700 veh/h	9	9	8	89%	89%
Turn Analysis Flows < 700 veh/h	185	136	161	74%	87%
Turn Analysis Flows 700 - 2,700 veh/h	51	28	41	55%	80%

Table 2.5: PM Calibration Summary Results

Criteria	Number of Links	Pass		Pass Rate	
		Prior	Post	Prior	Post
RSI Links Flows < 700 veh/h	6	4	4	67%	67%
RSI Links Flows 700 - 2,700 veh/h	12	11	12	92%	100%
Turn Analysis Flows < 700 veh/h	173	124	145	72%	84%
Turn Analysis Flows 700 - 2,700 veh/h	61	29	41	49%	67%

VALIDATION

2.5.2 Validation sites have not been used in the model development and can therefore be considered as an independent check of the model performance.

2.5.3 Table 2.6 to Table 2.8 show the summary of validation results for AM peak, Inter-Peak and PM hours.

Table 2.6: AM Validation Summary Results

Link Description	No. of Links	Flow Criteria		GEH Statistic		Either Criteria	
		Pass	% Pass	Pass	% Pass	Pass	% Pass
Individual links with flow less than 700 veh/h	3	3	100%	2	67%	3	100%
Individual links with flow between 700 – 2,700 veh/h	10	9	90%	9	90%	9	90%
All Links	13	12	92%	11	85%	12	92%

Table 2.7: Inter-Peak Calibration Summary Results

Link Description	No. of Links	Flow Criteria		GEH Statistic		Either Criteria	
		Pass	% Pass	Pass	% Pass	Pass	% Pass
Individual links with flow less than 700 veh/h	4	4	100%	4	100%	4	100%
Individual links with flow between 700 – 2,700 veh/h	9	9	100%	9	100%	9	100%
All Links	13	13	100%	13	100%	13	100%

Table 2.8: PM Validation Summary Results

Link Description	No. of Links	Flow Criteria		GEH Statistic		Either Criteria	
		Pass	% Pass	Pass	% Pass	Pass	% Pass
Individual links with flow less than 700 veh/h	3	2	67%	1	33%	2	67%
Individual links with flow between 700 – 2,700 veh/h	10	10	100%	10	100%	10	100%
All Links	13	12	92%	11	85%	12	92%

3 THE UNCERTAINTY LOG AND FORECAST YEARS

3.1 DEMAND FORECASTING FOR SPECIFIC DEVELOPMENTS

3.1.1 The base year and forecast years were identified within the ASRs and are presented below:

- 2015 Base Year
- Opening Year
  - 2022 Opening Year for Arundel
- Intermediate Year
  - 2037 Intermediate Year for Arundel
- 2041 Horizon Year (as determined at the SMP Modelling Technical Board Meeting on 5th October 2015 and as specified in the guidance TAME Advice Note 1 v1.0).

3.1.2 However, following consultation with both colleagues in highway design and Benchmark Estimating Limited, the quantity surveyors employed by Highways England, it was agreed that a number of options would require a three year build programme for Arundel. Therefore an Opening Year of 2023 was assumed for both schemes. This would also result in the same intermediate year of 2038. Finally as the intermediate year of 2038 was very near to the horizon year of 2041, it was decided to forecast only to the worst case of 2041.

3.1.3 Therefore the base year, and the two future years generalised costs have been calculated for are summarised below.

- 2015 Base Year
- 2023 Opening Year
- 2041 Horizon Year.

3.1.4 Data was provided by Local Authorities using the current Local Plans to determine the anticipated level of development surrounding the A27 and proposed scheme:

- West Sussex County Council
- Arun District Council.

3.1.5 The local authorities provided information for potential residential and employment development sites in their respective areas. This information was analysed and the development sites were entered into an Uncertainty Log.

3.1.6 The Uncertainty Log was then shared with the local authorities and following consultation the project team got their agreement on the level of certainty for each development identified. This was undertaken in accordance with the guidance in WebTAG Unit 4M 'Forecasting and Uncertainty'.

3.1.7 The Uncertainty Log outlines the developments which are to be explicitly modelled as part of the core scenario and the evidence behind this inclusion.

3.1.8 The Uncertainty Log presents the developments included and excluded from the forecasting model and a justification (provided by the local authorities) which shows the likelihood category assigned to them. Based on this 'likelihood category' provided by the local authority this determined whether the development was to be included in the forecast modelling. Table 3-1 presents the definition of uncertainty with more details in the Uncertainty Log in Appendix II-1.

Table 3.1: Definition of Uncertainty

Uncertainty Assumption (Alternative Scenario Options)	Definition of Development Type	Status
Near Certain	The outcome will happen, or there is a high probability that it will happen	■ Intent announced by proponent to regulatory agencies ■ Approved development proposals ■ Projects under construction
More than Likely	The outcome is likely to happen, but there is some uncertainty	■ Submission of planning or consent application imminent ■ Development application within the consent process
Reasonably Foreseeable	The outcome may happen, but there is significant uncertainty	■ Identified within a development plan ■ Not directly associated with the transport strategy/scheme, but may occur if the transport strategy/scheme is implemented ■ Development conditional on the transport strategy/scheme proceeding ■ A committed policy goal, subject to tests (e.g. of deliverability) whose outcomes are subject to significant uncertainty
Hypothetical	There is considerable uncertainty whether the outcome will ever happen	■ Conjecture based on currently available information ■ Discussed on a conceptual basis ■ One of a number of possible inputs in an initial consultation process ■ A policy aspiration

3.1.9 Trip generation totals for site-specific developments were calculated using the TRICS database and added to the forecast trip matrices, as appropriate and controlled to NTEM V6.2.

4 REFERENCE CASE FORECAST DEMAND AND SUPPLY

4.1 OVERVIEW OF DEMAND FORECASTING PROCEDURE

4.1.1 The forecasting methodology has been developed in accordance with *TAME Advice Note 1 v1.0 – 09/06/2015: Roads Investment Strategy 1 – PCF Stage 1 Modelling Requirements.* This provides a number of relaxations compared with usual WebTAG compliant approaches.

4.1.2 There are five options for Arundel as outlined in Section 1.

4.1.3 Growth factors were derived from NTEM V6.2 datasets accessed via the TEMPRO V6.2 program for Car User Classes while NTM was used for LGV and HGV growth. The use, in Stage 1, of the NTEM V6.2 datasets was agreed with Highways England TAME.

4.1.4 For each modelled peak hour the base year matrix was used as a starting point. TEMPRO growth factors were assigned to each base year model zone with the origin and destination totals for each base year zone increased appropriately. These forecast year origin and destination totals were then used to Furness the base year matrix to generate a matrix for the forecast year peak hour which represented background growth in traffic. Furnessing is a process by which the matrix is balanced in order to meet targets totals for origins and destinations. Since both trip ends are factored, the process is referred to as being doubly-constrained. The combined fuel and income adjustment factor was then applied to the background growth matrix, and finally the committed development trips were added to create the final core scenario matrices. The following sections describe this process in more detail.

4.1.5 A single Core growth scenario has been produced for this assessment with the developments included within this as Near Certain and More than Likely shown in Table 3.2. Low and high growth forecasts were omitted to meet programme requirements in agreement with Highways England TAME.

4.2 DEMAND FORECASTING WITH NTEM

4.2.1 The NTEM V6.2 dataset provides forecasts for Car Drivers and are accessed through the TEMPRO 6.2 (Trip End Model Presentation Program) program. TAG Unit M4 outlines the DfT's technical guidance for forecasting and uncertainty in developing traffic models.

4.2.2 As land use developments are a source of uncertainty, the total growth predicted by the forecast model is to reflect the total growth predicted by TEMPRO in order to be consistent with national and regional planning policy. Table 4.1 shows the equivalence between the TEMPRO time periods and the model time periods and Table 4.1 shows the equivalence between the TEMPRO user classes and the model user classes.

Table 4.1: TEMPRO Time Period Equivalence

Model Time Period	Model Time Period Name	TEMPRO Time Period
01	AM (average hour)	Weekday AM peak period (0700-0959)
02	IP (average hour)	Weekday Inter peak period (1000-1559)
03	PM (average hour)	Weekday PM peak period (1600-1859)

Table 4.2: TEMPRO User Class Equivalence

Model User Class	Model User Class Name	TEMPRO User Class	OD or PA
1	Cars – Commuting	HB Work	OD
2	Cars Employers Business	HB Employers Business, NHB Employers Business	OD
3	Cars Other	HB Shopping, HB Personal Business, HB Recreation / Sport, HB Visiting friends and relatives, HB Holiday / Day trip, NHB Work, NHB Education, NHB Shopping, NHB Personal Business, NHB Recreation / Sport, NHB Holiday / Day trip	OD
4	LGV	- (NTM Growth)	-
5	HGV	- (NTM Growth)	-

4.2.3 Unadjusted TEMPRO factors, which were effectively used as a constraint on the forecast matrix, were derived for study areas. The definitions of the study areas used are detailed in Table 4.3. The SATURN model zone system has a UK coverage, therefore model zones were each assigned to a relevant study area.

Table 4.3: TEMPRO Study Areas

TEMPRO Study Area	Study Area Description
1	Adur
2	Arun
4	Chichester, Crawley, Horsham, Mid Sussex (Rest of West Sussex)
5	Berkshire, Buckinghamshire, Isle of Wight, Kent, Oxfordshire, Surrey, East Sussex (Rest of South East England)
6	Brighton & Hove
7	East Midlands
8	East of England
9	London
10	North East England, North West England, Yorkshire & Humber
11	South West England
12	Wales
13	West Midlands

4.2.4 The unadjusted TEMPRO growth factors derived for each of the study areas is provided in Appendix III.

4.3 LGV & HGV GROWTH WITH NTM

4.3.1 The National Transport Model (NTM) developed by the DfT provides a systematic means of comparing the national consequences of widely applied transport policies, against a range of background scenarios which take into account the major factors affecting future patterns in travel.

4.3.2 The DfT has produced the 'Road Traffic Forecasts 2015' (RTF15) that presents forecasts for:

→ Road traffic growth

- Vehicle pipe emissions
- Congestion
- Journey time

4.3.3 For the A27 modelling, forecast developments are controlled by the NTM in accordance with WebTAG. The NTM is used to provide goods vehicle growth factors, which cannot be derived from local traffic data, owing to the strategic nature of HGV traffic.

4.3.4 LGV and HGV growth was derived from the NTM Road Traffic Forecasts 2015 (RTF15) Scenario 1. The factors derived were based on extrapolating the growth in traffic mileage to create pro-rata growth factors between the years modelled in RTF15 for the South East of England. Growth factors were then calculated for the years between the 2015 base year and modelled forecast years, detailed in Table 4.4.

Table 4.4: National Transport Model – LGV and HGV growth rates

PERIOD	LGV	HGV
2015 to 2023	22.2%	8.8%
2015 to 2041	66.9%	32.0%

4.4 BACKGROUND AND DEVELOPMENT TRAFFIC MATRICES

MODEL TIME PERIODS AND YEARS

4.4.1 The forecast year modelling has been undertaken for the same time periods as the base model. These are;

- AM Peak Average Hour: 07:00 – 10:00
- IP Average Hour: 10:00 – 16:00
- PM Peak Average Hour: 16:00 – 19:00

4.4.2 The network has been modelled for 2023 and 2041.

4.4.3 The development of the background traffic matrices is described in Section 4 for each of the forecast modelling years.

4.5 CONSTRUCTION OF CORE SCENARIO (DO MINIMUM) MATRICES

The level of growth was determined using the developments identified in the 'Uncertainty Log' detailed in section 3.

4.5.1 Table 4.5 compares the level of housing and jobs included in the Uncertainty Log (Near Certain and More than Likely) to the increase in households and jobs in the planning data within NTEM 6.2. This comparison shows that in 2023 the level of development within Arun identified within the Uncertainty Log is significantly higher in terms of housing and jobs compared to the forecast growth in NTEM 6.2.

