A428 Black Cat to Caxton Gibbet improvements

TR010044

Volume 7

7.9 Sensitivity Test using 2020 Uncertainty Log Data

Planning Act 2008

Regulation 5(2)(q)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

26 February 2021

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

A428 Black Cat to Caxton Gibbet improvements

Development Consent Order 202[ ]

Sensitivity Test using 2020 Uncertainty Log Data

Regulation Reference:	Regulation 5(2)(q)
Planning Inspectorate Scheme Reference	TR010044
Application Document Reference	TR010044/APP/7.9
Author	A428 Black Cat to Caxton Gibbet improvements Project Team, Highways England

Version	Date	Status of Version
Rev 1	26 February 2021	DCO Application

Table of contents

Table of Figures

Table of Tables

1. Executive summary

1.1.1 This report relates to the A428 Black Cat to Caxton Gibbet improvements scheme (the Scheme). The purpose of this report is to set out the outcome of a sensitivity test that has been undertaken to consider the potential impact of an update to the Uncertainty Log. The purpose of the Uncertainty Log is to record the assumptions relating to land use and infrastructure that will affect travel demand and supply and therefore underpin future traffic forecasts used for the Transport Assessment **[TR010044/APP/7.2]**.

1.1.2 The sensitivity test has revealed that no changes to the Scheme design are required. In addition, there are no changes expected to the conclusions on the overall significance of the assessments contained in the Environmental Statement **[TR010044/APP/6.1]** for the Scheme, and therefore no changes are required to the mitigation proposed for the Scheme.

1.1.3 This approach to assessment is considered proportionate and reasonable. It accords with the approach contained in Transport Appraisal Guidance (TAG) Unit M4 (Forecasting and Uncertainty). The sensitivity analysis was presented to relevant local authorities at a meeting on 5 February 2021, where it was agreed that the approach taken was appropriate.

2 Introduction

2.1 Background

2.1.0 This report relates to the A428 Black Cat to Caxton Gibbet improvements scheme (the Scheme). In seeking the legal powers to construct, operate and maintain the Scheme, Highways England (the Applicant) is making an application for a Development Consent Order (DCO) to the Secretary of State for Transport.

2.1.1 The purpose of this report is to set out the outcome of a sensitivity test that has been undertaken to consider the potential impact of an update to the Uncertainty Log. The purpose of the Uncertainty Log is to record the assumptions relating to land use and infrastructure that will affect travel demand and supply and therefore underpin future traffic forecasts used for the Transport Assessment **[TR010044/APP/7.2]**.

2.1.2 The Uncertainty Log that underpins the traffic model forecasts prepared for the Transport Assessment that forms part of the DCO application is based on data gathered in 2018 (2018 Uncertainty Log (UL) Data). The Scheme design and environmental assessment in the DCO application is also based on the 2018 UL Data.

2.1.3 However, recognising that the Scheme is in a growth area, updated information was requested from a number of local authorities to determine the extent of any changes in future land use projections which might impact on the traffic forecasts. Revised traffic forecasts were prepared from new planning data collected in 2020 (2020 Uncertainty Log (UL) Data), provided by the local authorities. A sensitivity test of these forecasts was subsequently carried out to determine whether the design, traffic impact and environmental assessment of the Scheme and mitigation for it (as based on forecasts derived from the 2018 UL Data) remained robust.

2.1.4 Undertaking a sensitivity test is an established way of considering the effect of uncertainty on project impacts, advocated in TAG Unit M4[1]. It enables a proportionate response to be taken to understand the potential effect of uncertainty on project impacts, and therefore whether design changes or further mitigation may be required.

2.2 Scheme description

2.2.1 The purpose of the Scheme is to address the problems of congestion, poor journey time reliability and poor resilience against incidents between the Black Cat and Caxton Gibbet roundabouts. The Scheme seeks to address these problems through construction of a new 10 mile (16 kilometre) dual 2-lane carriageway from the Black Cat roundabout to Caxton Gibbet roundabout, to be known as the A421 (hereafter referred to as the 'new dual carriageway') and in

[1] TAG Unit M4 'Forecasting Uncertainty' released in May 2019

addition approximately 1.8 miles (3 kilometre) of tie-in works shown in schematic form in **Figure 2-1**.

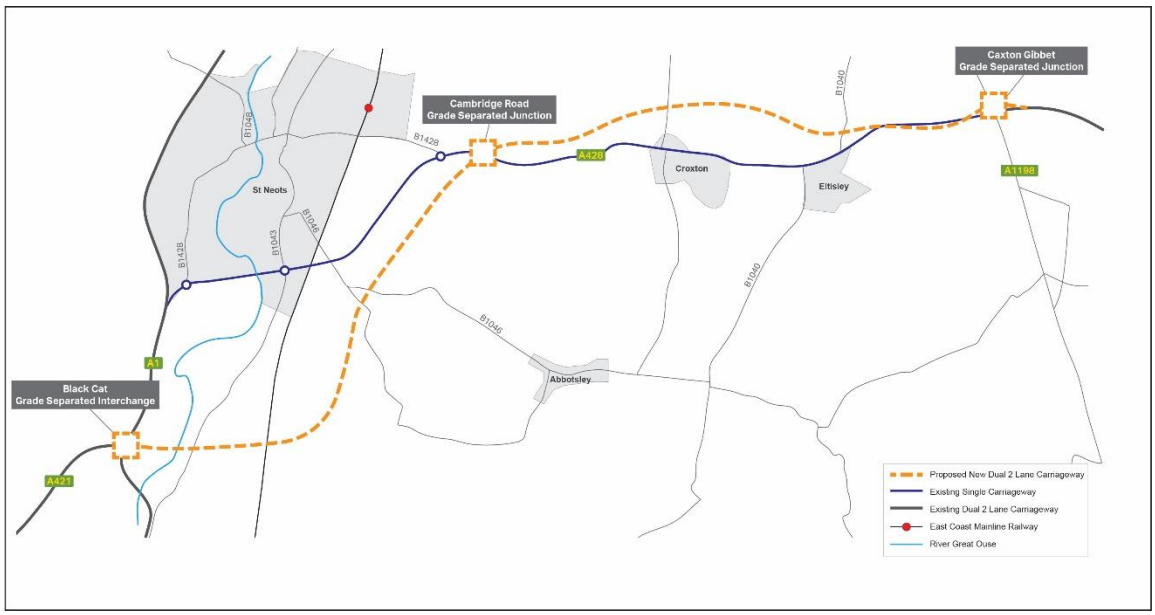

Figure 2-1 - The Scheme

2.2.2 The Scheme includes the following components:

a. A new three-level grade separated junction at Black Cat roundabout, with the A1 at the lower level, the new dual carriageway on the upper level and a roundabout between the two at approximately existing ground level. In addition to slip roads, a new free flowing link between the A421 eastbound carriageway and the A1 northbound carriageway will also be provided.

b. A new grade separated all movements junction will be constructed to the east of the existing Cambridge Road roundabout to provide access to the new dual carriageway and maintain access to the existing A428.

c. At the Caxton Gibbet roundabout, a new grade separated all movements junction will be constructed, incorporating the existing roundabout on the south side of the new dual carriageway and a new roundabout on the north side. The new dual carriageway will then tie-in to the existing A428 dual carriageway to the east of the new Caxton Gibbet junction.

d. In the vicinity of the new Black Cat junction, direct access onto the A1 from some local side roads and private premises will be closed for safety reasons. A new local road will provide an alternative route. The existing Roxton Road bridge will be demolished and replaced with a new structure to the west to accommodate the realigned A421.

e. New crossings will be constructed to enable the new dual carriageway to cross the River Great Ouse, East Coast Main Line railway, Barford Road, the B1046/Potton Road, Toseland Road and the existing A428 at Eltisley.

f. The existing A428 between St Neots and Caxton Gibbet will be de-trunked and retained for local traffic and public transport with maintenance responsibility transferred to the local highway authorities.

g. An alternative access will be provided to side roads at Chawston, Wyboston and Eltisley.

h. There will be safer routes for walkers, cyclists and horse riders.

2.2.3 A detailed description of the Scheme is set out in **Chapter 2, The Scheme** of the Environmental Statement **[TR010044/APP/6.1]**.

3 Context

3.1 Traffic

3.1.1 The Uncertainty Log contains details of future infrastructure improvement schemes and developments, whether housing or employment, which are known about at the time of compilation. The schemes and developments within the Uncertainty Log are categorised in line with TAG Unit M4 to reflect their level of certainty. Those that meet the TAG criteria of 'near certain' or 'more than likely' are then included in the future year core scenario forecasts for the scheme being appraised.

3.1.2 The Uncertainty Log was fully updated in late 2018 for the Scheme and formed the basis for the development of the traffic forecasts as reported in the Combined Modelling and Appraisal (ComMA) report **[TR010044/APP/7.10]**. The traffic forecasts developed from the 2018 UL Data formed the basis for the Transport Assessment **[TR010044/APP/7.2]**, the environmental assessments reported in the Environmental Statement **[TR010044/APP/6.1]** and economic appraisal of the Scheme, see section 4.7 of the Case for the Scheme **[TRO10044/APP/7.1]**.

3.1.3 It was decided that since the Scheme is in a 'growth area', a review of the Uncertainty Log should be undertaken to assess whether there had been any significant changes to proposed future land use that might influence forecasts of future traffic flows.

3.1.4 Data to update the Uncertainty Log was obtained from a number of local authorities between January to May 2020 (2020 UL Data) in order to assess the extent of changes and to determine whether sensitivity testing may be required.

3.1.5 The 2020 UL Data was obtained for the following districts that fell within the Area of Detailed Modelling; Bedford Borough, Central Bedfordshire, Greater Cambridge (Cambridge City and South Cambridgeshire), Huntingdonshire and Milton Keynes. The data obtained therefore facilitated a partial geographic update to the Uncertainty Log. This was considered a proportionate approach since it enabled the potential scale of the change within the area directly affected by the Scheme to be assessed.

3.1.6 The 2020 UL Data identified differences in the forecast development assumptions used when compared to the 2018 UL Data. This related to changes in housing, employment and infrastructure data.

3.1.7 **Table 3-1** presents the changes in housing quantum since November 2018 by comparing the 2020 UL data with the 2018 UL data.

Table 3-1 Housing future year change from 2018 UL to 2020 UL

	Core Scenario		% change	
District	**2025**	**2040**	**2025**	**2040**
Bedford	-1,460	-692	-15%	-5%
Cambridge City	-178	429	-2%	4%
Central Bedfordshire	3,818	6,968	54%	92%
Huntingdonshire	-1,475	-449	-14%	-3%
Milton Keynes	2,015	2,108	13%	12%
South Cambridgeshire	758	7,907	5%	28%
Totals	**3,479**	**16,271**	**5%**	**16%**

3.1.8 **Table 3-2** presents the changes in employment quantum since November 2018 by comparing the 2020 UL data with the 2018 UL Data.

Table 3-2 Employment future year change from 2018 UL to 2020 UL

	Core Scenario		%Change	
District	**2025**	**2040**	**2025**	**2040**
Bedford	393	8,556	3%	38%
Cambridge City	1,103	3,178	10%	19%
Central Bedfordshire	12,933	9,669	181%	66%
Huntingdonshire	3,190	961	51%	7%
Milton Keynes	1,140	-208	17%	-5%
South Cambridgeshire	1,088	6,487	9%	35%
Totals	**19,847**	**28,643**	**34%**	**30%**

3.1.9 **Table 3-1** shows that with respect to housing, there was a notable increase in demand in the South of Central Bedfordshire and South Cambridgeshire and Milton Keynes areas.

3.1.10 The main changes in the job forecasts occurred in sites that went from the scoping stage to the submission of planning applications as floorspace quantum and land uses were confirmed with the Bedford Business Park accounting for the largest increase since the 2018 UL Data.

3.1.11 A number of minor issues were identified with the network coding in early 2020. These issues were mainly related to the Without Scheme (Do Minimum) networks where the networks were modified to include the future year highway schemes resulting from new 2020 UL Data developments. Some issues were noted with the 2015 Base Year network although these were of less significance.

3.1.12 This resulted in the network coding being amended to include revisions as follows:

a. Links
   i. A number of highway link distances.
   ii. Speed flow curves through Cambourne, between the A1198 and A428.
   iii. Speed coded on Cambridge Road, west of the Cambridge Road junction.
   iv. Inclusion of the Woodside Link scheme and exclusion of Sundon Road in Dunstable.

b. Junctions
   i. A428 at Cambourne – modified layout.
   ii. A14/A1307 junction near Dry Drayton - capacity indices and link lengths
   iii. A5/A4146 junction, south of Milton Keynes – junction layout and signal timings.
   iv. A14 Milton Junction – speeds, signal timings and layout arrangements.
   v. A14 Cambridge to Huntingdon Scheme - signal timings for some junctions in the Huntingdon area.
   vi. M1 Junction 13 – link distance corrections.

c. Additional Do Minimum schemes.
   i. A number of additional Do Minimum schemes were included as part of the 2020 UL update.

3.1.13 As most of the revisions related to the future year networks they had no bearing on the 2015 Base Year network. The few issues that were applicable to the Base Year network were not considered likely to have a material impact on the model outputs and therefore it was considered that there was no need to make any changes to these networks.

3.1.14 Revisions were also made to the With Scheme (Do Something) highway network as follows, to:

a. Incorporate the latest Scheme design.
b. The location of the modified Potton Road junction.
c. A number of highway link distances.

3.1.15 In addition, a number of additional modelling refinements were included in the sensitivity test forecasts. These encompassed:

a. Constraining traffic growth to National Trip End Model (NTEM) totals applied over a wider area (i.e. over 25 districts) rather than at district level, to ensure that growth within zones could be accommodated and to avoid distorting the pattern of growth in zones with significant developments.

b. Use of updated development trip rate assumptions for specific developments.

c. Use of May 2020 DfT TAG databook (2018 UL forecasts utilised the then current 2019 TAG databook). It should be noted that the changes between the 2019 and 2020 TAG databooks were relatively minor.

3.1.16 It should be noted that the above refinements were not considered to result in any significant change but were included for completeness.

3.1.17 A sensitivity test was carried out in July 2020 that included preparing traffic forecasts incorporating the 2020 UL Data, and the revised network coding and modelling assumptions. This has collectively been referred to as the 2020 UL Data.

3.1.18 The changes in traffic flows predicted to occur on the highway network arising from the 2020 UL Data were compared with the forecasts derived from the original 2018 UL Data. An assessment of how the impact of the Scheme could change with these changes in traffic demand was also carried out. This also considered how the resultant traffic flows could potentially affect the operation of the wider highway network, although no detailed junction modelling was carried out.

3.2 Design

3.2.1 The Scheme design has been developed using the 2018 UL Data, which formed the basis of the forecasts in the A428 Strategic Traffic Model.

3.2.2 Following the preparation of the 2020 UL Data, the impacts on the design for the main scheme junctions and dual carriageway links in the vicinity of the Scheme was assessed using the revised forecasts based on the 2020 UL Data.

3.3 Environment

3.3.1 An assessment of the air quality effects of the Scheme was undertaken using the 2018 UL Data along with the Defra datasets and tools that were available at the time of the assessment. This assessment is presented in **Chapter 5 Air quality** of the Environmental Statement **[TR010044/APP/6.1]**.

3.3.2 The 2020 UL assessment concluded that there would be no significant effects overall on air quality due to the Scheme. Whilst the majority of the air quality study area was predicted to experience air quality well below the relevant objective values in the Scheme opening year, one area was predicted to experience annual mean concentrations above the objective value for nitrogen dioxide. This area was a row of seven houses along the southbound carriageway of the A1 in Sandy, where the receptors are very close to the edge of the carriageway. An imperceptible increase in annual mean concentrations was predicted at these receptors, and therefore there were no significant effects identified.

3.3.3 An assessment of the traffic noise effects of the Scheme was undertaken using the 2018 UL Data. The assessment concluded several significant adverse effects were likely to occur as a result of the Scheme, as well as a number of beneficial effects. A number of affected routes on the wider network, which are predicted to result in changes of road traffic noise levels of 1dB(A) in the short term and 3dB(A) in the long term, were also identified.

3.3.4 Following the preparation of the 2020 UL Data, a sensitivity test for noise and air quality was undertaken to consider the potential change to the effects and impacts identified using the 2018 UL Data and presented in the Environmental Statement.

4 Sensitivity test approach

4.1.1 Traffic forecasts based upon the 2020 UL Data were prepared as a sensitivity test to check the validity of the current forecasts based upon the 2018 UL Data. The sensitivity test focussed on the following subject areas:

a. Traffic (main Scheme junctions and a number of wider area junctions (see Tables 5-1 and 5-2 of this report)).

b. Design (junction and links).

c. Environment (noise and air quality).

4.1.2 The methodology for the sensitivity test is set out below.

4.2 Traffic

4.2.1 Revised traffic forecasts were prepared from the 2020 UL Data for the 'With Scheme' and 'Without Scheme' scenarios for the Scheme opening year (2025) and design year (2040). These forecasts also included:

a. Updated network coding refined and updated on parts of the highway network.

b. The growth in traffic forecasts constrained over a wider area than during the assessment of the 2018 UL Data.

c. Revised development trip rate assumptions.

d. Updated TAG Databook assumptions.

4.2.2 The sensitivity test for traffic consisted of comparing forecasts derived from the 2020 UL Data with the original forecasts from the 2018 UL Data. This included comparing:

a. Traffic flow changes.

b. Capacity assessments at main scheme junctions.

c. Flow changes at a number of existing junctions and links across the network.

d. Scheme economics.

4.3 Scheme design

4.3.1 The sensitivity test assessed the impact of the 2020 UL Data on the merge and diverge design for all the slip roads at the three grade separated junctions and the capacity of the dual 2-lane carriageway links in the vicinity of the Scheme in the Design Year of 2040. The slip road merge and diverge designs were assessed using the slip road and mainline traffic flows generated by the 2020 UL Data, in accordance with DMRB standard CD122 "Geometric design of grade separated junctions".

4.3.2 VISSIM simulation modelling using the 2020 UL Data has been undertaken at the three main Scheme junctions: Black Cat Junction, Cambridge Road Junction and Caxton Gibbet Junction for the Design Year of 2040.

4.4 Environment

4.4.1 The 2020 UL Data was used to assess potential operational noise and air quality impacts. A qualitative review has been undertaken for air quality along with proportionate quantitative modelling. In addition, a qualitative review and a full quantitative assessment has been completed for noise.

4.5 Air quality

4.5.1 The air quality assessment presented in the Environmental Statement identified that most receptors within the air quality study area were predicted to experience annual mean concentrations of pollutants within the relevant objective values in the Scheme opening year.

4.5.2 At seven properties located close to the A1 in the Sandy AQMA, annual mean concentrations of nitrogen dioxide (NO_2) were predicted to be above the objective value of 40µg/m^3 in the opening year, with a range from 52.7-58.3µg/m^3 predicted with the scheme in operation. This is due to their proximity to the southbound carriageway of the A1, with the closest receptors approximately 1.5m from the edge of the road.

4.5.3 In the air quality assessment carried out with the 2018 UL Data and presented in the Environmental Statement, imperceptible increases (+0.2µg/m^3) were predicted at these receptors. This effect was therefore considered not to be significant for air quality.

4.5.4 As these receptors are predicted to experience annual mean concentrations above the objective value in the Scheme opening year, there is a risk that a change in traffic flows with the 2020 UL Data could lead to a greater increase in concentrations with the Scheme and therefore a potentially significant effect.

4.5.5 In order to understand the potential effects of the 2020 UL Data on the air quality assessment, a staged review of the data was undertaken. In addition, some sensitivity tests were undertaken on the 2018 UL Data. The focus of these tests was therefore the receptors identified above in Sandy.

4.5.6 This was undertaken as a series of steps as set out below.

a. Step 1a - Sensitivity test dispersion modelling of Sandy Air Quality Management Area (AQMA) using theoretical 2018 UL Data scenarios.

b. Step 1b - Qualitative review of 2020 UL Data including:

   i. Screening of 2020 UL Data against LA105[2] criteria to identify any additional areas of Affected Road Network (ARN) that are not currently considered.

   ii. Review additional ARN areas for sensitivity to changes in air quality.

   iii. Review of changes in traffic between 2018 UL Data and 2020 UL Data in the Sandy AQMA with reference to Step 1a sensitivity tests.

[2] Highways England (2019). DMRB, LA 105 'Air quality' Revision 0.

iv. Review of changes in traffic between 2018 UL Data and 2020 UL Data along the existing ARN.

4.5.7 On the basis of the above qualitative review, professional judgement was used to identify areas for spot modelling, whereby small sections of the study area were progressed to detailed modelling using the 2020 UL Data.

Step 2 – Spot modelling

4.5.8 It was identified from the above qualitative review that one area should be subject to further consideration with a localised spot model using the 2020 UL Data.

4.5.9 Along a new section of ARN along the A1 near Sandy a new link was identified that was coincident with the pollution climate mapping (PCM) network with the 2020 UL Data. Spot modelling of this location was undertaken to confirm there was no risk to compliance with EU Limit Values.

4.5.10 The changes in traffic flows along the A1 past the properties in Sandy identified above fell within those considered in the Step 1a sensitivity tests. This means that small changes above the objective value are anticipated at these receptors.

4.5.11 Further modelling of the seven receptors predicted to be above the objective value with the 2018 UL Data in Sandy AQMA has been undertaken to confirm the outcome of the qualitative review above and to identify the predicted concentrations at those receptors with the 2020 UL Data.

4.5.12 Additionally, Defra has published updated tools[3][4] and datasets[5][6] since completion of the air quality modelling and the PCM spot modelling identified in paragraph 4.5.9 above. These updated tools and datasets have been included within the modelling exercise for the receptors within Sandy AQMA to ensure the most complete assessment is undertaken for these receptors. Details on these changes are set out in Appendix B of this report. The outcome of this modelling exercise is set out in Chapter 5 of this report.

4.6 Noise

4.6.1 Noise modelling has been carried out using the 2018 UL Data within a defined study area to determine the likely impacts and effects at noise sensitive properties and communities (receptors) within 600m of the existing A428 and the new dual carriageway. The selection of these two roads follows the approach set out in DMRB guidance for noise assessments (LA111[7]).

4.6.2 Modelling of the 2018 UL Data considered two scenarios:

[3]Department for Environment, Food and Rural Affairs (2020). NO_2 Adjustment for NO_X Sector Removal Tool v8.0. https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxsector

[4] Department for Environment, Food and Rural Affairs (2020). NO_X to NO_2 Calculator v8.1. https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

[5] https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

[6]Department for Environment, Food and Rural Affairs (2020). 2018-based background maps for NO_X and NO_2. https://uk-air.defra.gov.uk/data/laqm-background-home

7 Highways England (2020), LA 111 Revision 2. 'Noise and Vibration'

a. Short-term changes (i.e. noise level changes between the without-scheme scenario in the opening year (2025) compared to those in the with-scheme scenario in 2025).

b. Long-term changes (i.e. noise level changes between the without-scheme scenario in 2025 compared to those in the with-scheme scenario in the design year (2040)).

4.6.3 The outcomes from this modelling predict both adverse impacts (i.e. noise increases) and beneficial impacts (i.e. noise reductions) across the study area, some of which are likely to result in likely significant effects. Significant adverse effects are predicted to potentially occur at receptors close to the Scheme in the vicinity of Potton Road, and isolated properties located along the new dual carriageway.

4.6.4 Additionally, adverse impacts are predicted at receptors in Roxton and to the east of Eltisley.

4.6.5 Beneficial impacts are predicted at receptors along the A1(M) between the Black Cat and St Neots junctions, as well as in Croxton and to the north of Eltisley.

4.6.6 In order to understand the potential for changes to these impacts and effects as a result of the 2020 UL Data, a staged review of the data was undertaken.

Step 1 - Simplified risk-based sensitivity test and basic noise level calculations

4.6.7 As the 2018 noise modelling has identified a range of noise impacts and effects (both adverse and beneficial) resulting from the Scheme, and given that some adverse effects are not currently considered as likely to be significant (but which could become significant through changes in the parameters of the 2020 UL Data), sensitivity testing was undertaken at locations across the entire noise study area.

4.6.8 The first step in the sensitivity testing involved the use of theoretical traffic data scenarios, focussing on the effect on road traffic noise levels at all properties within the same study area used for the assessment carried out using the 2018 UL Data. These tests included:

a. Increasing the with-scheme traffic flows on strategic routes in 2025 by 4% (in line with the 4% indicated long-term increases on the new dual carriageway) (Test 1).

b. Increase the with-scheme traffic flows on strategic routes in 2025 by 10% (Test 2).

4.6.9 On the basis of the outcome of this testing, a decision was made to undertake detailed modelling. Although this test identified that changes in traffic flows on the strategic road network of up to 10% were unlikely to lead to additional significant adverse effects, the testing did not account for changes in traffic flow on non-strategic roads, which may lead to new and/or different effects for noise.

Step 2 – Full noise modelling

4.6.10 Following the outcome of Step 1, detailed noise modelling using 2020 UL Data across the noise study area was undertaken and a comparison of the findings was made with the modelled outputs derived from the 2018 UL Data. This comparison has allowed an analysis to be undertaken of any new and/or different noise effects resulting from the 2020 UL Data, as well as any changes to noise mitigation which may be required.

5 Results of the sensitivity test

5.1.1 This section of the report sets out the results of the sensitivity test in terms of traffic, design, air quality and noise.

5.2 Traffic flow changes

5.2.1 A review was undertaken of the changes in traffic flows predicted to occur on the wider highway network arising from the forecasts prepared from the 2020 UL Data.

5.2.2 This involved a comparison of the traffic flows for the Scheme opening year (2025) and design year (2040) for the Do Something and Do Minimum scenarios and focused on changes in Annual Average Daily Traffic (AADT) forecast flows. An analysis of the changes in peak hour flows was also carried out for the Scheme junctions and a number of existing junctions.

5.2.3 An assessment of the impact on the Scheme as a result of the revised forecast flows was then carried out. This review considered whether any changes in design may be required together with a proportionate assessment of how the resultant traffic flows might affect the operation of the wider highway network.

5.2.4 The comparison of the daily flow changes between the 2018 UL data and the 2020 UL data for the Do Minimum and Do Something Scenarios for 2025 and 2040 are presented in Figures A1 to A10. This also included a comparison of the relative changes in flows between the Do Minimum and Do Something between the 2018 UL and 2020 UL forecasts.

5.2.5 The flow changes for the 2025 Do Minimum presented in Figures A1 and A2 (within Appendix A of this report) demonstrate that changes are modest, with a reduction of approximately 3% on the A428 between Hardwick and St Neots and an increase of 3% on the A14 north west of Cambridge. There are more significant reductions on the A1198 south of Caxton Gibbet.