Table 4.5: Overview of Core Scenario Developments

Council	Uncertainty Log - Housing (dwellings)	Uncertainty Log - Total Jobs	NTEM 6.2 – Housing 2015 to 2023	NTEM 6.2 – Jobs 2015 to 2023	NTEM 6.2 – Housing 2015 to 2041	NTEM 6.2 – Jobs 2015 to 2041
Arun	2,305	2,055	5,112	1,184	16,001	1,498

4.5.2 Adjustments were made to the planning data within TEMPRO using the Alternative Planning Assumptions tool to derive adjusted car traffic growth factors. These factors represent the background growth in car traffic. Table 4.6 and Table 4.7 compare the growth in housing and jobs in TEMPRO compared to the Uncertainty Log for 2015-2023 and 2015-2041.

Table 4.6: TEMPRO planning data differences - 2023

Council	TEMPRO Household Growth	TEMPRO Job Growth	Uncertainty Log Household Growth	Uncertainty Log Job Growth	Difference in Household Growth	Difference in Job Growth
Arun	5,112	1,184	2,305	2,055	2,807	-872

Table 4.7: TEMPRO planning data differences - 2041

Council	TEMPRO Household Growth	TEMPRO Job Growth	Uncertainty Log Household Growth	Uncertainty Log Job Growth	Difference in Household Growth	Difference in Job Growth
Arun	16,001	1,498	3,300	2,055	12,701	-557

4.5.3 Table 4.6 shows the level of housing growth in the Uncertainty Log in 2023 with a greater number of jobs in Arun District than that contained within NTEM. The Alternative Planning Assumptions tool within the TEMPRO V6.2 program was used to adjust the planning data.

4.5.4 The revised background factors derived from the Alternative Planning Assumptions tool within TEMPRO are detailed in Appendix III.

4.5.5 Section 3 of the report outlines the uncertainty log and the developments that are included in the core forecast modelling. The trip distribution for the committed developments identified to be used in the forecast model was derived based on existing distribution from a neighbouring SATURN zone with similar land use.

4.5.6 As discussed in previous sections, the Core scenario has been constrained to TEMPRO 6.2. Unadjusted TEMPRO growth factors were applied to the base year matrix which created a constraint target for each car user class within the matrix. The adjusted TEMPRO growth factors were then applied to the base year matrix, representing background growth in traffic. Trips related to the developments in the Uncertainty Log were then added to the matrix. The matrix was then constrained to ensure the final matrix total equalled the constraint target for each user class i.e. the matrix total if only unadjusted TEMPRO V6.2 growth factors were applied. The development trips were preserved during this process, but the remainder of the matrix was constrained to the growth in TEMPRO V6.2. A summary of the matrix totals is presented in Appendix IV.

4.5.7 Table 4.8 outlines how the car matrix totals compare when constrained to TEMPRO to when it is not constrained to TEMPRO, i.e. unconstrained. This shows there is a significant difference in terms of the planning assumptions within TEMPRO compared to what has been advised by the local planning authorities.

Table 4.8: Matrix totals

Stage of Matrix Development	Constrained Car Matrix	Unconstrained Car Matrix	Difference
AM 2023	23,838	26,144	-8.82%
AM 2041	25,646	28,164	-8.94%
IP 2023	21,188	23,247	-8.86%
IP 2041	23,855	26,331	-9.40%
PM 2023	28,052	30,537	-8.14%
PM 2041	30,478	33,360	-8.64%

FUEL AND INCOME FACTORS

4.5.8 WebTAG Unit M4 7.4.13 stipulates in the absence of a Variable Demand Model (VDM) *"the trip matrix should be multiplied by two factors, one for growth in income, the other for growth in fuel".* Factors were derived from the WebTAG Databook v1.5 (July 2016), M 4.2.1 using the formulas defined in Box 3 of WebTAG Unit M4 7.4.13.

4.5.9 Table 4.9 details the combined fuel and income factors which were applied to the car matrix after it has been constrained to TEMPRO.

Table 4.9: Fuel & Income Factor Adjustments

Period	Income Factor Adjustment	Fuel Cost Factor Adjustment	Final Combined Factor
2015 to 2023	1.017	1.022	1.039
2015 to 2041	1.072	1.032	1.104

4.5.10 A summary of the increase in matrix totals for the three modelled periods is presented below. Table 4.10 shows the percentage growth in matrix totals for the Core scenario as compared to the 2015 Base scenario.

Table 4.10: Growth in Matrix Totals over 2015

Period	2023	2041
AM	10.5%	30.0%
IP	11.8%	36.4%
PM	10.3%	30.1%

4.6 COMMITTED NETWORK IMPROVEMENTS

4.6.1 West Sussex County Council (WSCC) were contacted to ascertain the committed highways schemes that will have a bearing on the network performance in the future. Table 4.11 contains a uncertainty log for highway infrastructure.

Table 4.11: Uncertainty Log for highway infrastructure

Scheme	Authority	Uncertainty	2023	2041
→ **A284 Lyminster Bypass/ Fitzalan Link Road (Opening Year 2018):** This scheme is split into two sections. The northern section of a new road from south of the A27 at Crossbush to East Street in Littlehampton town centre, with a new roundabout on the A259 Worthing Road. This will enhance the link between Littlehampton and the A27 and will form part of the West Sussex strategic road network. The southern section between Toddington Nurseries and the A259 and the extension to the Littlehampton Academy access will be delivered by private developers. The proposed bypass will improve north-south access to Littlehampton by removing the delays associated with the existing A284 Lyminster Road and the Wick level crossing.	WSCC	**More than likely**	✓	✓
→ **A259 Corridor Improvements (Opening Year currently unknown but assumed it will be before 2023):** This scheme provides a continuous strategic corridor comprising approximately 5.1km of dual carriageway between the new A259/A284 roundabout in the west and the A259/A280 roundabout in the east. This scheme is an online improvement, mostly within the existing highway boundary, and also includes a number of junction improvements.	WSCC	**More than likely**	✓	✓
→ **Bognor Regis Relief Road (Opening Year 2016):** This scheme connects the A29 at Shripney to the A259 at Felpham, through a viaduct and forms part of the Bognor Regis Northern Relief Road.	WSCC	**More than likely**	✓	✓
→ **A27 Chichester Bypass Improvement Scheme:** Advice from Highways England is that an Uncertainty Log should contain Highways England Road Investment Strategy (RIS) schemes however on 28 February 2017, the Secretary of State wrote to Highways England instructing them to stop work on the A27 Chichester Bypass major improvement scheme	Highways England	**Hypothetical**	✗	✗

4.6.2 The More than Likely schemes were included in the Core scenario (Do Minimum) 2023 and 2041 forecasting models. Figure 1 outlines the locations of the Core (Do Minimum) schemes included Core (Do Minimum) 2023 and 2041 forecasting models. The Core scenario (Do Minimum) models thus comprise the three WSCC More than Likely schemes but with no A27 Chichester Bypass Improvement Scheme as it is classified as Hypothetical in the Uncertainty Log.

4.6.3 The following options have been taken forward for traffic forecasting and economic assessment for the Arundel study area are:

- → Option 0A
- → Option 1
- → Option 3

- Option 5A
- Option 5B.

4.6.4 The five Arundel options were assessed individually . The report presents the performance of each option and identifies which performs better for each study area. All options are also compared against the Core (Do Minimum) 2023 and 2041 forecasting models to provide an indication of impact on the overall network performance.

5 DEMAND FORECAST

5.1.1 This section of the report outlines the performance of the three options under assessment for Arundel. Option descriptions are presented in Section 1.3

5.1.2 This section presents the impact of each option to determine if they improve the existing traffic issues within the study area.

5.2 GENERALISED COSTS

5.2.1 Generalised cost parameters for route assignment in pence per minute (PPM) and pence per kilometre (PPK) were calculated using:

- Values of time
- GDP growth rates, purpose splits and vehicle occupancies
- Vehicle operating costs recommended by the DfT for use in economic appraisals of transport projects in England.

5.2.2 With advice and agreement with Highways England TAME the values for the last two points above were based on the November 2016 WebTAG databook tables and are consistent with the latest guidance contained within WebTAG Unit A1.3. Following advice within WebTAG Unit A1.3 the Value of Time for HGV has been calculated at twice the WebTAG Unit A1.3 values as these values do not take into account the influence of owners on the routeing of HGV. The generalised costs for the 2023 and 2041 core scenario models are provided in Table 5.1 and Table 5.2 respectively.

Table 5.1: 2023 forecast year Generalised Cost Parameters

Time Period	Cost	Cars – Commuting	Cars – In Work	Cars – Other	LGV	HGV
AM	PPM	22.60	33.70	15.59	23.82	48.37
	PPK	5.55	12.35	5.55	12.87	49.21
IP	PPM	22.97	34.54	16.61	23.82	48.37
	PPK	5.55	12.35	5.55	12.87	49.21
PM	PPM	22.68	34.19	16.33	23.82	48.37
	PPK	5.55	12.35	5.55	12.87	49.21

Table 5.2: 2041 forecast year Generalised Cost Parameters

Time Period	Cost	Cars – Commuting	Cars – In Work	Cars – Other	LGV	HGV
AM	PPM	32.41	48.33	22.36	34.16	69.36
	PPK	5.26	12.00	5.26	13.04	53.10
IP	PPM	32.94	49.52	23.82	34.16	69.36
	PPK	5.26	12.00	5.26	13.04	53.10
PM	PPM	32.52	49.03	23.82	34.16	69.36
	PPK	5.26	12.00	5.26	13.04	53.10

5.3 VARIABLE DEMAND MODELLING

5.3.1 It was agreed with Highways England TAME that Variable Demand Modelling (VDM) would not be undertaken at PCF Stage 1. This will be undertaken at Stage 2 using the South East Regional Transport Model.

5.4 MODEL CONVERGENCE

5.4.1 Model convergence is needed to ensure traffic flows remain stable between successive iterations of the model. In accordance with criteria set out in the WebTAG Unit M3.1, the parameters %Flow and Delta (δ) have been monitored to determine the level of convergence. %Flow measures the proportion of links in the network with flows changing by less than 5% from the previous iteration and δ is the difference between costs on chosen routes and costs on minimum cost paths. %GAP is a generalisation of the δ function to include the interaction effects within the simulation. The convergence criteria used to assess when a model is considered to have converged is shown in table 5.3.

Table 5.3: Convergence criteria

Measure of convergence	Acceptable value
'Delta' and %GAP	→ Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change < 1%	→ Four consecutive iterations greater than 98%
Percentage of links with cost change < 1%	→ Four consecutive iterations greater than 98%
Percentage change in total user costs	→ Four consecutive iterations less than 0.1%

Source: WebTAG Unit M3.1, Section 3, Table 4, January 2014

5.4.2 A level of convergence which is sufficient to ensure that scheme benefits can be estimated robustly above model 'noise' is essential and a lower value of %GAP than the 0.1% guideline may need to be achieved. The Core (Do Minimum) 2023 and 2041 forecast year models have an ISTOP value of 98% (RSTOP value of 97.5%) with a %GAP of 0.05 set as the convergence criteria with both needing to be reached for four successive iterations before convergence is reached.

5.4.3 Table 5.4 indicates that satisfactory convergence has been achieved. TAG Unit 3.10.4 suggests that delta (**δ**) values of less than 0.1% are reasonable targets. As shows, all delta values are less than 0.2% therefore the Core (Do Minimum) scenario models (2023 and 2041) the required convergence standards.