5.2.0 The flow changes for the 2025 Do Something presented in Figures A3 and A4 (within Appendix A of this report) show a broadly similar pattern to the Do Minimum. Flows on the Scheme are changed by less than 5%.

5.2.1 The relative flow differences between the Do Minimum and Do Something between the 2018 UL and 2020 UL forecasts for 2025 presented in Figure A5 (within Appendix A of this report) shows that there is a modest increase on the existing A428 east of Cambourne and also between Eltisley and Cambridge Road. There is a small decrease on the existing A428 between Cambridge Road and Barford Road.

5.2.2 The flow changes for the 2040 Do Minimum presented in Figures A6 and A7 (within Appendix A of this report) demonstrate that there are modest increases in flows across the study area. However, similar to the 2025 forecast, there is a more significant reduction on the A1198 south of Caxton Gibbet.

5.2.3 The flow changes for the 2040 Do Something are presented in Figures A8 and A9 (within Appendix A of this report). The flow changes can be summarised as follows:

a. On the Scheme, flows increase by 3% between Caxton Gibbet and the Cambridge Road junction and by 4% between Cambridge Road and the A1.

b. On the existing A428 between Wyboston Junction and Eltisley, flows reduce by between 6 and 13%. Between Cambourne and Madingley flows increase by between 4 and 7%.

c. Over the wider study area flows increase on the A1 between Wyboston and Buckden by 5%. Flows are reduced by 24% south of Caxton Gibbet to Caxton.

5.2.4 The relative flow differences between the Do Minimum and Do Something between the 2018 UL and 2020 UL forecasts for 2040 presented in Figure A10 (within Appendix A of this report) shows that there is a modest increase on the existing A428 east of Cambourne and also between Eltisley and Cambridge Road. These is a decrease on the existing A428 between Cambridge Road and Barford Road.

Capacity assessment at Scheme junctions

5.2.5 An assessment of the Scheme junctions at Black Cat, Cambridge Road and Caxton Gibbet was carried out using the VISSIM software to identify any changes in predicted delays based upon the 2020 UL Data.

5.2.6 The VISSIM model results for Black Cat for the 2040 PM peak are presented in Figure 5-1 and Figure 5-2 for the 2018 UL Data and 2020 UL Data assessments respectively.

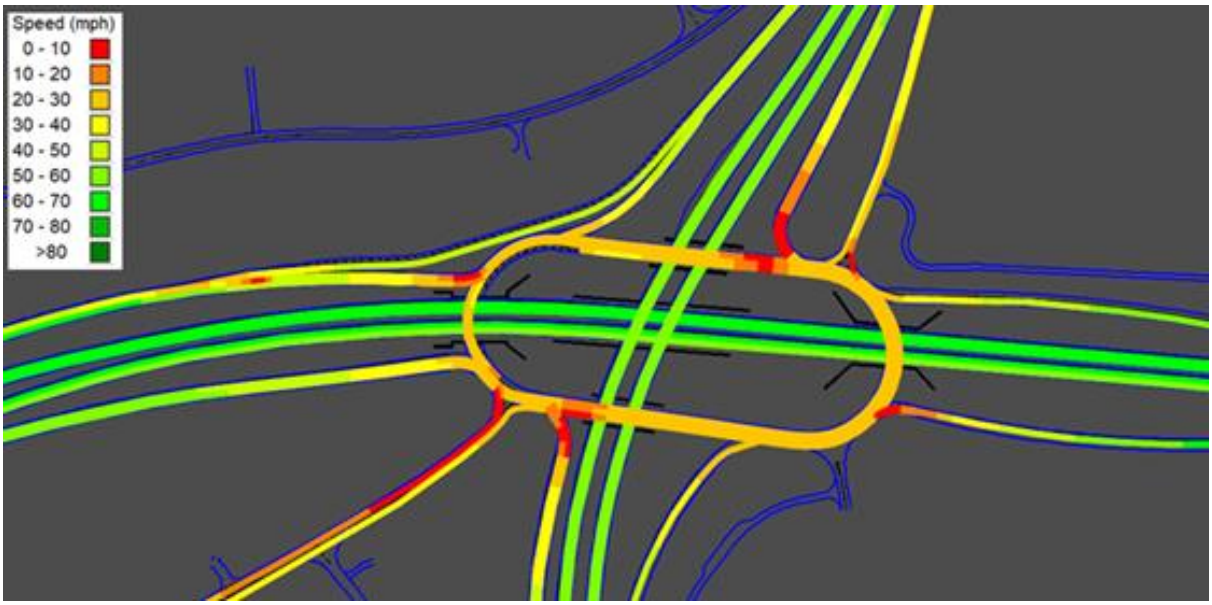

Figure 5-1 Black Cat 2040 PM Peak 2018 UL data

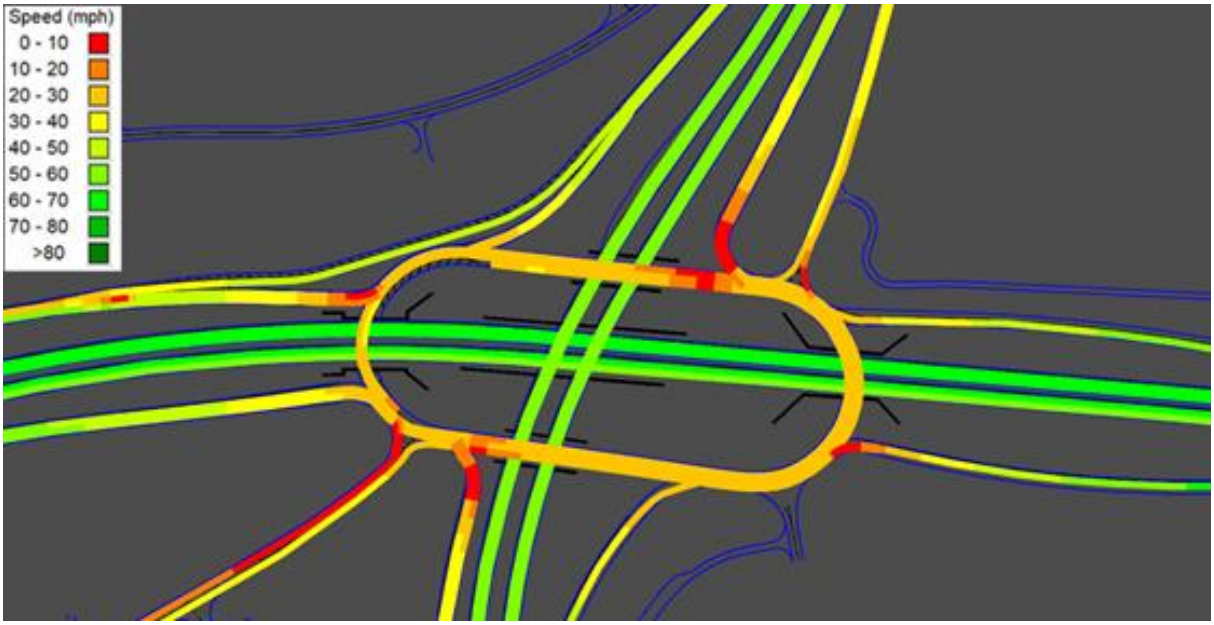

Figure 5-2 Black Cat 2040 PM Peak 2020 UL data

5.2.7 **Figure 5-1** and **Figure 5-2** show the predicted PM peak speeds at the junction. The VISSIM model results demonstrate that the Black Cat junction will operate within capacity with both the 2018 UL Data and 2020 UL Data based flows, with no discernible differences in results.

5.2.8 The operation at the merge/diverge locations at the junction is predicted to be smooth and does not show any congestion with either of the 2018 UL Data or 2020 UL Data forecast flows. The mainline carriageways and slip roads are free-flowing and operate within capacity for both flow scenarios models.

5.2.9 The VISSIM model results for the Cambridge Road junction for the 2040 PM peak are presented in **Figure 5-3 and Figure 5-4** for the 2018 UL Data and 2020 UL Data assessments respectively.

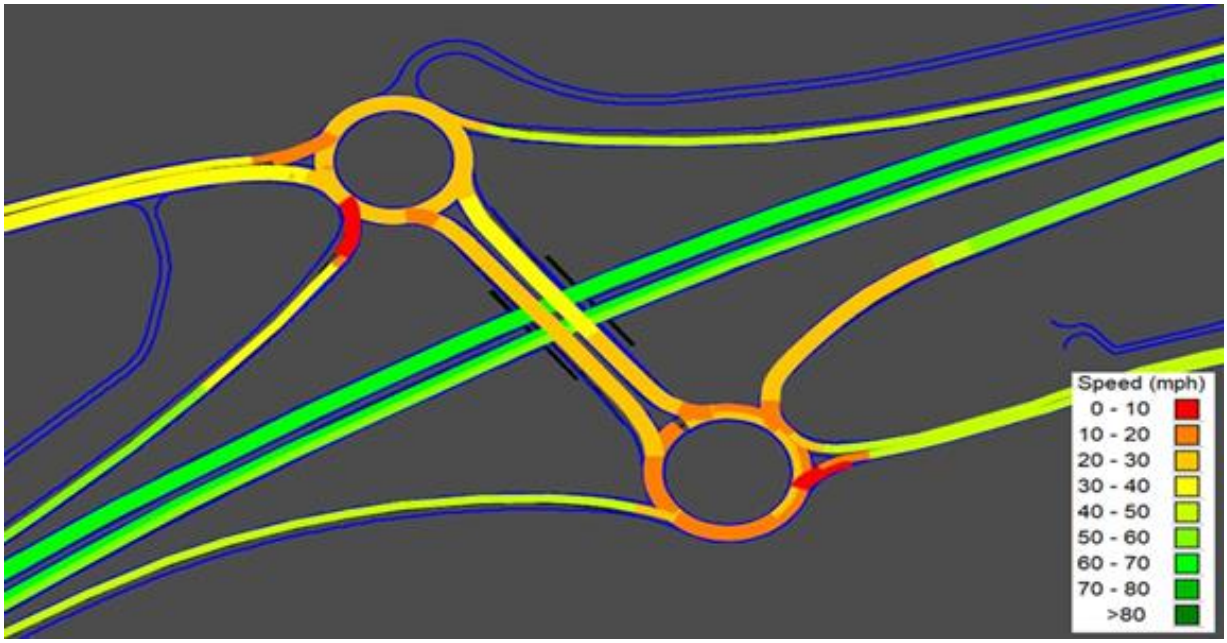

Figure 5-3 Ridge Road 2040 PM Peak 2018 UL data

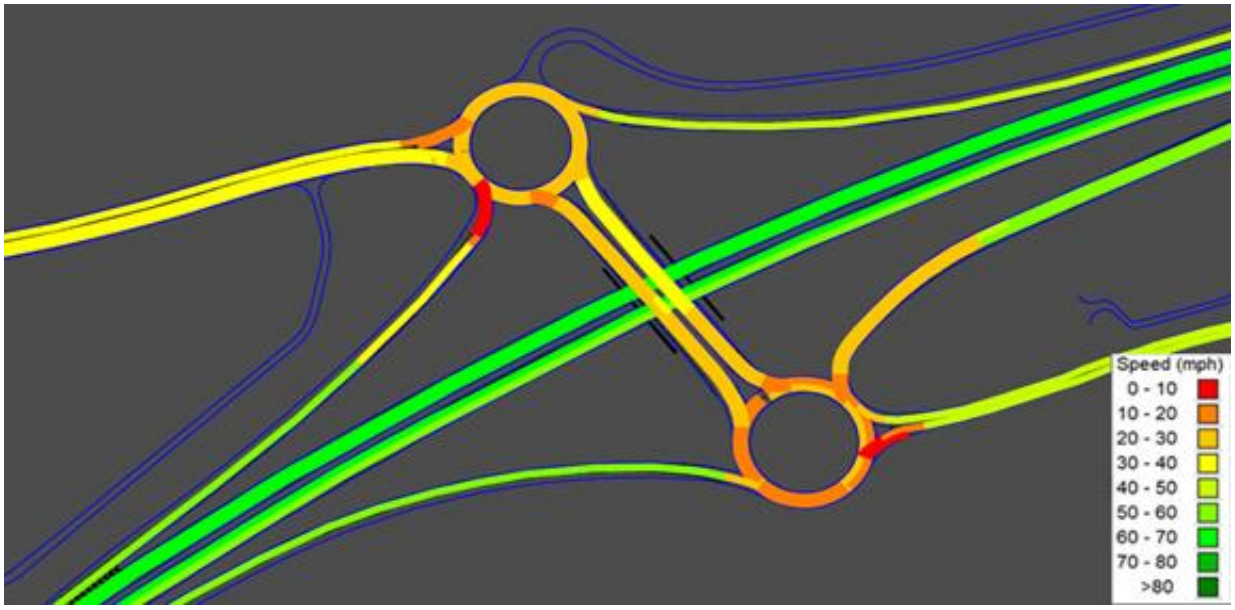

Figure 5-4 Cambridge Road 2040 PM Peak 2020 UL data

5.2.10 **Figure 5-3 and Figure 5-4** show the predicted PM peak speeds at the junction. The VISSIM model results demonstrate that the Cambridge Road junction will operate within capacity with both the 2018 UL Data and 2020 UL Data based forecast flows.

5.2.11 The average speed results from the VISSIM models for 2018 UL Data or 2020 UL Data flows are not significantly different. Results suggest that small queues will form at stop lines, but the queues are not extensive. There are free flowing conditions on the Scheme.