Table 5.4: Core (Do Minimum) scenario: Convergence criteria

	PEAK HOUR	ITERATION	DELTA (**Δ**)	%FLOW	&GAP
CORE (DO MINIMUM) SCENARIO: 2023	AM PEAK	16	0.0014	97.6	0.0061
		17	0.0015	98.7	0.0015
		18	0.0011	98.2	0.0029
		19	0.001	99.0	0.0015
	INTER PEAK	9	0.0008	97.9	0.0025
		10	0.0014	98.2	0.00054
		11	0.0004	97.9	0.0015
		12	0.0003	98.9	0.00031
	PM PEAK	23	0.0216	98.6	0.040
		24	0.0162	98.9	0.044
		25	0.0175	98.8	0.037
		26	0.0167	98.6	0.041
CORE (DO MINIMUM) SCENARIO: 2041	AM PEAK	44	0.0208	99.1	0.010
		45	0.0153	99.6	0.0099
		46	0.0098	99.5	0.0087
		47	0.0093	99.4	0.0091
	INTER PEAK	18	0.0102	98.8	0.026
		19	0.0101	97.9	0.020
		20	0.0084	98.6	0.016
		21	0.0074	98.6	0.016
	PM PEAK	49	0.0182	98.7	0.048
		50	0.0170	99.0	0.037
		51	0.0235	99.1	0.039
		52	0.0150	99.4	0.045

5.5 MODEL SUMMARY STATISTICS: CORE (DO MINIMUM) MODEL

5.5.1 The modelling approach for the study involved the production of three modelled time periods for two forecast years. The results from each modelled period will be considered individually in terms of Do Minimum against Do Something. The results reported include:

- Traffic volumes – defined in terms of Passenger Car Units (PCUs) per hour
- Total travel time – defined as the sum of time spent on the modelled network by all vehicles during the modelled period
- Total delay – defined as the sum of time spent in transient queues, over capacity queues and experiencing link delay
- Total travel distance – defined as the sum of distance travelled on the modelled network by all vehicles during the modelled period
- Overall average speed – the total travel distance divided by the total travel time.

5.5.2 Table 5.5 shows how the Core (Do Minimum) network performance changes over the forecast period with core growth in demand.

Table 5.5: Network Statistics for base and DM models

	Indicator			Change Relative to Base		
Base Year (per hour)	AM peak	Inter peak	PM peak			
Total Travel Time (pcu hrs)	5,624	4,642.8	6,563.6			
Total Delay (pcu hrs)	435.6	334	485.1			
Total Travel Distance (pcu km)	313,074.7	262,890.3	34,4122.8			
Average Speed (km/h)	55.7	56.6	52.4			
Total Trips	27,784.1	24,103.9	31,380			
2023 Do Minimum (per hour)						
Total Travel Time (pcu hrs)	6,746.2	5,581.6	7,322.1	19.95%	20.22%	11.56%
Total Delay (pcu hrs)	1,003.1	741.2	1,124.9	130.28%	121.92%	131.89%
Total Travel Distance (pcu km)	345,376.7	297,907,6	367,562.2	10.32%	13.32%	6.81%
Average Speed (km/h)	51.2	53.4	50.2	-8.08%	-5.65%	-4.20%
Total Trips	30,673.7	26,935.1	33,643.8	10.40%	11.75%	7.21%
2041 Do Minimum (per hour)						
Total Travel Time (pcu hrs)	8,565.4	7,298.1	9,408.8	52.30%	57.19%	43.35%
Total Delay (pcu hrs)	1,482.5	1,190.3	1,625.8	240.34%	256.38%	235.15%
Total Travel Distance (pcu km)	411,963.1	365,629.9	427,279.7	31.59%	39.08%	24.16%
Average Speed (km/h)	48.1	50.1	45.4	-13.64%	-11.48%	-13.36%
Total Trips	36,138.3	32839.4	39,684.8	30.07%	36.24%	26.47%

5.5.3 Table 5.5 shows the comparison between the base year model and the two forecast Core (Do Minimum) 2023 and 2041 forecast year models. The statistics from the overall model results provide an indication on the operation and success of the Core (Do Minimum) 2023 and 2041 forecast year models. As expected, with increased demand following traffic growth for the forecast assessment years, the model has significant increases in travel time, delay, and distance travelled.

6 ASSIGNMENT RESULTS FOR ECONOMIC ASSESSMENT

6.1 INTRODUCTION

6.1.1 This section of the report reports of the assignment results for economic assessment in terms of the level of model convergence reached, network statistics and changes in traffic flows.

OPTION MODELS

6.1.2 For the option assessment, we have assumed a study area as shown in Figure 1.

6.1.3 The five Arundel options were assessed individually. The report presents the performance of each option and identifies which performs better for each study area. All options are also compared against the Core (Do Minimum) 2023 and 2041 forecast year model to provide an indication of impact on the overall network performance. The option drawings are presented in Appendix V.

6.1.4 The following sections outlines the overall convergence statistics, modelling statistics and traffic flows for the option models in the 2023 and 2041 forecast years.

6.2 ARUNDEL OPTIONS

MODEL CONVERGENCE

6.2.1 Appendix IV shows the convergence statistics for all Arundel options:

- Option 0A
- Option 1
- Option 3
- Option 5A
- Option 5B

6.2.2 The information shown indicates that satisfactory convergence has been achieved. TAG Unit 3.10.4 suggests that delta (**δ**) values of less than 0.1% are reasonable targets. As shows, all delta values are less than 0.2% therefore the Arundel option models (2023 and 2041) meet the required convergence standards.

ARUNDEL OPTIONS

6.2.3 Table 6.1 presents the network statistics for the Arundel options and provides an indication of the performance of the Arundel models. Figure 5 shows the locations of the Arundel Options.

6.2.4 The results show that Option 0A has the largest network delay and travel time and the lowest network speeds. This option consists of junction improvements only, encompassing improvements to Crossbush Junction, Causeway roundabout, and Ford Road roundabout. This option does not include a new by-pass, and therefore does not provide the same improvements to the network as the other four options. Therefore, it is clear from the modelling results that a by-pass is required to provide the network improvements and reduce delay and improve travel time.

6.2.5 From the full by-pass options Option 5A and Option 5B have the least network delay and the highest average speed and provide the best-performance out of the Arundel options. Option 5A slightly out-performs Option 5B in all modelling periods and is identified as the best performing option for the Arundel study area.

Table 6.1: Arundel Option Network Statistics

	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
	2023 Opt 0A			2023 Opt 1			2023 Opt 3			2023 Opt 5A			2023 Opt 5B		
Total Travel Time (pcu hrs)	6,708.1	5,564.0	7,270.5	6,598.0	5,476.3	7,121.0	6,587.7	5,460.8	7.093.4	6,559.9	5,436.1	7,054.7	6,575.9	5,432.8	7,131.7
Total Delay (pcu hrs)	967.3	722.0	1,144.3	932.1	692.9	1,069.7	918.6	675.7	1,032.7	932.3	693.2	1,070.6	968.5	707.7	1,112.1
Total Travel Distance (pcu km)	346,665.3	298,353,4	368,799.3	345,200.4	297,000.3	366,698.1	349,036.8	300,355.0	370,964.2	347,320.9	299,116.9	368,867.5	346,965.9	298,616.9	367780.2
Average Speed (km/h)	51.7	53.6	50.7	52.3	54.2	51.5	53.0	55.0	52.3	52.9	55.0	52.3	52.8	55.0	51.6
Total Trips (pcu)	30,673.7	26,935.0	33,643.8	30,673.7	26,935.0	33,643.8	30,673.7	26,935.0	33,643.8	30,673.7	26,935.0	33,643.8	30,673.7	26,935.0	33,643.8
	2041 Opt 0A			2041 Opt 1			2041 Opt 3			2041 Opt 5A			2041 Opt 5B		
Total Travel Time (pcu hrs)	8,539.4	7,268.5	9,322.5	8,394.4	7,141.3	9,065.4	8,371.0	7,106.0	9,058.4	8,280.8	7,070.7	8,955.0	8,312.9	7076.8	9,087,2
Total Delay (pcu hrs)	1,491.3	1,183.8	1,682.2	1,421.6	1,125.1	1,566.6	1,395.4	1,090.6	1,51.8.2	1,373.1	1,103.2	1,526.4	1,420.4	1,121.5	1,591.8
Total Travel Distance (pcu km)	413,132.1	367,148.8	434,587.0	410.721.1	365,087,6	434,559.1	415,198.4	391,162.9	436,410.0	413,130.4	367,327.6	434,403.8	412,204.4	366,434.8	433,517.9
Average Speed (km/h)	48.4	50.5	46.6	48.9	51.1	47.9	49.6	52.0	48,2	49.9	48,1	48.5	49.6	51.8	47.7
Total Trips (pcu)	36,138.5	32,839.3	39.684.8	36,138.5	32,839.3	39,684.8	36,138.5	32,839.3	38,684.8	36,138.5	32,839.3	39,684.8	36,138.5	32,839.3	39,684.8

6.2.6 Appendix VI presents the traffic flow diagrams for the Arundel options and the traffic flow comparison diagrams. The diagrams provide an indication of impact on traffic flows for each of the assessment periods for each of the options. This provides a more detailed review of the true impact of the proposed options through the analysis of the traffic impact in the local area.

6.2.7 For an overview of the impact of flows, Table 6.2 to 6.7 presents the network flow for key points in the AM peak (2023 and 2041), interpeak (2023 and 2041) and PM peak (2023 and 2041) scenarios.

6.2.8 The location of these key points is presented in Figure 5. These points are the bypass itself (if the option has a bypass), the arms where it re-joins the network and the A27 arms of two major junctions near Arundel.

6.2.9 The table shows that Option 0A attracts more road users to the existing key junctions than the DM model in all scenarios Option 1 attracts the largest amount of users to a potential bypass than the other options and also increases flow over both junctions, but decreases it significantly going into Arundel.

6.2.10 Option 3, Option 5A and Option 5B attract a significant amount of traffic away from Ford Road roundabout to the potential bypass, but increases traffic using Crossbush roundabout.

Table 6.2: Network flow (for key points as presented in Figure 5) in the 2023 AM peak scenario

2023 AM Peak	Flows						
	Base (2016 only)	Core (DM)	Option 0A	Option 1	Option 3	Option 5A	Option 5B
New bypass - eastbound	N/A	N/A	N/A	1811	1267	1446	1508
New bypass - westbound	N/A	N/A	N/A	1600	1197	1374	1480
East of new bypass connecting junction - eastbound	N/A	N/A	N/A	1	28	32	30
East of new bypass connecting junction - westbound	N/A	N/A	N/A	0	52	111	116
West of new bypass connecting junction - eastbound	N/A	N/A	N/A	1812	1295	1465	1490
West of new bypass connecting junction - westbound	N/A	N/A	N/A	1544	1249	1462	1549
East of Crossbush Roundabout – A27 eastbound	1263	1473	1812	1961	1868	2020	2080
East of Crossbush Roundabout – A27 westbound	1115	1520	1582	1716	1609	1733	1861
North of Crossbush Roundabout – A27 northbound	1284	1331	1404	52	282	282	287
North of Crossbush Roundabout – A27 southbound	1500	1500	1707	145	603	594	593
East of Ford Roundabout – A27 eastbound	1301	1224	1661	1812	531	522	521
East of Ford Roundabout – A27 westbound	1267	1310	1315	1544	245	244	249
West of Ford Roundabout – A27 eastbound	1152	1170	1273	1320	28	67	58
West of Ford Roundabout – A27 westbound	1116	1196	1152	1196	52	93	97

Table 6.2: Network flow (for key points as presented in Figure 5) in the 2041 AM peak scenario for the Arundel Options

2041 AM Peak	Flows						
	Base (2016 only)	Core (DM)	Option 0A	Option 1	Option 3	Option 5A	Option 5B
New bypass - eastbound	N/A	N/A	N/A	2,141	1,434	1,561	1,664
New bypass - westbound	N/A	N/A	N/A	1,950	1,443	1,655	1,682
East of new bypass connecting junction - eastbound	N/A	N/A	N/A	1	23	26	45
East of new bypass connecting junction - westbound	N/A	N/A	N/A	0	105	168	290
West of new bypass connecting junction - eastbound	N/A	N/A	N/A	2,142	1,475	1531	1492
West of new bypass connecting junction - westbound	N/A	N/A	N/A	1,885	1,548	1,752	1,756
East of Crossbush Roundabout – A27 eastbound	1,263	1,500	2,041	2,360	2,274	2,367	2,370
East of Crossbush Roundabout – A27 westbound	1,115	1,666	1,826	2,013	1,900	2,076	2,135
North of Crossbush Roundabout – A27 northbound	1,284	1,458	1,700	62	402	402	424
North of Crossbush Roundabout – A27 southbound	1,500	1,550	1,943	167	795	772	698
East of Ford Roundabout – A27 eastbound	1,301	1,247	1,905	2,142	710	687	614
East of Ford Roundabout – A27 westbound	1,267	1,204	1,619	1,885	353	353	375
West of Ford Roundabout – A27 eastbound	1,152	1,118	1,392	1,450	23	77	41
West of Ford Roundabout – A27 westbound	1,116	1,294	1,341	1,441	105	111	111

Table 6.3: Network flow (for key points as presented in Figure 5) in the 2023 Inter peak scenario for the Arundel Options

2023 Inter Peak	Flows						
	Base (2016 only)	Core (DM)	Option 0A	Option 1	Option 3	Option 5A	Option 5B
New bypass - eastbound	N/A	N/A	N/A	1,512	1,192	1,381	1,496
New bypass - westbound	N/A	N/A	N/A	1,380	999	1,178	1,187
East of new bypass connecting junction - eastbound	N/A	N/A	N/A	5	57	100	8
East of new bypass connecting junction - westbound	N/A	N/A	N/A	0	66	139	145
West of new bypass connecting junction - eastbound	N/A	N/A	N/A	1,517	1,248	1,471	1,483
West of new bypass connecting junction - westbound	N/A	N/A	N/A	1,337	1,065	1,287	1,311
East of Crossbush Roundabout – A27 eastbound	1,160	1,419	1,552	1,670	1,621	1,790	1,893
East of Crossbush Roundabout – A27 westbound	1,040	1,581	1,634	1,722	1,655	1,781	1,827
North of Crossbush Roundabout – A27 northbound	1,107	1,273	1,329	139	404	401	410
North of Crossbush Roundabout – A27 southbound	1,416	1,500	1,551	231	510	506	504
East of Ford Roundabout – A27 eastbound	1,264	1,335	1,402	1,517	328	326	324
East of Ford Roundabout – A27 westbound	1,003	1,155	1,164	1,337	262	262	267
West of Ford Roundabout – A27 eastbound	1,064	1,139	1,178	1,247	57	109	57
West of Ford Roundabout – A27 westbound	861	1,022	949	994	66	130	135

Table 6.4: Network flow (for key points as presented in Figure 5) in the 2041 Inter peak scenario for the Arundel Options

2041 Inter Peak	Flows						
	Base (2016 only)	Core (DM)	Option 0A	Option 1	Option 3	Option 5A	Option 5B
New bypass - eastbound	N/A	N/A	N/A	1,892	1,379	1,661	1,565
New bypass - westbound	N/A	N/A	N/A	1,678	1,258	1,308	1,634
East of new bypass connecting junction - eastbound	N/A	N/A	N/A	6	60	47	33
East of new bypass connecting junction - westbound	N/A	N/A	N/A	0	80	170	349
West of new bypass connecting junction - eastbound	N/A	N/A	N/A	1,897	1,439	1,696	1,500
West of new bypass connecting junction - westbound	N/A	N/A	N/A	1,626	1,338	1423	1,884
East of Crossbush Roundabout – A27 eastbound	1,160	1,478	1,914	2,047	1,990	2,243	2,196
East of Crossbush Roundabout – A27 westbound	1,040	1,852	1,934	2,078	1,982	1,998	2,353
North of Crossbush Roundabout – A27 northbound	1,107	1,468	1,669	175	472	468	485
North of Crossbush Roundabout – A27 southbound	1,416	1,500	1,889	280	702	686	690
East of Ford Roundabout – A27 eastbound	1,264	1,318	1,745	1,897	476	462	467
East of Ford Roundabout – A27 westbound	1,003	1,235	1,509	1,626	294	294	311
West of Ford Roundabout – A27 eastbound	1,064	1,226	1,377	1,432	60	89	65
West of Ford Roundabout – A27 westbound	861	1,190	1,155	1,212	80	158	161

Table 6.5: Network flow (for key points as presented in Figure 5) in the 2023 PM peak scenario for the Arundel Options

2023 PM Peak	Flows						
	Base (2016 only)	Core (DM)	Option 0A	Option 1	Option 3	Option 5A	Option 5B
New bypass - eastbound	N/A	N/A	N/A	1,759	1,257	1,374	1,498
New bypass - westbound	N/A	N/A	N/A	1,981	1,511	1,621	1,501
East of new bypass connecting junction - eastbound	N/A	N/A	N/A	15	61	95	18
East of new bypass connecting junction - westbound	N/A	N/A	N/A	0	79	128	141
West of new bypass connecting junction - eastbound	N/A	N/A	N/A	1,774	1,318	1,453	1,475
West of new bypass connecting junction - westbound	N/A	N/A	N/A	1,948	1,590	1,669	1,601
East of Crossbush Roundabout – A27 eastbound	1,227	1,390	1,519	1,669	1,624	1,694	1,793
East of Crossbush Roundabout – A27 westbound	1,476	1,681	1,761	1,929	1,867	1,869	1,872
North of Crossbush Roundabout – A27 northbound	1,437	1,500	1,773	40	398	350	408
North of Crossbush Roundabout – A27 southbound	1,500	1,500	1,834	395	819	802	795
East of Ford Roundabout – A27 eastbound	1,263	1,245	1,530	1,774	485	468	470
East of Ford Roundabout – A27 westbound	1,311	1,055	1,790	1,948	375	327	381
West of Ford Roundabout – A27 eastbound	1,006	1,025	1,173	1,242	61	95	53
West of Ford Roundabout – A27 westbound	1,281	1,327	1,428	1,475	79	111	120

Table 6.6: Network flow (for key points as presented in Figure 5) in the 2041 PM peak scenario for the Arundel Options

2041 PM Peak	Flows						
	Base (2016 only)	Core (DM)	Option 0A	Option 1	Option 3	Option 5A	Option 5B
New bypass - eastbound	N/A	N/A	N/A	2,113	1,405	1,607	1,697
New bypass - westbound	N/A	N/A	N/A	1,402	1,747	2,007	1,951
East of new bypass connecting junction - eastbound	N/A	N/A	N/A	17	70	72	62
East of new bypass connecting junction - westbound	N/A	N/A	N/A	0	114	290	368
West of new bypass connecting junction - eastbound	N/A	N/A	N/A	2,130	1,475	1,533	1,500
West of new bypass connecting junction - westbound	N/A	N/A	N/A	2,365	1,861	2,062	2,060
East of Crossbush Roundabout – A27 eastbound	1,227	1,244	1,564	1,994	1,881	2,027	2,090
East of Crossbush Roundabout – A27 westbound	1,476	1,768	1,869	2,249	2,142	2,278	2,326
North of Crossbush Roundabout – A27 northbound	1,437	1,500	1,940	43	506	413	517
North of Crossbush Roundabout – A27 southbound	1,500	1,500	1,945	473	999	984	983
East of Ford Roundabout – A27 eastbound	1,263	1,178	1,658	2,130	627	621	612
East of Ford Roundabout – A27 westbound	1,311	928	1,904	2,365	503	419	514
West of Ford Roundabout – A27 eastbound	1,006	1,062	1,197	1,378	70	87	76
West of Ford Roundabout – A27 westbound	1,281	1,319	1,533	1,601	114	145	144

7 SUMMARY AND CONCLUSION

7.1 CONCLUSION

7.1.1 This report presents the traffic forecasting methodology and assessment for the proposed options for the Arundel study area.

7.1.2 The report outlines the development of the forecast matrices and outlines the significant difference between the level of development outlined in the 'Uncertainty Log' and the details in TEMPRO V6.2. Following Highways England guidance, the forecast matrices for all assessment periods has been constrained to TEMPRO growth.

7.1.3 The modelling results demonstrate that, in terms of overall network summary statistics, Option 5A and Option 5B have the best performing network for Arundel.

7.2 DISCUSSION OF WHERE THE MODEL IS LESS ROBUST WITH STATEMENT ON HOW THIS IMPACTS ON THE MODEL'S PERFORMANCE

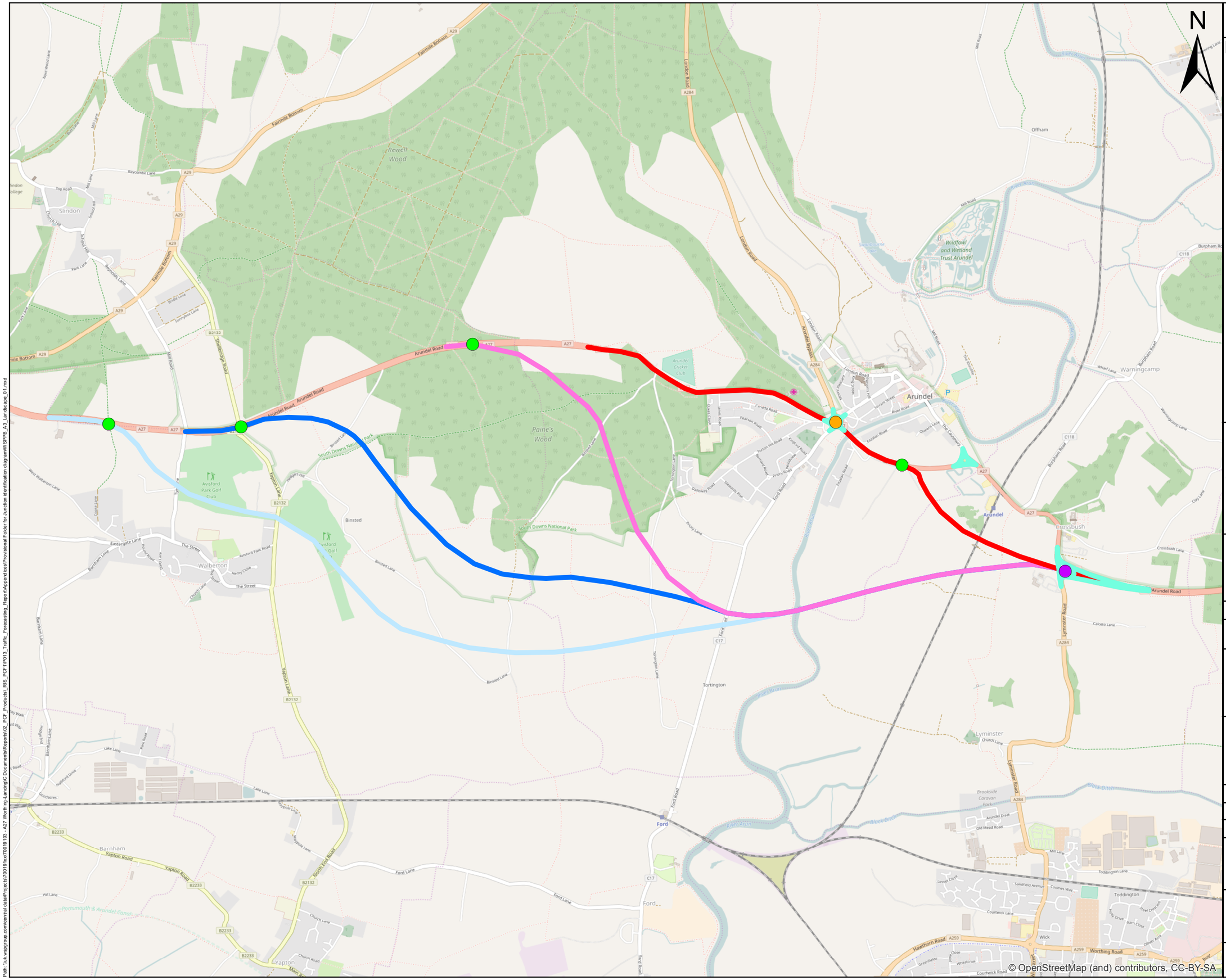
7.2.1 The network coding is detailed on and near the A27, and less detailed at the edges of the model. The zoning system has the purpose of loading the traffic onto the network and distributing it to the A27, which is the main focus of the model and other key routes in the study area. Therefore, the level of performance on the A27 is acceptable, whereas less attention has been given to the less detailed, local network away from the A27 other than on the feeder routes for the A27 corridor. This is consistent with the approach to the base year model and detailed in the LMVR, and is also applicable to the forecasting models.