5.2.12 The VISSIM model results for the Caxton Gibbet junction for the 2040 PM peak are presented in Figures 5-5 and 5-6 for the 2018 UL Data and 2020 UL Data assessments respectively.

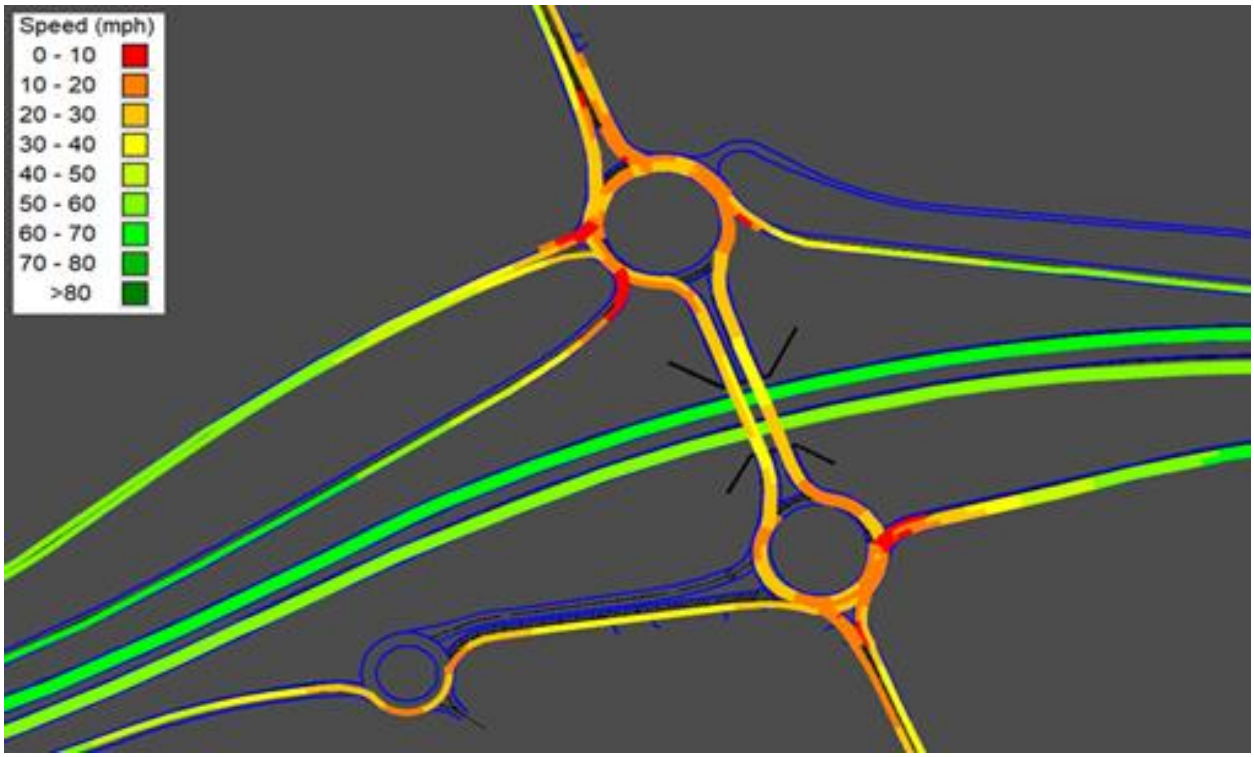

Figure 5-5 Caxton Gibbet 2040 PM Peak 2018 UL data

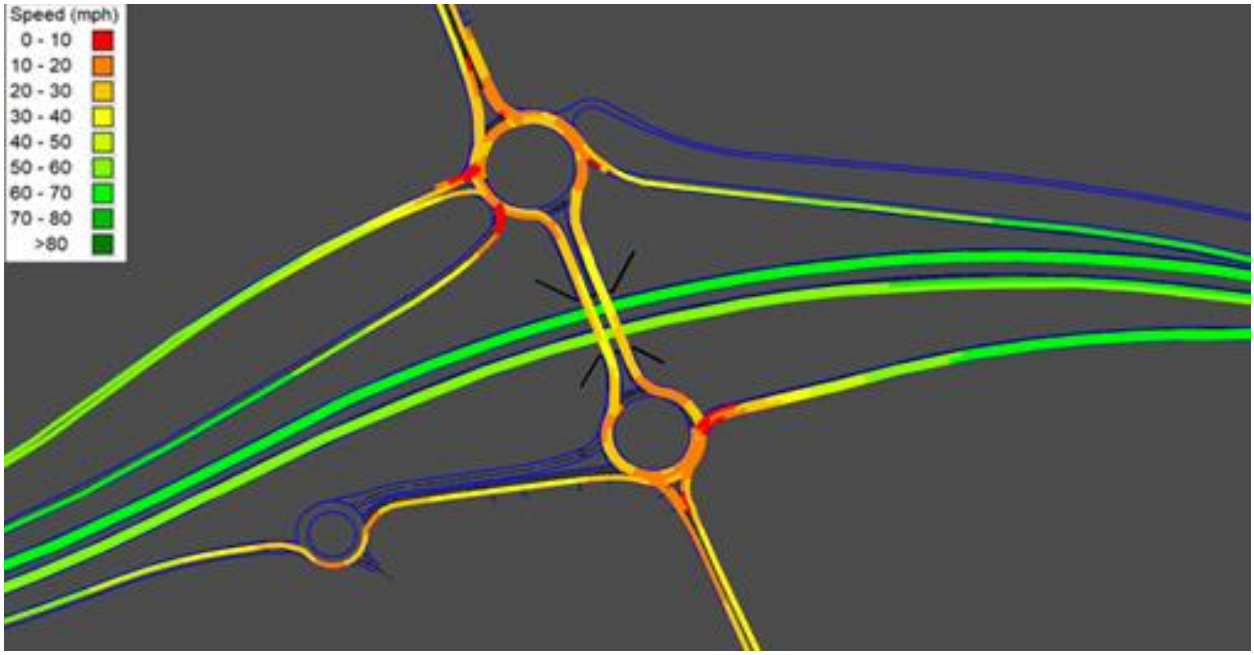

Figure 5-6 Caxton Gibbet 2040 PM Peak 2020 UL data

5.2.13 **Figure 5-5** and **Figure 5-6** show the predicted PM peak speeds at the junction. The VISSIM model results demonstrate that the Caxton Gibbet junction will operate within capacity with both the 2018 UL and 2020 UL based forecast flows.

5.2.14 The average speed results from the VISSIM models for 2018 UL or 2020 UL flows are similar with small queues forming at stop lines, but the queues are not extensive. There are free flowing conditions on slip roads and on the Scheme.

Wider junction assessments

5.2.15 An assessment was also carried out to determine the extent of flow changes between the 2018 UL Data and 2020 UL Data based forecasts and how this could potentially affect the operation of the wider highway network.

5.2.16 This work focused upon an examination of flow changes at a number of existing junctions within the study area where peak hour congestion was identified. It should however be noted that no detailed modelling of the junctions was carried out.

5.2.17 The analysis focused on the following junctions:

a. A1 Buckden Roundabout
b. A1 Sandy Roundabout
c. A1 Biggleswade North Roundabout
d. M1 J13 Roundabout (East of Milton Keynes)
e. A421/A6 Roundabout (South of Bedford)
f. M11/A14 Girton Interchange

5.2.18 A summary of the flow changes between the 2018 and 2020 UL data for each approach arm at Buckden, Sandy and Biggleswade North junctions on the A1 is presented in **Table 5-1**.

Table 5-1 Relative differences between Do Minimum and Do Something Flows at approaches to A1 junctions (2040 Peak Hour)

Difference of Difference (2020 UL - 2018 UL) hourly flows						
Junction Details	AM (2040)			PM (2040)		
	2018 UL Diff	2020 UL Diff	Diff	2018 UL Diff	2020 UL Diff	Diff
A1 Buckden Roundabout						
A1 (North)	11	17	7	-4	33	38
High Street (Village Road)	-11	1	12	17	-22	-39
A1 (South)	93	193	100	89	93	3
B661 Perry Rd	5	-16	-22	-20	-2	18
A1 Sandy Roundabout						
A1 London Rd (North)	12	127	115	-24	-30	-6
B1042 Bedford Rd (East)	37	-172	-209	79	119	41
A1 High Rd (South)	-54	-48	7	-83	-60	23
A603 (West)	1	4	3	30	11	-19
A1 Biggleswade North Roundabout						
A1 (North)	129	191	62	70	160	90
A6001 Hill Ln (East)	-84	-60	24	-116	-222	-105
A1 (South)	63	53	-10	81	211	130
B658 Hill Ln (West)	-112	-151	-39	-73	-99	-26

5.2.19 **Table 5-1** shows that the relative change between the Do Minimum and Do Something flows is generally less than 50 vehicles per hour. However, the most significant changes as a result of the 2020 UL data occur at:

a. A1 South approach at Buckden in the PM peak, with the 2020 UL resulting in an increase of an additional 100 vehicles compared with the 2018 UL data

b. A1 London Road (North) approach at Sandy Junction in the AM peak with an additional 115 vehicles. However this is off-set by a decrease of over 200 vehicles on B1042 Bedford Road.

c. A1 north and A1 south approaches at Biggleswade North with an additional 90 and 130 vehicles respectively in the PM peak.

5.2.20 A summary of the flow changes between the 2018 and 2020 UL data for each approach arm at M1 J13, A421/A6 and M11 J14 Girton is presented in **Table 5-2**.

Table 5-2 Relative differences between Do Minimum and Do Something Flows at approaches to M1 J13, A421/A6 and M11/A14 Girton (2040 Peak Hour)

Difference of Difference (2020 UL - 2018 UL) hourly flows						
Junction Details	AM (2040)			PM (2040)		
	2018 UL Diff	2020 UL Diff	Diff	2018 UL Diff	2020 UL Diff	Diff
M1 J13: A421 RAB						
A421 (North)	63	67	4	181	74	-107
A421 (East Dumbbell)	9	27	18	-46	-61	-15
A421 (West)	81	42	-39	2	0	-2
A421/ A6 RAB						
A6 (North)	-2	11	13	-36	-67	-31
A421 Off-Slip (East)	-13	-88	-75	144	118	-26
A6 (South)	103	110	7	-11	25	36
A421 Off-Slip (West)	16	11	-5	51	-71	-122
M11 J14 (Girton Interchange)						
A428 (West)	314	320	7	201	211	10
M11 (South) to A14 (East) Loop	-16	-25	-9	-82	-32	49
A14 (North-West) to A14 (East)	-99	-98	1	-41	-70	-29
Total Flow into A14 (East)	199	200	1	79	110	31

5.2.21 **Table 5-2** shows that the relative change between the Do Minimum and Do Something flows is relatively modest with some reductions in the PM peak at M1 J13 and A421/A6.

5.2.22 There is a modest increase at Girton in the PM peak, although the changes on any single arm are less than 50 vehicles per hour.

5.2.23 In summary, based upon the assessment of the flow changes presented above it was concluded that the 2020 UL Data is unlikely to result in a significant change in the assessments carried out using the 2018 UL Data which are reported in the Transport Assessment Annex.

5.3 Scheme design

5.3.1 As noted above, VISSIM simulation modelling was carried out at the three main Scheme junctions using the 2020 UL Data. The results indicated that the designs for the Black Cat, Cambridge Road and Caxton Gibbet junctions would operate satisfactorily and within capacity at the design year of 2040.

5.3.2 As a result of the sensitivity test of the 2020 UL Data, three departures from standards may be required due to the change in slip road and mainline flows at three locations within the Scheme. These are at the following locations:

a. Black Cat Junction A1 Northbound Merge.

b. Black Cat Junction A421 Eastbound Diverge.

c. Caxton Gibbet Junction A428 Westbound Diverge.

5.3.3 Summary details of the departures from standards identified during this sensitivity test were submitted to Highways England Safety, Engineering & Standards (SES) for review. It has been confirmed by SES that the departures from standard are acceptable in principle. As a result, no additional changes would be required to the Scheme design as a result of the 2020 UL Data forecasts.

5.4 Scheme economics

5.4.1 An assessment of the Transport Economic Efficiency (TEE) benefits was carried out on the 2020 UL Data using the Department for Transport program TUBA. This demonstrated that TEE benefits (including time and vehicle operating costs) increased by 4% compared to the benefits derived from the 2018 UL Data.

5.4.2 No assessment of accident benefits, environmental benefits or wider economic benefits was carried out using the 2020 UL Data. However, it should be noted that since TEE benefits constitute the majority of scheme benefits, (98% of initial benefits and over 60% of adjusted benefits) it was concluded that the 2020 UL Data would likely result in no more than a marginal change in the overall benefits.

5.5 Air quality

Step 1a - Sensitivity tests

5.5.1 The outcome of the sensitivity tests carried out in relation to the seven identified receptors at Sandy along the A1 indicated the following:

a. For Test 1 (increases in congestion during the AM and PM peak periods) all seven identified receptors would be anticipated to experience a medium increase in annual mean NO_2 concentrations at concentrations above the objective value.

b. For Test 2 (increases in traffic flows of 5% across the whole day (approximately 2,200 AADT)) the seven identified receptors would be anticipated to experience a small increase (1.8-2.0µg/m^3) in annual mean NO_2 concentrations at concentrations above the objective value.

c. For Test 3 (increases in traffic flows of 10% across the whole day (approximately 4,300 AADT)) the seven identified receptors would be anticipated to experience a medium increase (3.4-3.8µg/m^3) in annual mean NO_2 concentrations at concentrations above the objective value.