7.2.2 There is traffic growth on the local network which increases traffic levels exiting from some zones. This is leading to junction capacity issues in the forecasts on unmitigated sections of the network, which may be a function of the general coding convention adopted. These issues therefore mean revisions to the coding of these junctions may be required, which would lead to subsequent revisions of the base model.

7.3 DISCUSSION OF WHERE THE MODEL'S REPRESENTATION OF TRAFFIC AND TRAVEL COULD BE FURTHER IMPROVED IN THE FUTURE

7.3.1 The PCF Stage 2 work will build on the modelling undertaken at PCF Stage 1. The results of the PCF Stage 1 model will be used to verify the output from the new South East Regional Transport Model and amend the approach to matrix building in the base year to incorporate new data, specifically Mobile Phone Data.

Figures



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Revision Details	By / Check	Date	Suffix

Drawing Status: FINAL

Job Title: A27 Arundel Bypass

Drawing Title: Positions of the Junctions Featured in the Arundel Flow Diagrams

Scale at A3: 1:22,710

Drawn		
HM		

Stage 1 check	Stage 2 check	Originated	Date
RW	RW	HM	27/01/2017

0 100 200 300 400 500 600 700 800 900
Metres

WSP | PARSONS BRINCKERHOFF
1 Capital Quarter,
Tyndal Street, Cardiff, CF10 4BZ
Tel: 02920 769200

Drawing Number: Figure 5

Rev: -

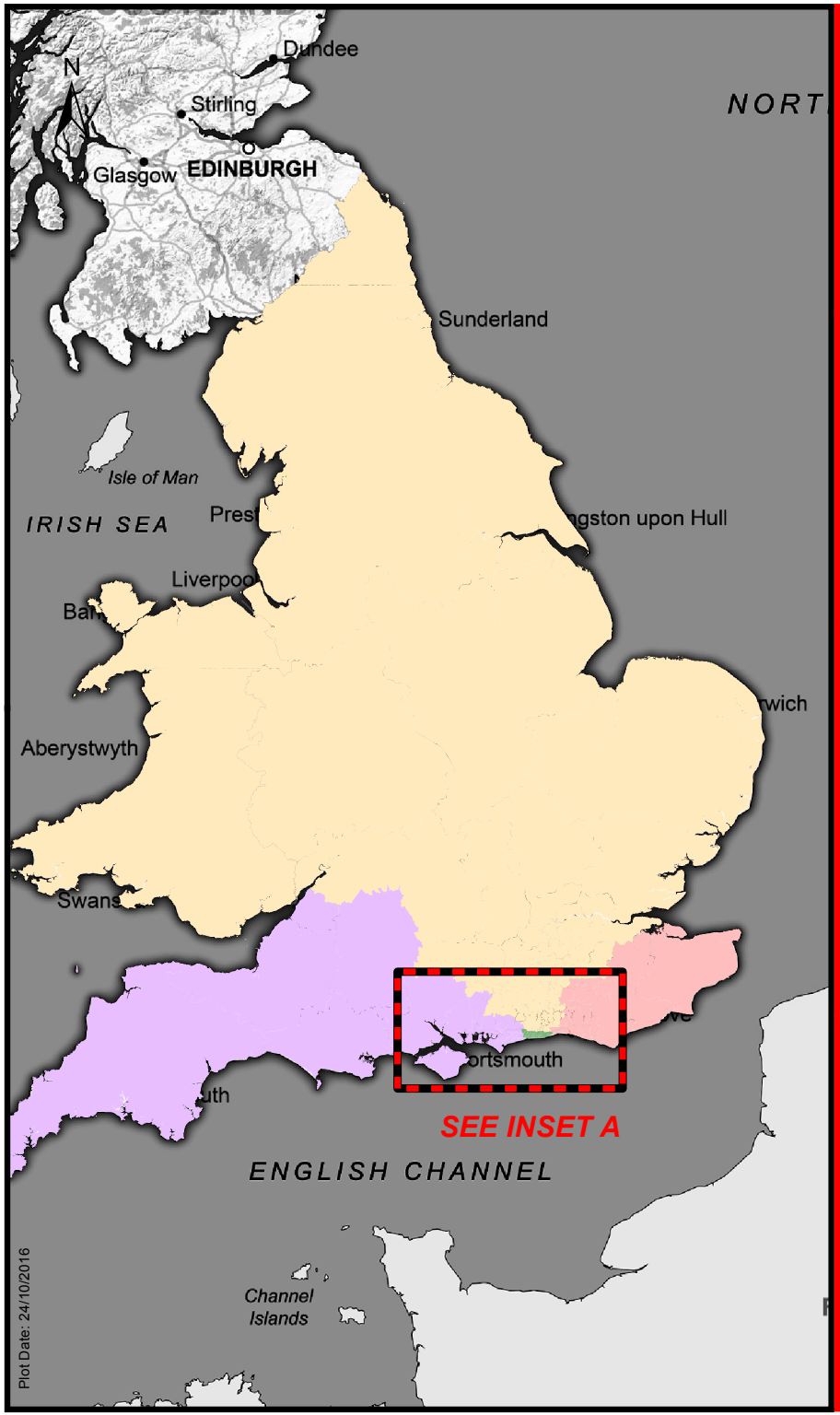
Path: \\uk.wspgroup.com\central data\Projects\70019xx\70019103 - A27 Worthing-Lancing\C Documents\Reports\02_PCF_Products_RIS_PCF1\P013_Traffic_Forecasting_Report\Appendices\Provisional Folder for Junction identification diagram\WSPPB_A3_Landscape_01.mxd

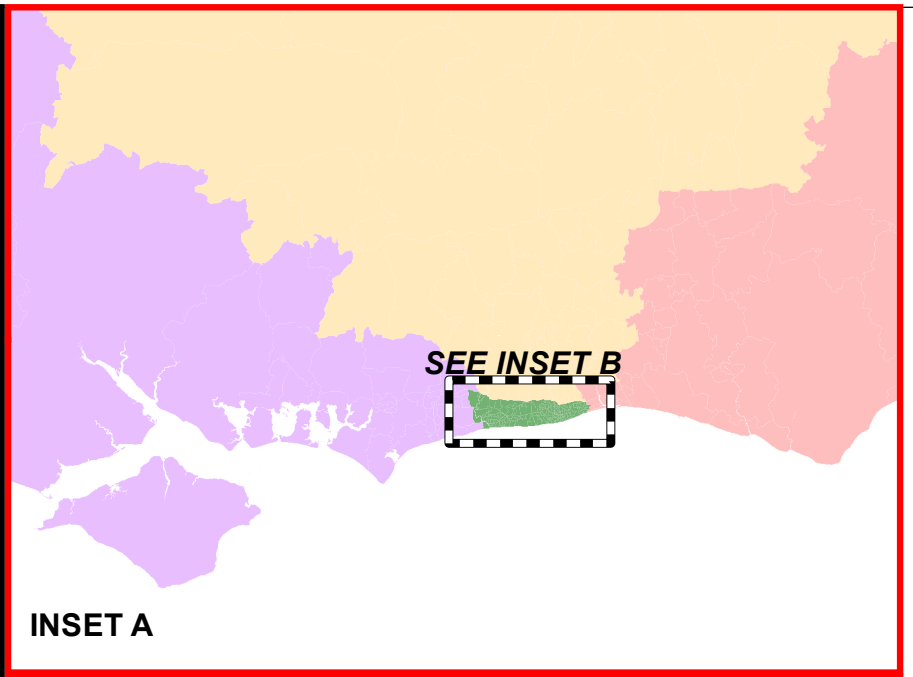
Appendix I

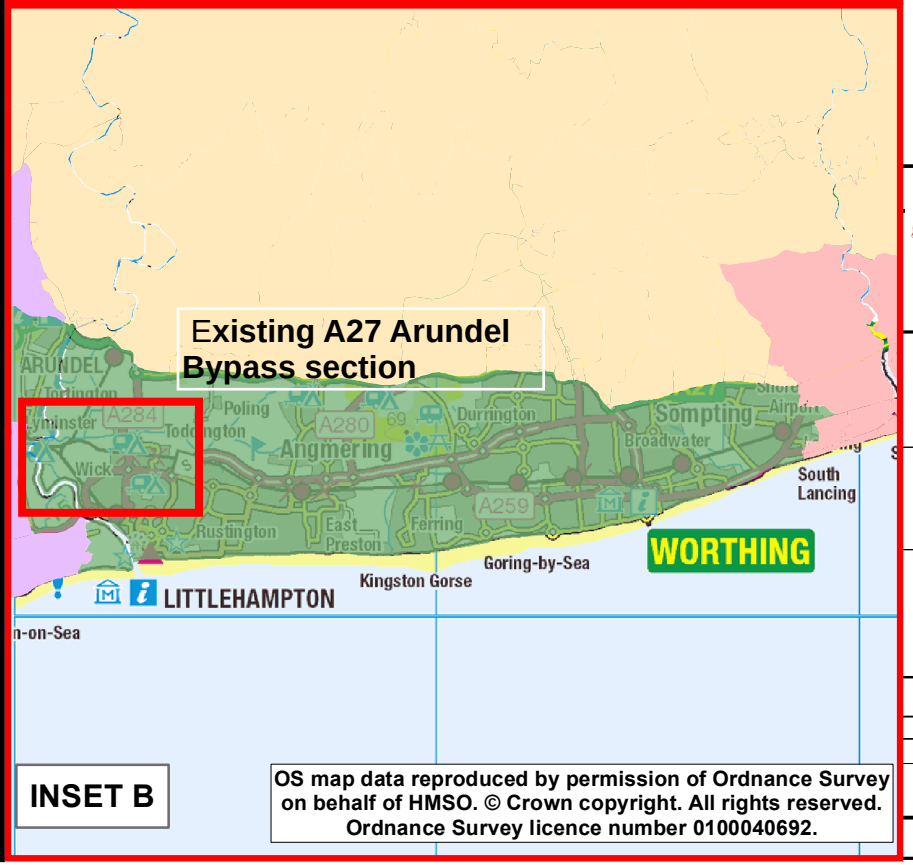
MODEL COVERAGE

APPENDIX I-1

LOCATION PLAN







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Legend

- North
- West
- East
- Internal

Sector #	Sector Ref	Zone Coverage
1	Internal	1 - 176
2	West	177 - 233
3	East	234 - 292
4	North	293 - 384

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70 Chancery Lane
London
WC2A 1AF
Tel: 44-(0)207 - 314 - 5000

Client: highways england

Site/Project:

A27 Arundel Bypass

Title:

SATURN Model Sector Structure

Drawn: SV	Checked: Michael Rolfe
	Approved: Andrew Stoneman
Date: 24/10/2016	Scale: NTS
Project Number:	
70019688 70019103	Appendix A-1