Step 1b - Qualitative review of 2020 UL Data

5.5.2 The sensitivity test demonstrated that the traffic changes associated with the 2020 UL Data, comparing the 'Do Minimum' and 'Do Something' flows past the receptors identified at Sandy, are within the ranges considered in the earlier sensitivity tests at approximately 900 AADT. It is therefore anticipated that the seven receptors at Sandy are expected to have small increases in annual mean NO_2 concentrations above the objective value. These are slightly worse impacts than identified in the Air Quality assessment that has been presented in **Chapter 5, Air Quality** of the Environmental Statement **[TR01004/APP/6.1]**. As identified in section 4.5 above, spot modelling of these receptors has been undertaken to confirm this qualitative review and the results are set out in Table 5-3, 5-4 and 5-5.

5.5.3 Increases and decreases in traffic flows were also identified across the wider air quality study area. However, baseline air quality is good across the wider area with no further receptors predicted to experience pollutant concentrations above the objective value in the Scheme opening year, therefore no potentially significant effects are anticipated in the wider area.

5.5.4 Some small sections of additional ARN were also identified. However, as the baseline air quality is good (well below 40µg/m^3) no likely significant effects are anticipated in these areas.

5.5.5 As identified in section 4.5 above, within the additional ARN links, one new PCM link was identified on the A1 near Sandy. This additional link was progressed to spot modelling to confirm there would be no potential for non-compliance with the EU Limit values for the 2020 UL Data.

Spot modelling of 2020 UL Data - PCM Link

5.5.6 Spot modelling of a new ARN link on the A1 near Sandy that is coincident with the PCM network was undertaken.

5.5.7 Predicted concentrations at the nearest qualifying feature were well below the annual mean NO_2 limit value with a maximum concentration with the scheme in operation of 27.1µg/m^3 predicted at a qualifying feature as set out in Table 5-3 therefore no compliance risk is identified with the 2020 UL Data.

Table 5-3 Results of PCM analysis

PCM Link Census ID	2025 PCM model NO_2 concentration (µg/m³)	Range of 2025 DM NO_2 concentrations (µg/m³) at qualifying features	Range of 2025 DS NO_2 concentrations (µg/m³) at qualifying features	Range of 2025 NO_2 concentration changes (µg/m³) at qualifying features
802006079	20.6	19.3 – 26.7	19.6 – 27.1	+0.3 to +0.4

Sandy

5.5.8 **Table 5-4** presents details of the human health receptors included in the air quality model for the spot model of the receptors exceeding the objective value. The locations of these receptors are shown in Figure 1 'Air Quality Receptors – Operational Assessment' of the ES **[TR010044/APP/6.2]**.

Table 5-4 Results of local air quality assessment at Sandy A1 receptors for the operation of the Scheme

ID	2015 Base NO_2 (µg/m³)	LTT_{E6} 2025 DM NO_2 (µg/m³)	LTT_{E6} 2025 DS NO_2 (µg/m³)	LTT_{E6} 2025 NO_2 Change (µg/m³)	Verification Zone	Magnitude of Change Band
R221	***71.7***	**56.0**	**56.9**	+1.0	A1H	Small
R222	***72.5***	**56.6**	**57.6**	+1.0	A1H	Small
R272	***72.5***	**56.6**	**57.6**	+1.0	A1H	Small
R273	***72.4***	**56.6**	**57.6**	+1.0	A1H	Small
R274	***72.3***	**56.4**	**57.4**	+1.0	A1H	Small
R284	***66.2***	**51.7**	**52.5**	+0.9	A1H	Small
R286	***65.7***	**51.3**	**52.2**	+0.9	A1H	Small
Exceedances of annual mean NO_2 UK AQS objective are highlighted in bold. Likely exceedances of the one hour mean NO_2 UK AQS objective are highlighted in bold and italicised.						

5.5.9 Annual mean concentrations of NO_2 are predicted to be above the 40µg/m3 annual mean NO_2 objective at all A1 Sandy receptors in the opening year. An increase in annual mean concentrations of NO_2 is predicted with the Scheme in place, due to an increase in traffic flow on the A1 (+908 AADT, of which +70 are HDVs across both carriageways, +835 AADT, of which +12 HDVs on the southbound carriageway). The magnitude of change is predicted to be small (between 0.4µg/m³ and 2.0µg/m³) at all receptors.

5.5.10 As the annual mean concentrations of NO_2 are below 60µg/m³ at all receptors in both the Do Minimum and Do Something scenarios, it is concluded that the hourly average air quality objective is unlikely to be exceeded in either scenario.

Table 5-5 Results of local air quality assessment at Sandy A1 receptors for the operation of the Scheme

Magnitude of change in annual mean NO_2 or PM_{10} (µg/m³)	Total number of receptors with:	
	Worsening of an air quality objective already above the objective or the creation of a new exceedance	Improvement of an air quality objective already above the objective or the removal of an existing exceedance
Large (>4)	0	0
Medium (>2)	0	0
Small (>0.4)	7	0

5.5.11 A conclusion of no likely significant air quality effects for human health is recorded due to the total number of receptors (less than 30) with a small magnitude of change in annual mean NO_2, in line with Paragraph 2.94 (Note 1) of LA 105. **Table 5-5** summarises the number of properties affected by the Scheme.

5.5.12 The conclusion of the operational local air quality assessment using the 2020 UL Data is that there is no likely significant air quality effect for human health at the houses along the A1 in Sandy.

5.5.13 The findings of the air quality assessment indicate that the Scheme using the 2020 UL Data is consistent with relevant planning policy and air quality action plans, and not significant for air quality.

Summary of air quality sensitivity test

5.5.14 Seven receptors located within the Sandy AQMA contribute to the overall evaluation of significance for air quality, however as the number of receptors with small changes above the objective value is less than 30, the overall effect on air quality is considered to be not significant.

5.5.15 In summary, there is no change to the overall conclusions of the air quality assessment anticipated with the use of the 2020 UL Data and effects will remain as "not significant".

5.6 Noise

5.6.1 The outcome of each of the sensitivity tests is set out below.

Step 1: Qualitative review of 2020 UL Data

5.6.2 The outcomes of the tests were as follows:

a. Both the tests (Test 1 and Test 2) concluded that negligible short term increases in noise levels were likely when compared to the modelling results using the 2018 UL Data. The majority of likely increases were in the order of 0.1-0.2 dB(A) and 0.2-0.4dB(A) for a 4% and 10% increase in strategic road traffic flows respectively. This included receptors at which significant adverse effects were predicted from the modelling using the 2018 UL data, as well as well as receptors at risk of potentially being identified as experiencing significant adverse effects from changes in the 2020 UL Data (Roxton).

b. The sensitivity testing indicates that the impacts on receptors at Roxton are likely to remain predominantly minor in magnitude, although some moderate magnitude impacts are possible (i.e. the increases are greater than or equal to 3.0 dB and less than 5.0 dB). Notwithstanding moderate magnitude increases potentially occurring with a 10% increase in traffic flows on strategic roads, should this increase be reflected in the 2020 UL Data then significant adverse effects were still considered to remain unlikely at these receptors.

Step 2 – Full noise modelling

5.6.3 It is recognised that traffic flow changes are unlikely to be restricted to strategic roads and the Step 1 sensitivity tests informing the qualitative review do not account for potential changes in traffic flow conditions on the wider road network. As this may lead to new and/or different effects for noise resulting in changes to mitigation proposals detailed noise modelling using the 2020 UL Data across the noise study area was undertaken and the results were compared with those derived using the 2018 UL Data.

5.6.4 This comparison confirmed that the traffic flow changes in the 2020 UL Data would not result in changes to existing likely significant effects, nor introduce new likely significant effects. Accordingly, the conclusions in the original noise assessment will not change and therefore no changes to noise mitigation measures are required.

6 Conclusions from the sensitivity test

6.1.1 The sensitivity test demonstrates that in the vicinity of the Scheme, flow changes between the 2018 UL Data and the 2020 UL Data forecasts in both the design and opening year were modest. Based upon the 2020 UL Data, the Scheme junctions will continue to operate within capacity. It was therefore concluded that:

a. No alterations to the Scheme design would be necessary.

b. There would be no change to the proposed mitigation.

c. There are no changes to the overall conclusions on significance in the Environmental Statement.

6.1.2 The sensitivity test demonstrates that the assessments for the Scheme as submitted are robust and it is appropriate for the Scheme to continue to rely on the 2018 UL Data.

6.1.3 At the meeting held on 5 February 2021, the conclusions of the sensitivity test were agreed in principle by the local authorities subject to receipt of 2018 UL Data related junction modelling and predicted traffic flow changes in the areas of St Neots, Cambourne, Caxton Gibbet and Sandy to confirm these conclusions. This information will be provided as soon as possible.