Appendix II

UNADJUSTED AND ADJUSTED TEMPRO FACTORS

UNADJUSTED TEMPRO FACTORS

UNADJUSTED DEVELOPMENT TOTALS

LOCALITY	2015 HOUSEHOLDS	2015 JOBS	2023 HOUSEHOLDS	2023 JOBS	2041 HOUSEHOLDS	2041 JOBS
Arun	71,204	58,107	76,316	59,290	87,205	59,605

CAR DRIVER - 2023

BASE YEAR:	**2015**
Trip end Type:	Origin / Destination
Future Year:	**2023**

NAME	AM Origin	AM Destination	IP Origin	IP Destination	PM Origin	PM Destination
Adur	1.0294	1.0458	1.055	1.054	1.0444	1.0341
Arun	1.0629	1.052	1.0839	1.0828	1.0602	1.0679
Worthing	1.0437	1.0388	1.0511	1.0511	1.0403	1.0428
Chichester, Crawley, Horsham, Mid Sussex (Rest of West Sussex)	1.0363	1.0383	1.0568	1.0567	1.0416	1.0411
Berkshire, Buckinghamshire, Isle of Wight, Kent, Oxfordshire, Surrey, East Sussex (Rest of South East England)	1.0493	1.0524	1.0683	1.0681	1.0545	1.0529
Brighton & Hove	1.0614	1.05	1.0565	1.0579	1.05	1.0555
East Midlands	1.0543	1.0543	1.0794	1.0794	1.0583	1.0583
East of England	1.0628	1.0723	1.0953	1.0948	1.0739	1.0684
London	1.0722	1.0592	1.0783	1.0792	1.0613	1.0682
North East England, North West England, Yorkshire & Humber	1.0523	1.0523	1.0657	1.0657	1.0539	1.0539
South West England	1.0488	1.0488	1.0781	1.0781	1.0539	1.0539

CAR DRIVER - 2041

BASE YEAR:	**2015**
Trip end Type:	Origin / Destination
Future Year:	**2041**

NAME	AM Origin	AM Destination	IP Origin	IP Destination	PM Origin	PM Destination
Adur	1.0848	1.1281	1.1746	1.1715	1.129	1.1021
Arun	1.1707	1.1399	1.258	1.2539	1.1709	1.1925
Worthing	1.1171	1.1027	1.1637	1.1628	1.1127	1.1214
Chichester, Crawley, Horsham, Mid Sussex (Rest of West Sussex)	1.1038	1.1037	1.176	1.1763	1.1187	1.1211
Berkshire, Buckinghamshire, Isle of Wight, Kent, Oxfordshire, Surrey, East Sussex (Rest of South East England)	1.142	1.1493	1.2112	1.2102	1.1591	1.1557
Brighton & Hove	1.1783	1.1388	1.1705	1.1753	1.1422	1.161
East Midlands	1.1602	1.1602	1.2529	1.2529	1.1763	1.1763
East of England	1.19	1.2159	1.301	1.2993	1.2248	1.2098
London	1.2208	1.1866	1.2498	1.2526	1.1921	1.2091
North East England, North West England, Yorkshire & Humber	1.1642	1.1642	1.2092	1.2092	1.1699	1.1699
South West England	1.1526	1.1526	1.2467	1.2467	1.1695	1.1695

ADJUSTED TEMPRO FACTORS

ADJUSTED DEVELOPMENT TOTALS

LOCALITY	2015 HOUSEHOLDS	2015 JOBS	2023 HOUSEHOLDS	2023 JOBS	2041 HOUSEHOLDS	2041 JOBS
Arun	71,204	58,107	74,011	58,107	83,905	58,107

CAR DRIVER - 2023

BASE YEAR:	**2015**
Trip end Type:	Origin / Destination
Future Year:	**2023**

NAME	AM Origin	AM Destination	IP Origin	IP Destination	PM Origin	PM Destination
Adur	1.0294	1.0459	1.0551	1.0540	1.0445	1.0342
Arun	1.0327	1.0291	1.0566	1.0553	1.0353	1.0384
Worthing	1.0319	1.0367	1.0444	1.0440	1.0360	1.0322
Chichester, Crawley, Horsham, Mid Sussex (Rest of West Sussex)	1.0357	1.0356	1.0550	1.0550	1.0393	1.0402

CAR DRIVER - 2041

BASE YEAR:	**2015**
Trip end Type:	Origin / Destination
Future Year:	**2041**

NAME	AM Origin	AM Destination	IP Origin	IP Destination	PM Origin	PM Destination
Adur	1.0848	1.1282	1.1747	1.1715	1.1291	1.1021
Arun	1.1290	1.1085	1.2179	1.2137	1.1362	1.1512
Worthing	1.1053	1.1005	1.1565	1.1552	1.1083	1.1107
Chichester, Crawley, Horsham, Mid Sussex (Rest of West Sussex)	1.1034	1.1019	1.1748	1.1752	1.1172	1.1205

Appendix III

MATRIX TOTALS AND CONVERGENCE

MATRIX TOTALS

AM 2023

User Class	Base Matrix	TEMPRO Constraint	Background Growth	Development TRIPS	Unconstrained	TOTAL
UC1	14,817.29	15,496.52	15,350.58	1,817.03	17,167.62	15,496.55
UC2	1,144.73	1,197.85	1,185.8	0	1,185.8	1,197.85
UC3	5,946.11	6,220.92	6,155.4	719.42	6,874.82	6,220.93
UC4	413	431.36	428.98	0	428.98	431.37
UC5	469.77	490.97	486.48	0	486.48	490.97
TOTAL	22,790.89	23,837.62	23,607.26	2,536.45	26,143.7	23,837.67

AM 2041

User Class	Base Matrix	TEMPRO Constraint	Background Growth	Development TRIPS	Unconstrained	TOTAL
UC1	14,817.29	16,670.05	16,487.06	2,011.44	18,498.51	16,670.09
UC2	1,144.73	1,289.71	1,274.56	0	1,274.56	1,289.71
UC3	5,946.11	6,695.02	6,611.31	796.39	7,407.7	6695
UC4	413	463.86	460.99	0	460.99	463.86
UC5	469.77	527.67	521.99	0	521.99	527.67
TOTAL	22,790.89	25,646.32	25,355.91	2,807.83	28,163.74	25,646.33

IP 2023

User Class	Base Matrix	TEMPRO Constraint	Background Growth	Development TRIPS	Unconstrained	TOTAL
UC1	3,421.57	3,634.24	3,594.53	1,645.64	5,240.17	3,634.24
UC2	822.66	875.47	864.04	0	864.04	875.47
UC3	13,231.26	14,065.17	13,904.45	651.55	14556	14,065.17
UC4	928.26	986.34	976.42	0	976.42	986.34
UC5	1,530.67	1,627.07	1,609.94	0	1,609.94	1,627.07
TOTAL	19,934.41	21,188.29	20,949.37	2,297.19	23,246.56	21,188.29

IP 2041

User Class	Base Matrix	TEMPRO Constraint	Background Growth	Development TRIPS	Unconstrained	TOTAL
UC1	3,421.57	4,087.09	4,037.92	1,984.33	6,022.25	4,087.08
UC2	822.66	987.82	973.92	0	973.92	987.82
UC3	13,231.26	15,838.85	15,638.03	785.65	16,423.68	15,838.82
UC4	928.26	1,109.13	1099	0	1,099	1,109.13
UC5	1,530.67	1,831.72	1,812.11	0	1,812.11	1,831.72
TOTAL	19,934.41	23,854.61	23,560.98	2,769.98	26,330.96	23,854.57

PM 2023

User Class	Base Matrix	TEMPRO Constraint	Background Growth	Development TRIPS	Unconstrained	TOTAL
UC1	13,438.33	14,088.79	13,954.87	1,986.46	15,941.33	14,088.83
UC2	1,367.28	1,435.21	1,418.4	0	1,418.4	1,435.21
UC3	10,084.9	10,581.94	10,461.68	786.49	11,248.17	10,581.97
UC4	560.9	588.76	584.17	0	584.17	588.76
UC5	1,293.96	1356.75	1345	0	1345	1,356.75
TOTAL	26,745.37	28,051.45	27,764.12	2,772.96	30,537.08	28,051.52

PM 2041

User Class	Base Matrix	TEMPRO Constraint	Background Growth	Development TRIPS	Unconstrained	TOTAL
UC1	13,438.33	15,298.6	15,128.43	2,327.89	17,456.31	15,298.55
UC2	1,367.28	1,560.93	1,539.67	0	1,539.67	1,560.93
UC3	10,084.9	11,502.78	11,348.15	921.67	12,269.82	11,502.8
UC4	560.9	641.1	635.43	0	635.43	641.09
UC5	1,293.96	1,474.29	1,459.13	0	1,459.13	1,474.29
TOTAL	26,745.37	30,477.7	30,110.8	3,249.56	33,360.36	30,477.66

	PEAK HOUR	ITERATION	DELTA (Δ)	%FLOW	&GAP
ARUNDEL OPTION 0A: 2023	AM PEAK	11	0.0014	98.1	0.0021
		12	0.0017	98.1	0.0011
		13	0.0009	98.8	0.0011
		14	0.0008	99.0	0.00098
	INTER PEAK	8	0.0007	97.5	0.0078
		9	0.0005	98.3	0.00078
		10	0.0004	98.6	0.00038
		11	0.0005	98.9	0.00037
	PM PEAK	16	0.0214	98.9	0.041
		17	0.0207	98.4	0.042
		18	0.0177	98.7	0.037
		19	0.0190	98.9	0.033
ARUNDEL OPTION 0A: 2041	AM PEAK	85	0.0093	97.5	0.013
		86	0.0117	98.1	0.013
		87	0.0182	97.9	0.012
		88	0.0151	98.5	0.037
	INTER PEAK	17	0.0031	98.5	0.0042
		18	0.0025	98.9	0.0052
		19	0.0049	99.1	0.0019
		20	0.0022	99.0	0.0018
	PM PEAK	59	0.0128	99.1	0.032
		60	0.0268	99.3	0.031
		61	0.0121	99.0	0.031
		62	0.0128	99.3	0.039

Arundel Option 1: Convergence

	PEAK HOUR	ITERATION	DELTA (Δ)	%FLOW	&GAP
ARUNDEL OPTION 1: 2023	AM PEAK	16	0.0010	98.5	0.0013
		17	0.0009	97.8	0.0012
		18	0.0011	98.4	0.00093
		19	0.0006	98.7	0.00079
	INTER PEAK	8	0.0009	97.7	0.00079
		9	0.0005	98.7	0.00052
		10	0.0005	98.8	0.00039
		11	0.0004	98.9	0.00031
	PM PEAK	19	0.0069	97.9	0.0089
		20	0.0103	98.4	0.016
		21	0.0064	98.7	0.0074
		22	0.0052	98.3	0.016
ARUNDEL OPTION 1: 2041	AM PEAK	172	0.0149	97.5	0.015
		173	0.0194	97.7	0.014
		174	0.0136	98.2	0.012
		175	0.0117	97.6	0.037
	INTER PEAK	37	0.0166	98.8	0.013
		38	0.0049	97.6	0.016
		39	0.0049	98.2	0.015
		40	0.0054	97.9	0.014
	PM PEAK	38	0.0166	99.1	0.040
		39	0.0155	99.1	0.031
		40	0.0156	99.0	0.031
		41	0.0126	98.7	0.039

Arundel Option 3: Convergence

	PEAK HOUR	ITERATION	DELTA (Δ)	%FLOW	&GAP
ARUNDEL OPTION 3: 2023	AM PEAK	13	0.0015	97.8	0.0021
		14	0.0014	98.0	0.0011
		15	0.0010	98.2	0.00092
		16	0.0007	99.0	0.00076
	INTER PEAK	8	0.0013	97.7	0.00099
		9	0.0009	98.1	0.00064
		10	0.0007	98.7	0.00051
		11	0.0006	98.9	0.00040
	PM PEAK	18	0.0134	97.6	0.028
		19	0.0110	97.8	0.029
		20	0.0315	98.5	0.023
		21	0.0101	98.2	0.027
ARUNDEL OPTION 3: 2041	AM PEAK	74	0.0122	97.6	0.018
		75	0.0134	98.2	0.014
		76	0.0103	98.5	0.017
		77	0.0128	98.2	0.039
	INTER PEAK	16	0.0061	97.8	0.0033
		17	0.0026	98.6	0.0021
		18	0.0035	98.8	0.0020
		19	0.0017	98.6	0.0041
	PM PEAK	35	0.0138	98.1	0.047
		36	0.0183	97.8	0.032
		37	0.0272	98.5	0.026
		38	0.0282	98.7	0.040

Arundel Option 5A: Convergence

	PEAK HOUR	ITERATION	DELTA (Δ)	%FLOW	&GAP
ARUNDEL OPTION 5A: 2023	AM PEAK	15	0.0016	98.5	0.0012
		16	0.0011	98.9	0.00083
		17	0.0006	97.9	0.00084
		18	0.0007	99.1	0.00057
	INTER PEAK	13	0.0009	98.8	0.0010
		14	0.0006	98.7	0.00069
		15	0.0005	99.1	0.00056
		16	0.0004	98.8	0.00069
	PM PEAK	55	0.0191	97.7	0.024
		56	0.0107	97.6	0.025
		57	0.0118	97.8	0.046
		58	0.0219	98.0	0.018
ARUNDEL OPTION 5A: 2041	AM PEAK	64	0.0078	97.9	0.014
		65	0.0096	98.2	0.014
		66	0.0098	98.3	0.012
		67	0.0093	98.8	0.037
	INTER PEAK	20	0.0040	97.7	0.0042
		21	0.0161	97.6	0.0068
		22	0.0033	97.8	0.0038
		23	0.0082	97.5	0.0047
	PM PEAK	44	0.0464	98.3	0.045
		45	0.0263	98.2	0.030
		46	0.0290	99.2	0.039
		47	0.0234	98.4	0.033

Arundel Option 5B: Convergence

	PEAK HOUR	ITERATION	DELTA (Δ)	%FLOW	&GAP
ARUNDEL OPTION 5B: 2023	AM PEAK	52	0.0022	97.9	0.0027
		53	0.0020	98.7	0.0028
		54	0.0026	97.7	0.0027
		55	0.0009	97.9	0.0014
	INTER PEAK	9	0.0010	98.2	0.0019
		10	0.0009	98.9	0.0012
		11	0.0009	98.8	0.00078
		12	0.0004	98.9	0.00066
	PM PEAK	42	0.0241	97.7	0.048
		43	0.0212	98.0	0.044
		44	0.0432	98.4	0.044
		45	0.0426	98.6	0.044
ARUNDEL OPTION 5B: 2041	AM PEAK	77	0.0179	97.9	0.013
		78	0.0202	98.4	0.011
		79	0.0087	98.9	0.011
		80	0.0120	99.3	0.036
	INTER PEAK	16	0.0126	97.6	0.0080
		17	0.0078	97.6	0.0098
		18	0.0098	98.3	0.0066
		19	0.0105	98.0	0.0086
	PM PEAK	62	0.0279	98.3	0.040
		63	0.0164	97.9	0.039
		64	0.0159	98.7	0.029
		65	0.0141	99.0	0.048

Appendix IV

OPTIONS DRAWINGS

APPENDIX IV-1

ARUNDEL OPTIONS

Millimetres 100 10 0

DO NOT SCALE

N

A284 ARUNDEL BYPASS

CASTLE

HOSPITAL

ARUNDEL

HAVENWOOD PARK

OPTION 2

A27 TO CHICHESTER (DUAL CARRIAGEWAY)

OLD SCOTLAND LANE

YAPTON LANE

RIVER ARUN

CROSSBUSH LANE

ARUNDEL BYPASS

OPTION 0BA

OPTION 0B

BINSTED LANE

CROSSBUSH JUNCTION

BINSTED

TORTINGTON PRIORY

WALBERTON

OPTION 5B

OPTION 5A

OPTION 5

OPTION 3

OPTION 1

OPTION 0A

A27 TO WORTHING (DUAL CARRIAGEWAY)

OPTION 4

TORTINGTON

FORD ROAD

TORTINGTON LANE

RIVER ARUN

ARUN VALLEY RAILWAY

KEY:

- OPTION 0A - JUNCTIONS IMPROVEMENTS ONLY
- OPTION 0B - ONLINE WIDENING INCORPORATING JUNCTIONS IMPROVEMENTS
- OPTION 0BA - ONLINE WIDENING + SHORT OFFLINE LINK PAST THE STATION
- OPTION 1 - ONLINE WIDENING + OFFLINE SECTION (WSCC PROPOSAL)
- OPTION 3 - OFFLINE PINK ROUTE
- OPTION 5 - OFFLINE GREEN ROUTE
- OPTION 5A - OFFLINE GREEN / BLUE / PINK ROUTE
- OPTION 5B - OFFLINE LIGHT BLUE ROUTE (AVOIDING THE ANCIENT WOODLAND)
- OPTION 2 - Not assessed as part of Stage 1
- OPTION 4 - Not assessed as part of Stage 1
- ANCIENT WOODLAND

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 (Reference shall also be made to the design hazard log).

Construction

Maintenance / Cleaning

Use

Decommissioning / Demolition

Rev.	Date	Description	By	Chk'd	App'd
P01	02/06/16	First Issue	TC	KM	BS

Drawing Status: FOR INFORMATION

Suitability: S2

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Client: Working on behalf of highways england

Project Title: REGIONAL INVESTMENT PROGRAMME
A27 ARUNDEL BYPASS

Drawing Title: INDICATIVE ALIGNMENT PROPOSALS
SCHEME SCHEMATIC
OPTIONS 0A, 0B/0BA, 1, 3, 5, 5A & 5B

Scale	Drawn	Checked	Approved	Authorised
1:10000	TC	KM	BS	AM
Original Size	**Date**	**Date**	**Date**	**Date**
A1	11/05/16	17/05/16	17/05/16	02/06/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551523 - WSP - HGN - A27AR - DR - D - 0001

Project Ref. No.: 70019688

Revision: P01

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Appendix V

OPTIONS TRAFFIC FLOW DIAGRAMS

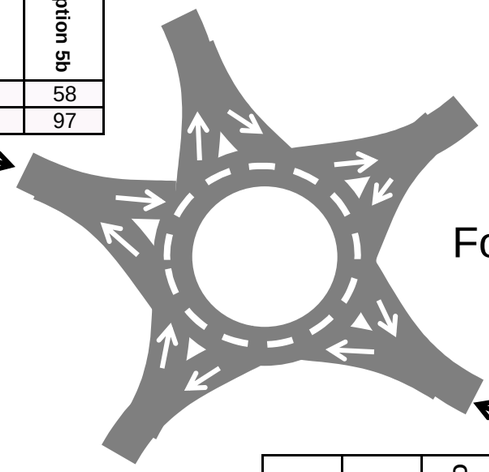
APPENDIX V-1

ARUNDEL OPTIONS – TRAFFIC FLOW DIAGRAMS

Arundel Assessment

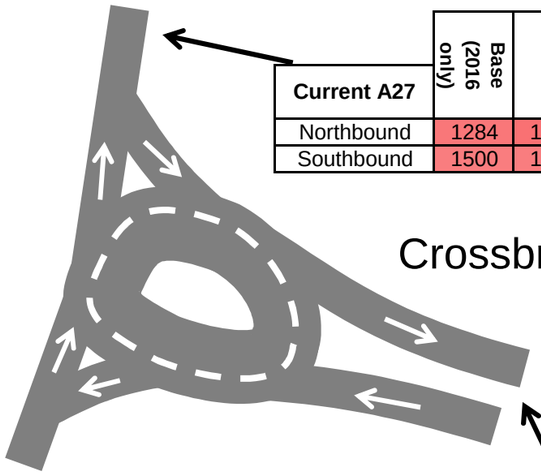
2023 AM Peak

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1152	1170	1273	1320	28	67	58
Westbound	1116	1196	1152	1196	52	93	97



Ford Roundabout

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Northbound	1284	1331	1404	52	282	282	287
Southbound	1500	1500	1707	145	603	594	593



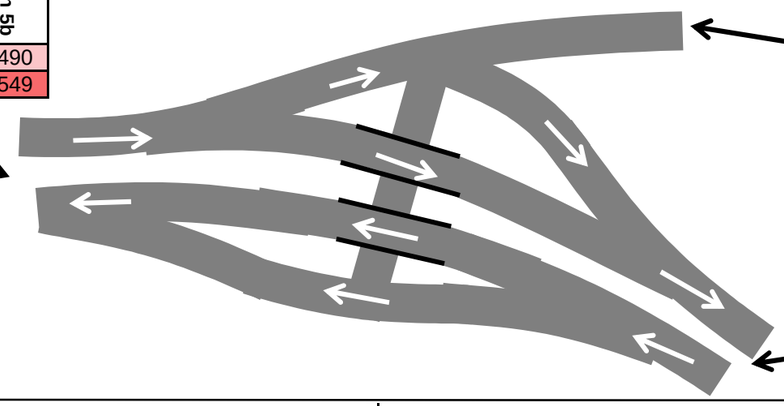
Crossbrush Roundabout

A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1263	1473	1812	1961	1868	2020	2080
Westbound	1115	1520	1582	1716	1609	1733	1861

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1301	1224	1661	1812	531	522	521
Westbound	1267	1310	1315	1544	245	244	249

West of New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	1812	1295	1465	1490
Westbound	N/A	N/A	N/A	1544	1249	1462	1549

New Bypass Junction



East of New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	1	28	32	30
Westbound	N/A	N/A	N/A	0	52	111	116

New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	1811	1267	1446	1508
Westbound	N/A	N/A	N/A	1600	1197	1374	1480

REV	DATE	DESCRIPTION	BY	CHKD	APPD

NOTES:

• PROJECT

A27 Arundel By-Pass

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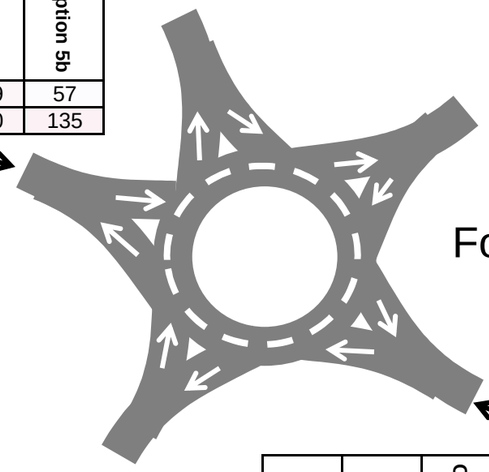
Arundel Assessment

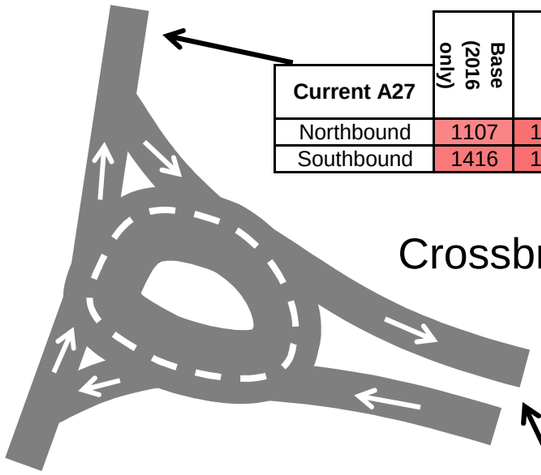
2023 IP Peak

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1064	1139	1178	1247	57	109	57
Westbound	861	1022	949	994	66	130	135