Appendix A

A.1 Traffic Flow Changes 2018 UL Data to 2020 UL Data

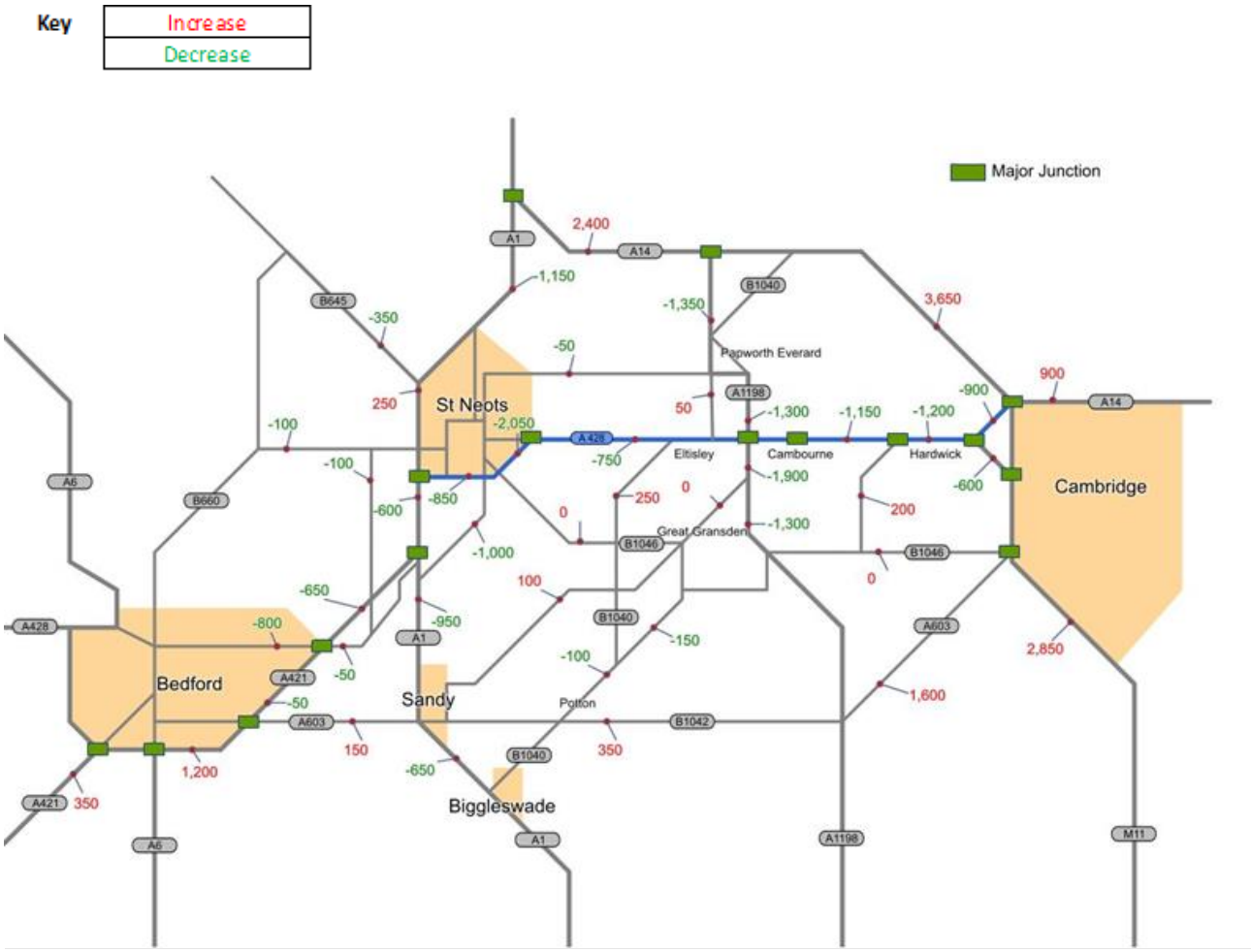

Figure A-1 - 2025 Do minimum AADT flow changes

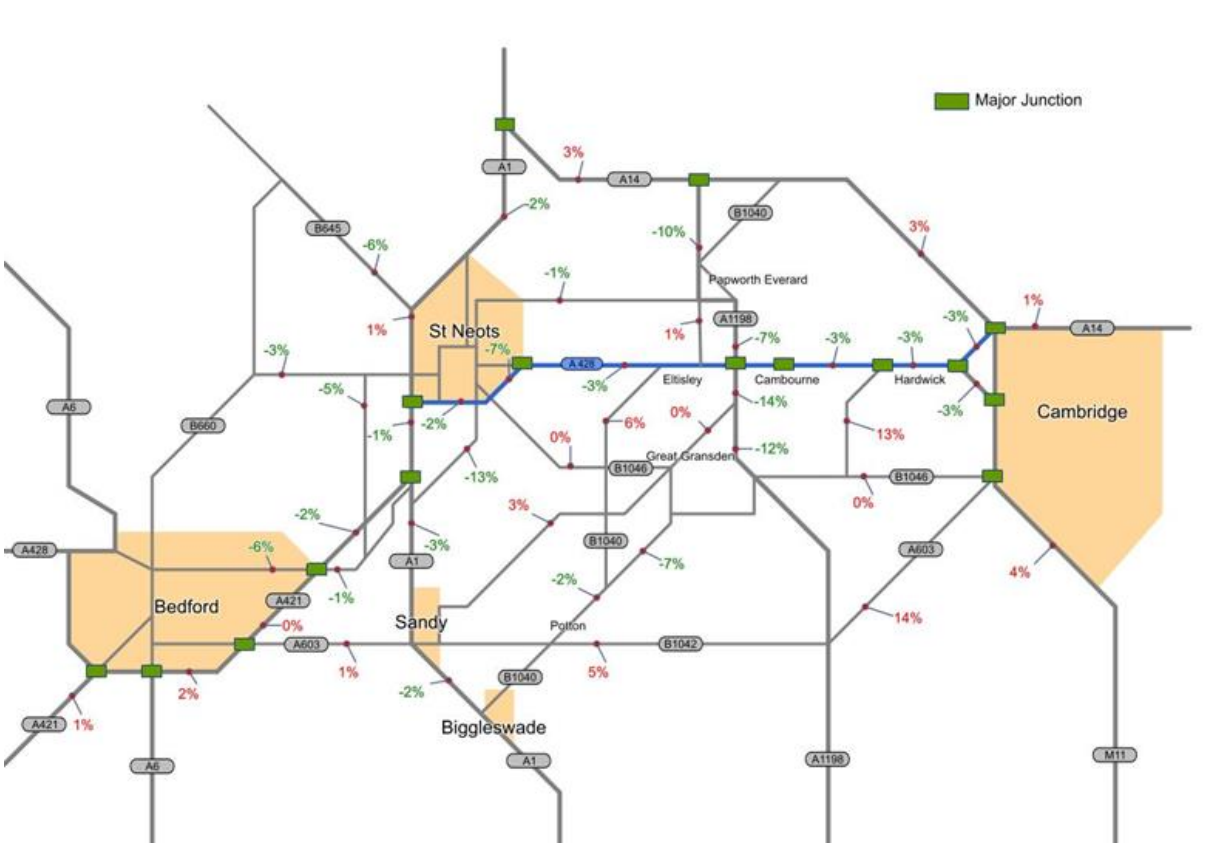

Figure A-2 - 2025 Do Minimum AADT Flow Changes (%)

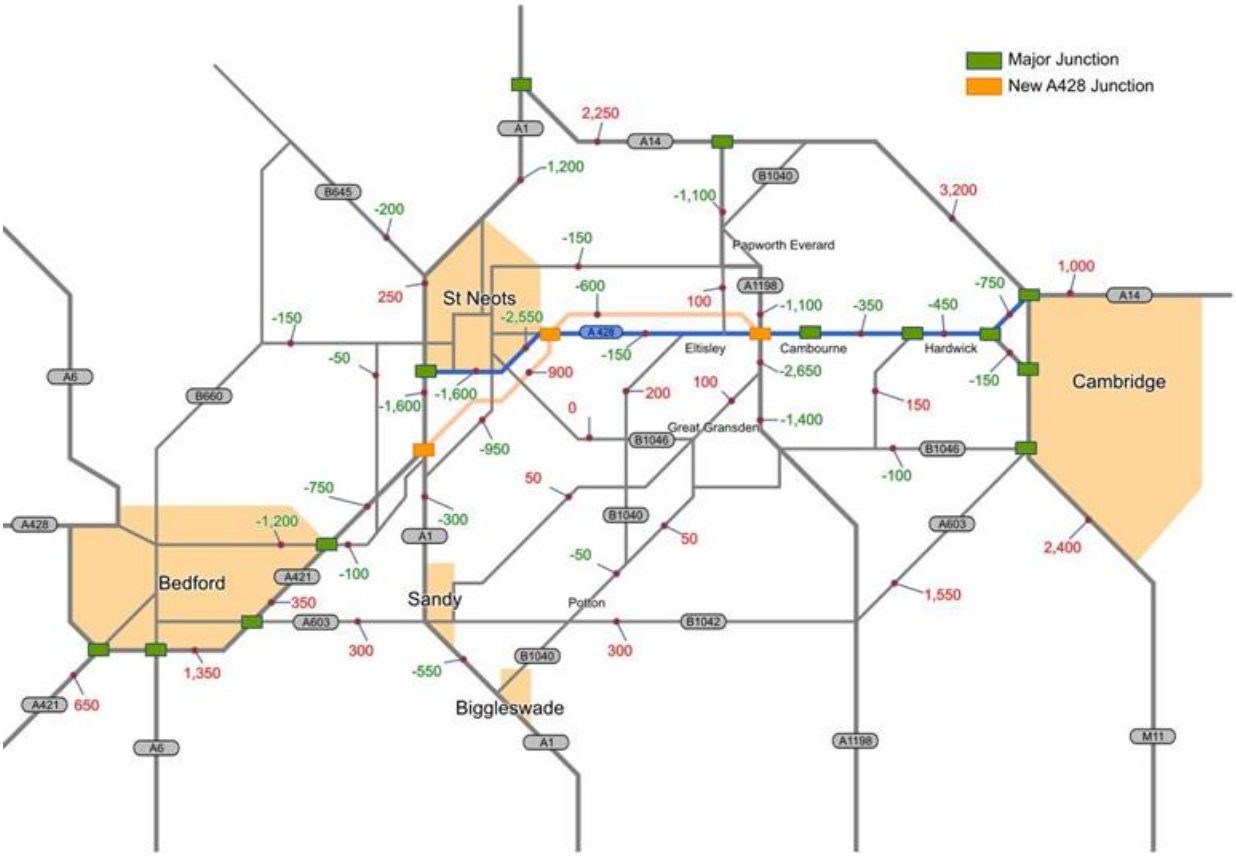

Figure A-3 - 2025 Do something AADT flow changes

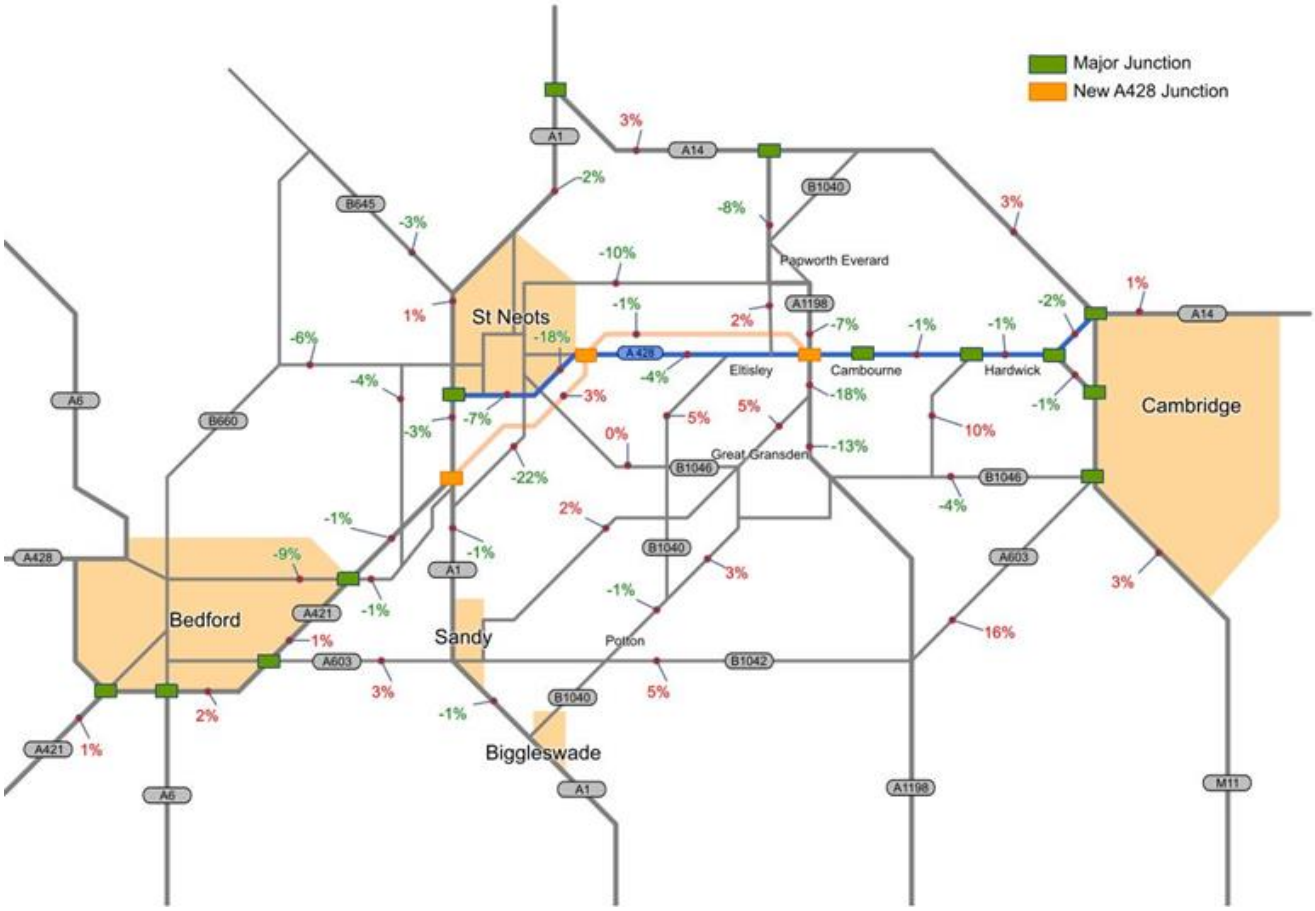

Figure A-4 - 2025 Do something AADT flow changes (%)

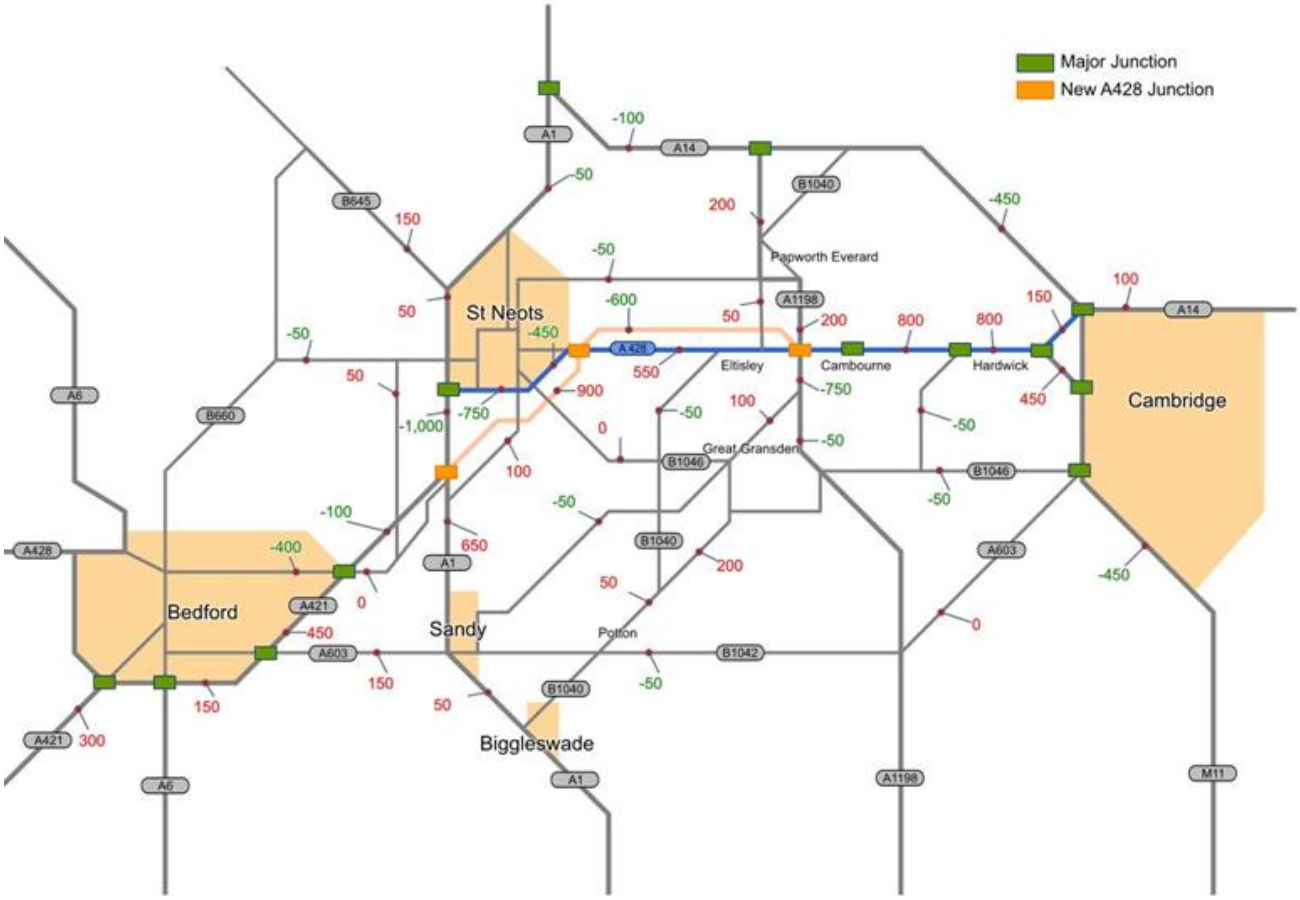

Figure A-5 – Relative change between do minimum and do something flows (2025 AADT)