Ford Roundabout

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Northbound	1107	1273	1329	139	404	401	410
Southbound	1416	1500	1551	231	510	506	504



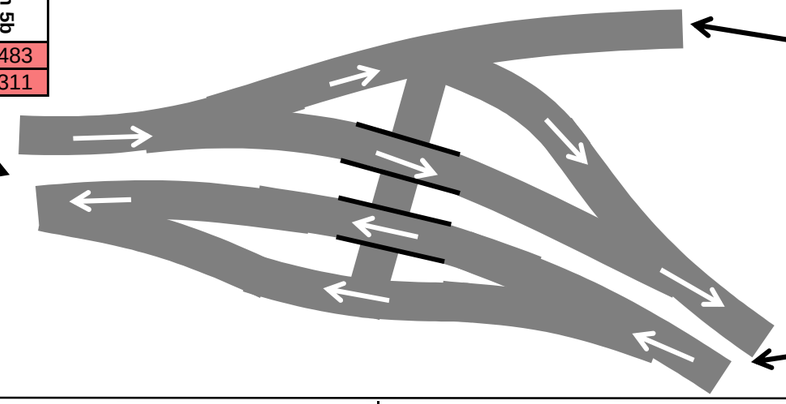
Crossbrush Roundabout

A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1160	1419	1552	1670	1621	1790	1893
Westbound	1040	1581	1634	1722	1655	1781	1827

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1264	1335	1402	1517	328	326	324
Westbound	1003	1155	1164	1337	262	262	267

West of New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	1517	1248	1471	1483
Westbound	N/A	N/A	N/A	1337	1065	1287	1311

New Bypass Junction



East of New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	5	57	100	8
Westbound	N/A	N/A	N/A	0	66	139	145

New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	1512	1192	1381	1496
Westbound	N/A	N/A	N/A	1380	999	1178	1187

REV	DATE	DESCRIPTION	BY	CHKD	APPD

NOTES:

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A27 Arundel By-Pass

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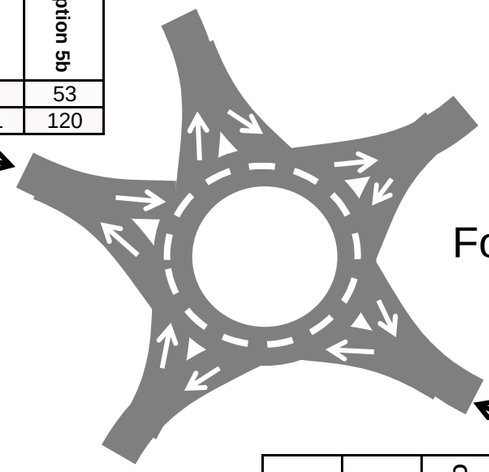
Arundel Assessment

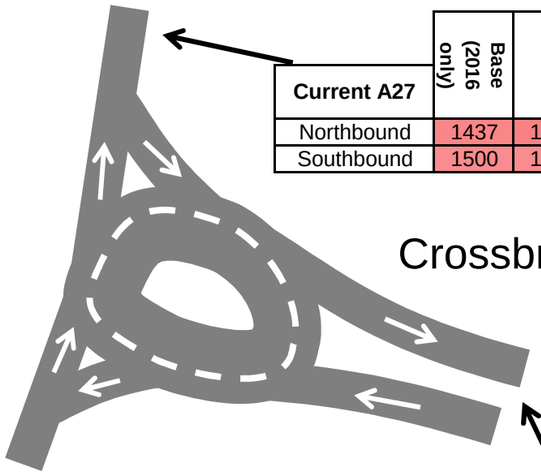
2023 PM Peak

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1006	1025	1173	1242	61	95	53
Westbound	1281	1327	1428	1475	79	111	120



Ford Roundabout

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Northbound	1437	1500	1773	40	398	350	408
Southbound	1500	1500	1834	395	819	802	795

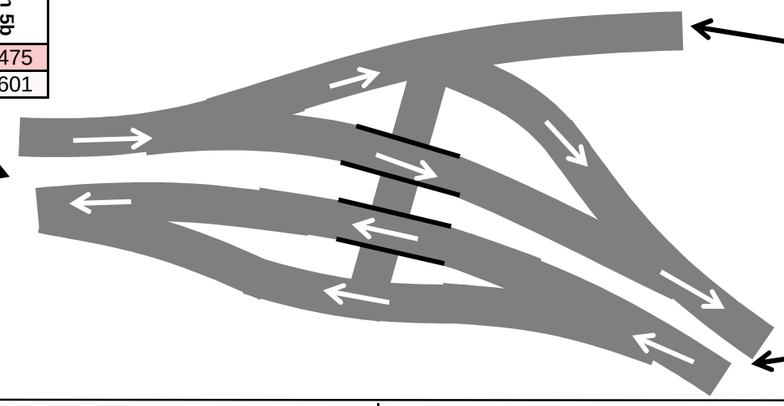


Crossbrush Roundabout

A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1227	1390	1519	1669	1624	1694	1793
Westbound	1476	1681	1761	1929	1867	1869	1872

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1263	1245	1530	1774	485	468	470
Westbound	1311	1055	1790	1948	375	327	381

West of New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	1774	1318	1453	1475
Westbound	N/A	N/A	N/A	1948	1590	1669	1601



New Bypass Junction

East of New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	15	61	95	18
Westbound	N/A	N/A	N/A	0	79	128	141

New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	1759	1257	1374	1498
Westbound	N/A	N/A	N/A	1981	1511	1621	1501

REV	DATE	DESCRIPTION	BY	CHKD	APPD

NOTES:

• PROJECT

A27 Arundel By-Pass

• FIGURE NUMBER

C-1-3

• FIGURE TITLE

A27 Arundel Assessment Key Flows

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Arundel Assessment

2041 AM Peak

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1152	1118	1392	1450	23	77	41
Westbound	1116	1294	1341	1441	105	111	111

Ford Roundabout

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Northbound	1284	1458	1700	62	402	402	424
Southbound	1500	1550	1943	167	795	772	698

Crossbrush Roundabout

A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1263	1500	2041	2360	2274	2367	2370
Westbound	1115	1666	1826	2013	1900	2076	2135

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1301	1247	1905	2142	710	687	614
Westbound	1267	1204	1619	1885	353	353	375

West of New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	2142	1475	1531	1492
Westbound	N/A	N/A	N/A	1885	1548	1752	1756

New Bypass Junction

East of New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	1	23	26	45
Westbound	N/A	N/A	N/A	0	105	168	290

New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	2141	1434	1561	1664
Westbound	N/A	N/A	N/A	1950	1443	1655	1682

REV	DATE	DESCRIPTION	BY	CHKD	APPD

NOTES:

• PROJECT

A27 Arundel By-Pass

• FIGURE NUMBER

C-1-4

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A27 Arundel Assessment Key Flows

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• DATE 20/03/17

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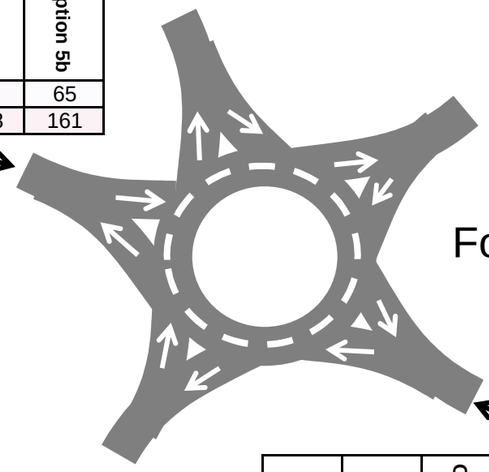
Arundel Assessment

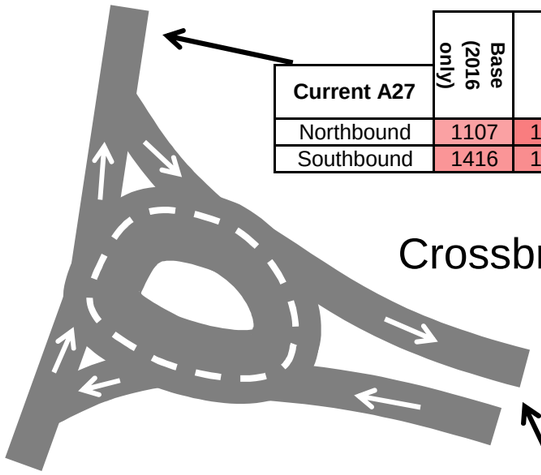
2041 IP Peak

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1064	1226	1377	1432	60	89	65
Westbound	861	1190	1155	1212	80	158	161



Ford Roundabout

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Northbound	1107	1468	1669	175	472	468	485
Southbound	1416	1500	1889	280	702	686	690



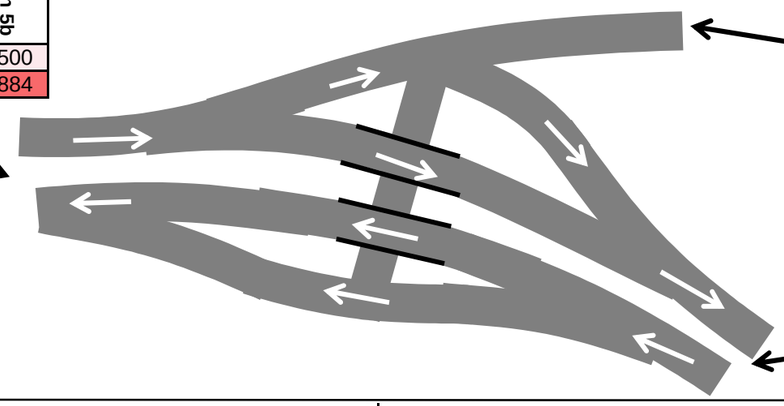
Crossbrush Roundabout

A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1160	1478	1914	2047	1990	2243	2196
Westbound	1040	1852	1934	2078	1982	1998	2353

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1264	1318	1745	1897	476	462	467
Westbound	1003	1235	1509	1626	294	294	311

West of New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	1897	1439	1696	1500
Westbound	N/A	N/A	N/A	1626	1338	1423	1884

New Bypass Junction



East of New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	6	60	47	33
Westbound	N/A	N/A	N/A	0	80	170	349

New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	1892	1379	1661	1565
Westbound	N/A	N/A	N/A	1678	1258	1308	1634

REV	DATE	DESCRIPTION	BY	CHKD	APPD

NOTES:

• PROJECT

A27 Arundel By-Pass

• FIGURE NUMBER

C-1-5

• FIGURE TITLE

A27 Arundel Assessment Key Flows

WSP | PARSONS BRINCKERHOFF

• DATE 20/03/17

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Arundel Assessment

2041 PM Peak

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1006	1062	1197	1378	70	87	76
Westbound	1281	1319	1533	1601	114	145	144

Ford Roundabout

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Northbound	1437	1500	1940	43	506	413	517
Southbound	1500	1500	1945	473	999	984	983

Crossbrush Roundabout

A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1227	1244	1564	1994	1881	2027	2090
Westbound	1476	1768	1869	2249	2142	2278	2326

Current A27	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	1263	1178	1658	2130	627	621	612
Westbound	1311	928	1904	2365	503	419	514

West of New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	2130	1475	1533	1500
Westbound	N/A	N/A	N/A	2365	1861	2062	2060

New Bypass Junction

East of New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	17	70	72	62
Westbound	N/A	N/A	N/A	0	114	290	368

New Bypass	Base (2016 only)	DM	Option 0a	Option 1	Option 3	Opiton 5a	Option 5b
Eastbound	N/A	N/A	N/A	2113	1405	1607	1697
Westbound	N/A	N/A	N/A	1402	1747	2007	1951

REV	DATE	DESCRIPTION	BY	CHKD	APPD

NOTES:

• PROJECT

A27 Arundel By-Pass

• FIGURE NUMBER

C-1-6

• FIGURE TITLE

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