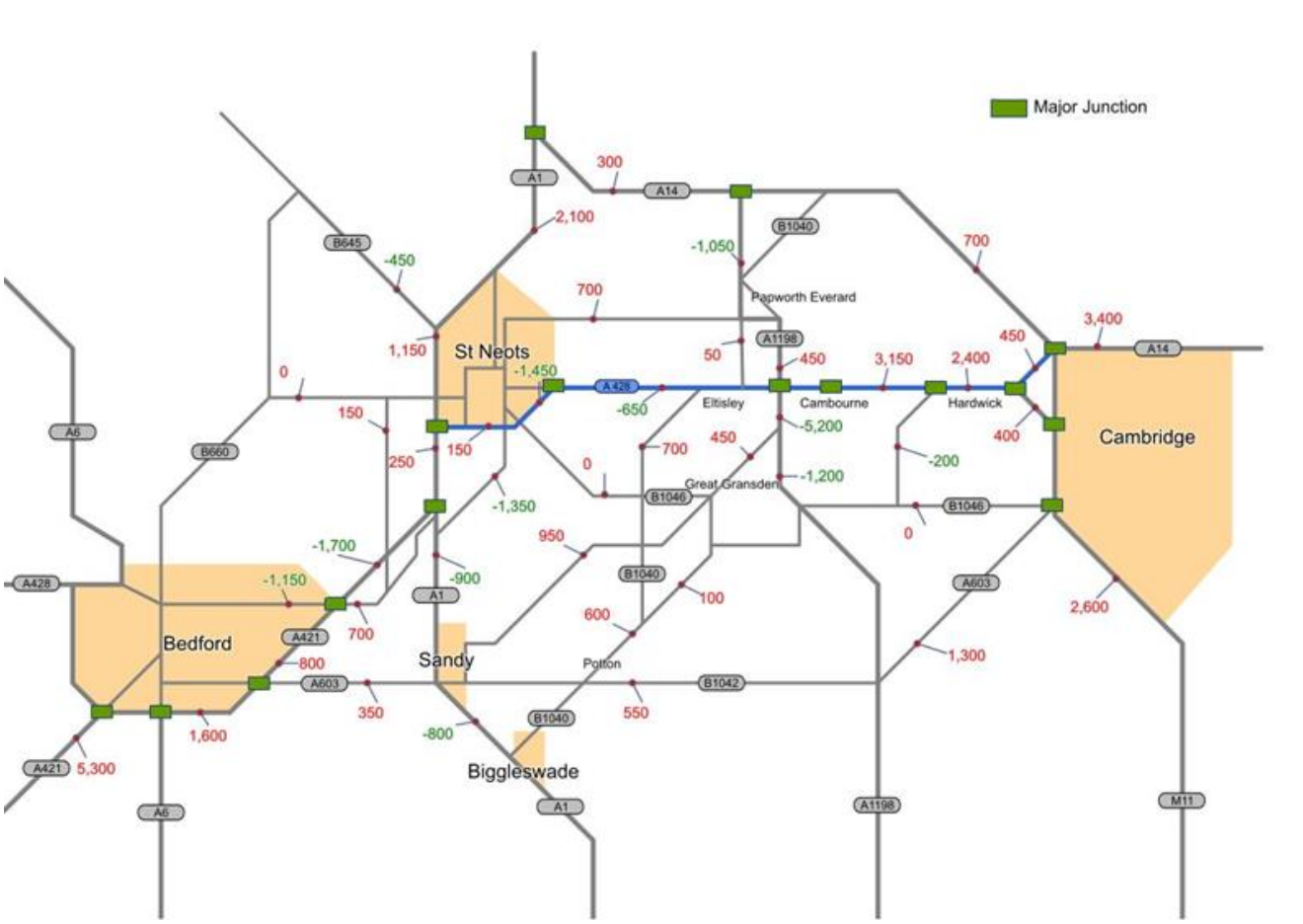

Figure A-6 – 2040 Do minimum AADT flow changes

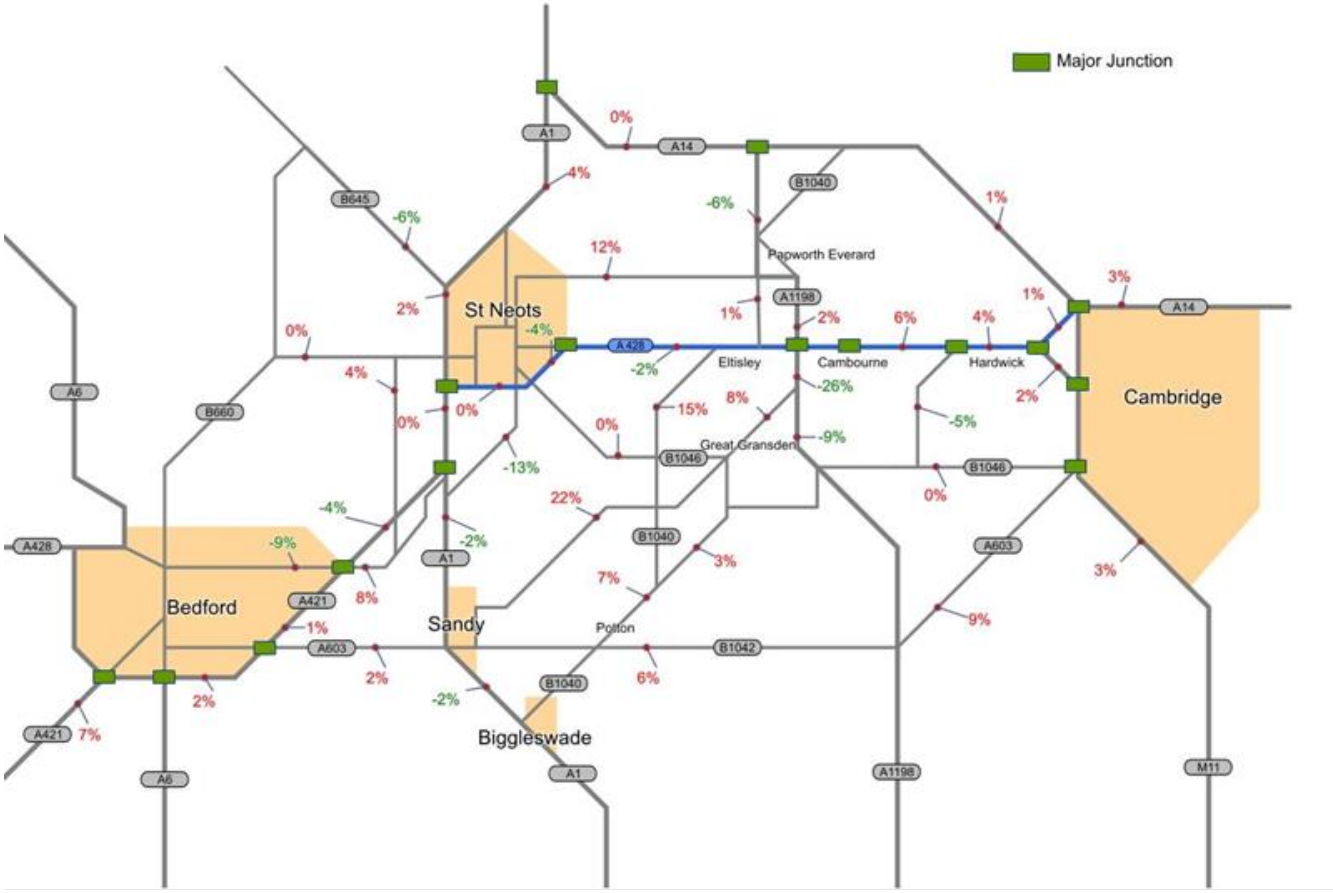

Figure A-7 – 2040 Do minimum AADT flow changes (%)

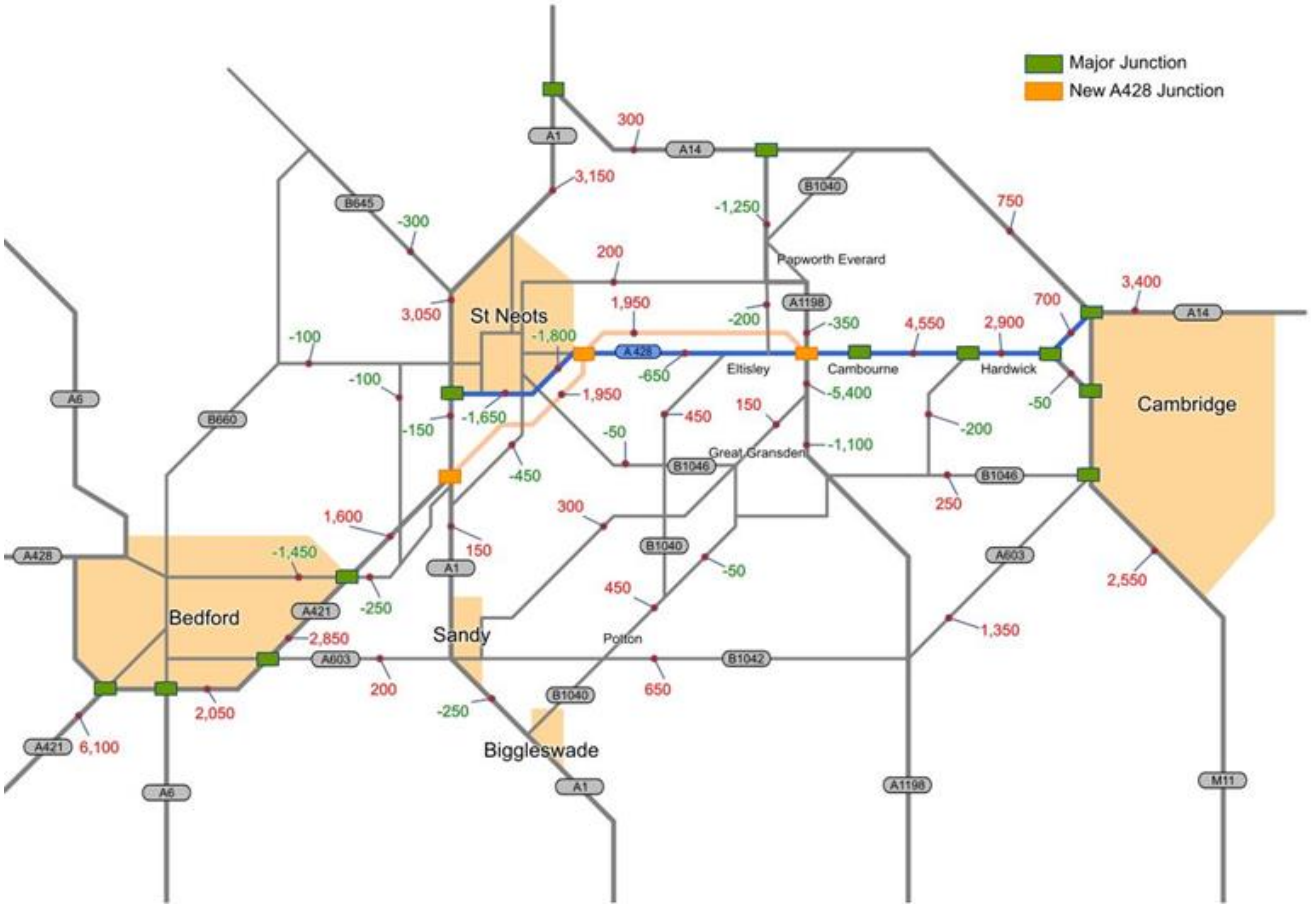

Figure A-8 – 2040 Do something AADT flow changes

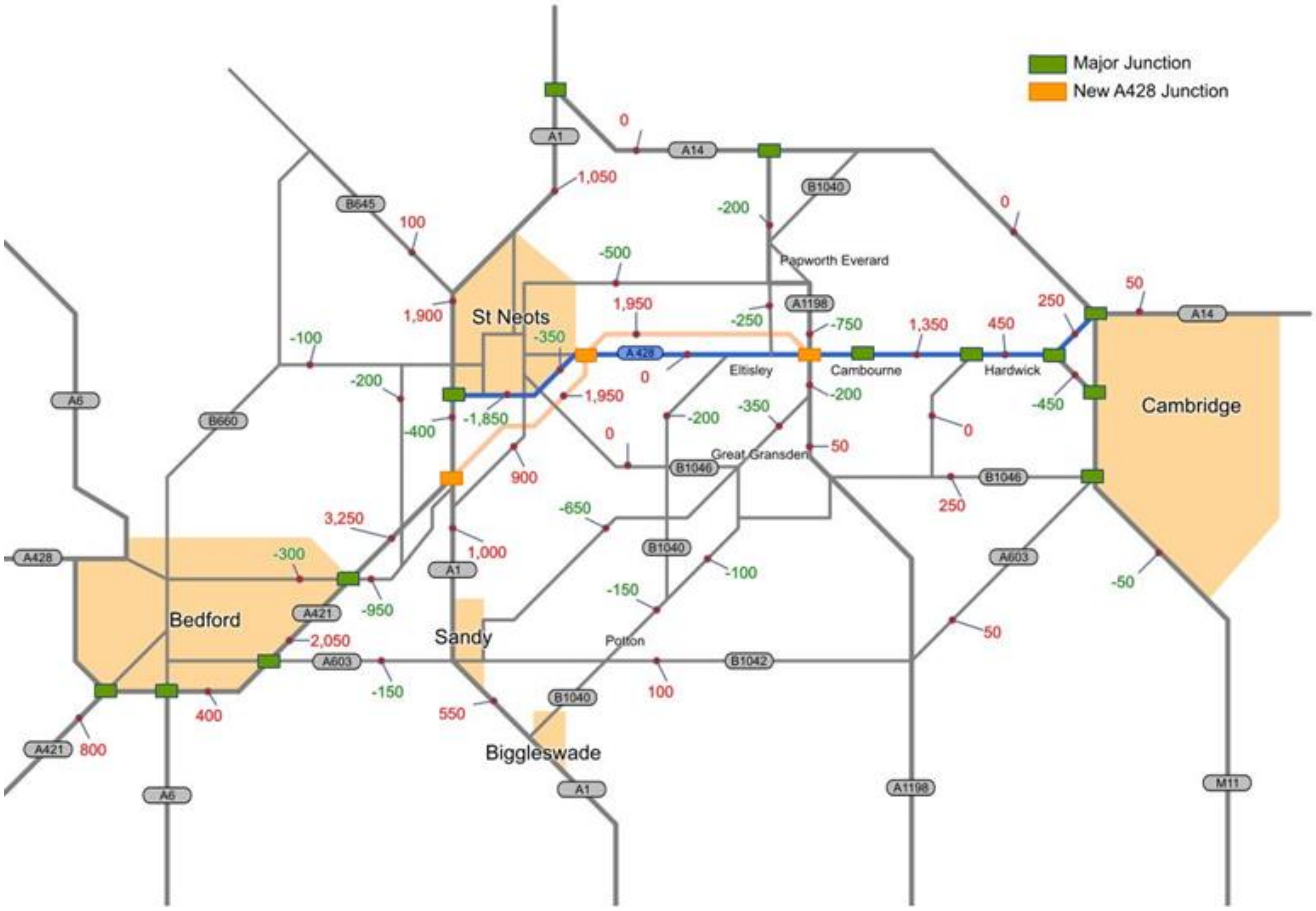

Figure A-9 – 2040 Do something AADT flow changes (%)

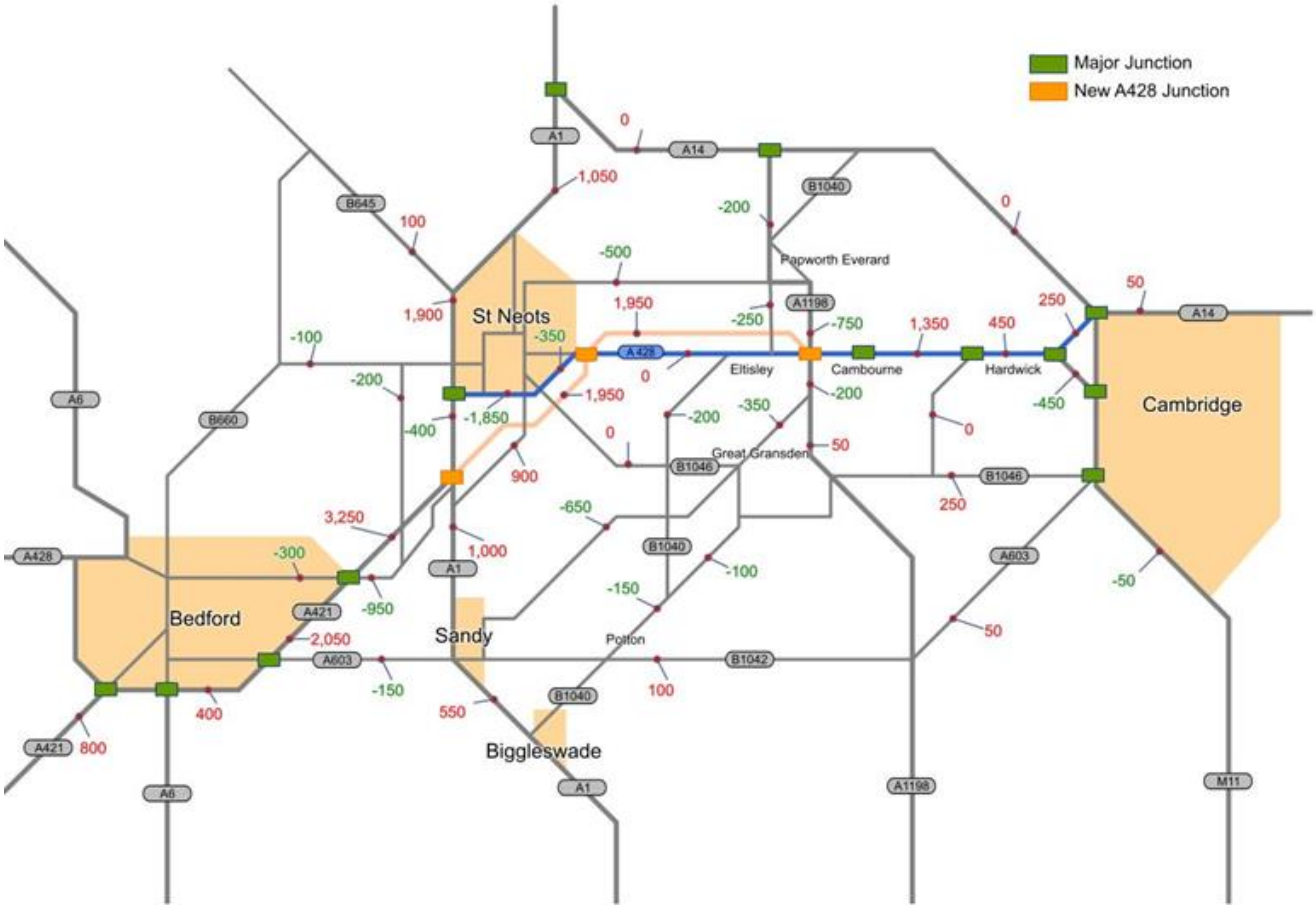

Figure A-10 – Relative change between do minimum and do something flows 2040 (AADT)

B.1 Air Quality Methodology

Assessment methodology changes for Sandy A1 Receptors modelling

B.1.1.1 The updated modelling for the Sandy A1 receptors followed the methodology presented in **Chapter 5, Air quality** of the Environmental Statement **[TR010044/APP/6.1]** and associated appendices. The following aspects of the assessment were updated to include the updated tools and datasets published by Defra.

Emission Rates

B.1.1.2 The emission rates used in the local air quality modelling were derived using the same procedure as described in Appendix 5.3 Air Quality Methodology of the Environmental Statement **[TR010044/APP/6.3]**, with the exception of the tool used to calculate the emission rates for each period. The "IAN 185-13 Speed Band Emission Factors v3.1" spreadsheet tool[8] was used for the modelling presented within this appendix. The tool was updated on 4 September 2020 to include emission factors based on Defra's Emissions Factors Toolkit (EFT) V10.1, which was released in August 2020[9].

Background concentrations

B.1.1.3 Predictions of total pollutant concentrations at receptors were calculated by combining the verified modelled road pollutant contributions with background concentrations. Background concentrations are those from many sources not explicitly modelled which individually may not be significant, but collectively, over a large area, need to be considered.

B.1.1.4 Annual average background concentrations used in the assessment of the Sandy A1 receptors presented in this report were derived from Defra's most recent 1km x 1km background maps which are based on a 2018 reference year[10] an update since the 2017-based background maps referred to in Appendix 5.3 'Air Quality Methodology' of the Environmental Statement **[TR010044/APP/6.3]**. The earliest background map available in the current dataset is 2018. To back-cast this to 2015 for NO_X to NO_2 calculations, monitoring NO_X data for 2015 and 2018 for four local background monitoring sites was compared, and an average factor of 1.1 was found to adjust 2018 data to represent 2015.

[8] Highways England (2020). IAN185-13 Speed Band Emission Factors v3.
[9] https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html
[10] Department for Environment, Food and Rural Affairs (2020). 2018-based background maps for NO_X and NO_2. https://uk-air.defra.gov.uk/data/laqm-background-home

B.1.1.5 In accordance with Local Air Quality Management Technical Guidance (LAQM.TG(16)[11]), as modelled national background maps are used in the assessment, these were first compared to local background monitoring to check they were representative of the area. Where the comparison showed that concentrations modelled in the national background maps did not represent local background monitoring, adjustment of the background map concentrations was undertaken.

B.1.1.6 The 'total concentrations' modelled in the national background maps also include local sources which are not considered to represent background values. Therefore, before adjustment, sector removal of emissions from motorways, trunk roads and A roads was undertaken using Defra's Sector Removal tool (v8.0, August 2020)[12]. This was to ensure the modelled national background maps were being compared with local background monitoring data on a like-for-like basis.

B.1.1.7 Before adjustment, the modelled NO_2 national background mapped values underestimated the monitored NO_2 at 4 local background monitoring locations by an average of 22%. The root mean square error (RMSE) of the unadjusted data was 3.6µg/m^3. An adjustment factor of 1.31, to be applied to the NO_X national background map, was derived using linear regression. After application of the adjustment factor and reconversion to NO_2, the RMSE was reduced to 1.7µg/m^3.

B.1.1.8 The adjusted sector-removed modelled national background maps were then used as inputs to follow on calculations in the assessment process for all scenarios. Sector removal of motorways, trunk roads and A roads is appropriate, as these roads were directly modelled within the air quality detailed modelling.

B.1.1.9 The background concentrations for each 1km x 1km square that the receptors intersect for 2015 and 2025 are presented in Table B-1. Backgrounds are presented to be below the objective value for each receptor.

[11] Department for Environment, Food and Rural Affairs (2018). Local Air Quality Management Technical Guidance (TG16)
[12] Department for Environment, Food and Rural Affairs (2020). NO_2 Adjustment for NO_X Sector Removal Tool v8.0. https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxsector

Table B-1 Estimated background pollutant concentrations at each receptor in the base year and opening year

Receptor	Background annual mean NO_2 (µg/m^3)	
	2015	2025
R221	14.2	9.8
R222	14.2	9.8
R272	14.2	9.8
R273	14.2	9.8
R274	14.2	9.8
R284	14.2	9.8
R286	13.9	9.7

Modelled NO_X to total NO_2 concentrations

B.1.1.10 The outputs of the dispersion model were post-processed to calculate total pollutant concentrations at receptors. For the assessment of the Sandy A1 receptors presented in this report the modelled road NO_X contributions have been converted to total NO_2 concentrations using Defra's NO_X to NO_2 v8.1 calculator[13] released in August 2020.

Verification

B.1.1.11 Modelled NO_2 concentrations in the base year were compared against monitored NO_2 concentrations in a process known as model verification. LAQM.TG(16) (Section 'Model Validation, Verification, Adjustment and Uncertainty', paragraphs 7.509-7.546) was followed and adjustment factors derived to bring modelled concentrations into line with monitored concentrations, where necessary. Within a large model study area different adjustment factors can be derived in different areas based on model performance in those areas. These areas are known as domains.

B.1.1.12 Based on changes to emission rates, model NO_X to NO_2 conversion and background concentrations, a new model verification for the 'A1 Houses' domain used within the Environmental Statement, which the assessed receptors fall into, was undertaken for the adjustment of model results.

[13] Department for Environment, Food and Rural Affairs (2020). NO_X to NO_2 Calculator v8.1. https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

B.1.1.13 A comparison of modelled estimates of road contribution NO_X with the road NO_X component derived from monitoring data was undertaken using Defra's NO_2 to NO_X calculator, version 7.1.1[14]. This version of the calculator was used for the base year as the earliest year in the current version (8.1) is 2018 and this therefore cannot be used for 2015. The results of the comparison of monitored and modelled road NO_X indicates that the model in the A1 Houses domain substantially underestimates road NO_x contributions (although statistics, such as root mean square error, to determine uncertainty do not apply as there is only one monitoring site within this domain), suggesting that model adjustment is required.

B.1.1.14 In order to improve model performance, a model adjustment factor was derived, in accordance with the methodology described in LAQM.TG16. The model adjustment factor applied to modelled road NO_X contributions within the A1 Houses domain is presented in Table B-2. Following post processing to obtain the total predicted NO_2 concentration at the measurement site, a comparison of the unadjusted and adjusted modelled estimates of total annual mean NO_2 with monitored concentrations is presented in Table B-3. The results show that the adjusted NO_2 concentrations modelled at the monitoring site in the A1 Houses domain are within +/- 10% of monitored concentrations following model adjustment, which is considered to be a robust level of performance.

Table B-2 Verification statistics

Model domain	Number of site comparisons	Number of monitoring sites within ±10% of the monitored concentration pre-adjustment	RMSE pre-adjust-ment (µg/m³)	Model adjust-ment factor	Adjusted model RMSE	Fractional Bias post adjust-ment)	Number of monitoring sites within ±10% of the monitored concentration post adjustment
A1 Houses	1	0	-	4.78	-	-	1
"-" indicates where only one measurement location is within a model zone and therefore statistics cannot be calculated							

Table B-3 Verification details at monitoring sites in the A1 Houses model domain

Site	Monitored NO_2 (µg/m³)	Monitored road-contributed NO_X (µg/m³)	Modelled road-contributed NO_X (µg/m³)	Modelled total NO_2 (µg/m³) pre-adjustment	Modelled total NO_2 (µg/m³) post-adjustment
LA7	67.3	132.8	27.8	27.9	67.3

[14] Department for Environment, Food and Rural Affairs (2019). NOX to NO2 Calculator v7.1.1