MOTT MACDONALD

Traffic Forecasting Report

Stroud Local Plan Traffic Modelling

March 2021

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The current Stroud District Local Plan was adopted in November 2015 and sets out the strategy for development within the District up until 2031. Stroud District Council started the process of reviewing the current Local Plan in 2017 and published a Draft Plan for Consultation in November 2019. The Draft Plan for Consultation identifies the development requirements for the District up to 2040 and sets out the Council's preferred development strategy for this period. It is anticipated that the new Local Plan will be adopted by Winter 2021/22, following periods of stakeholder and public consultation.

Stroud Local Plan Traffic Modelling

This report details the development of traffic forecasting undertaken in relation to the Draft Local Plan. The overall purpose of the traffic modelling work presented in this report is to assess the impact of the proposed Local Plan site allocations on both the local and strategic road networks, and to articulate a long-term transport investment strategy within the county and adjoining areas. The modelling work is intended to provide a cumulative assessment of the traffic impacts associated with the Local Plan site allocations, rather than providing detailed modelling analyses of individual sites.

The Gloucestershire countywide traffic model has been used as the basis for assessing the Local Plan proposals. Traffic impacts of the Local Plan proposals have been assessed through the development of 2040 future year forecast scenarios that consider travel demand associated with the proposed site allocations included in the November 2019 Draft Local Plan.

To mitigate the impact of the Local Plan sites, a package of indicative highway capacity improvements at key 'pinch-points' has been developed in collaboration with Gloucestershire County Council, Stroud District Council and Highways England and assessed using the traffic model. As a parallel piece of work to the traffic modelling assessments, a Sustainable Transport Strategy has also been developed that sets out a strategic approach to achieving mode shift. This strategy includes a selection of interventions and has been used to inform forecast demand reductions applied within the traffic modelling work.

Although some residual capacity issues remain within the network, overall, the mitigated forecasts demonstrate that the impacts of the proposed Local Plan sites can be largely addressed, and that the highway network can operate at similar levels of performance to the Baseline situation.

Preferred Mitigation

As noted above, the traffic modelling assessments undertaken to date have culminated in the identification of a preferred set of highway and sustainable transport mitigation interventions. At this stage, the preferred package of mitigation is intended to represent a strategic approach to mitigating the impact of the proposed Local Plan development sites. The strategy identifies the main locations and broad scale of likely interventions required and provides a starting point for the development of detailed schemes related to particular developments as they come forward through the planning process.

The highway improvement schemes within the preferred mitigation strategy are summarised below. Given the early stage of option development, the estimated costs for each scheme are subject to a large degree of uncertainty and are therefore presented within broad cost bands.

Notwithstanding the above, and based on the modelling and assessments documented in this report, the following mitigation measures are considered necessary to suitably alleviate the traffic impacts of the proposed Local Plan.

Preferred Highway Mitigation Strategy

Very High cost schemes (>£10m)

- **M5 Junction 12** – replacement of existing single overbridge dumbbell arrangement with a new grade-separated signalised roundabout;
- **M5 Junction 14** – replacement of existing single overbridge diamond interchange with new grade-separated signalised roundabout.

High cost schemes (£2.5m-£10m)

- **A38 Cross Keys Roundabout** – widening and signalisation of both A38 approach arms;
- **St Barnabas Roundabout** – approach widening on three arms and associated circulatory capacity improvements;
- **A38 / A430 / B4008 Cole Avenue** – widening of southbound A430 to three lanes, with nearside flare extension and widening on B4008 and westbound A38 approaches;
- **A419 / Oldends Roundabout** – dualling of A419 between Oldends and Chipman's Platt roundabouts;
- **A38 / B4509** – replacement of existing signal-controlled junction with large at-grade roundabout.

Medium cost schemes (£250k-£2.5m)

- **A38 / Epney Road** – widening of both A38 approaches to two ahead lanes, plus right-turn lanes;
- **A38 / B4071 Perry Way** – conversion of existing give-way junction to signal control, with associated widening on minor arm approach;
- **A38 at Claypits** – widening of both A38 approaches to two ahead lanes at existing signalised junction;
- **M5 Junction 13** – inclusion of traffic signals on all approaches to existing roundabout junction;
- **A46 / Dudbridge Hill** – Dudbridge Hill eastbound approach widening to three lanes on entry to junction;
- **A38 / B4066** – conversion to signal control with flare extension on B4066 approach;
- **A38 / B4066 Berkeley Road** – addition of traffic signals, with flaring provided on A38 southbound approach;
- **A38 / Alkington Lane** – signalisation of existing three-arm give-way junction, with widening on Alkington Lane approach;
- **B4066 / Alkington Lane** – introduction of traffic signal control.

Low and very low cost schemes

- **B4008 / Stonehouse** – simple signalisation scheme, with limited/no widening or kerb realignment;
- **B4008 / A38 northbound off-slip** – signal re-optimisation;
- **A419 Boakes Drive roundabout** – minor widening on A419 approach arms;
- **B4066 / Station Road roundabout** – limited widening on B4066 eastbound approach to existing roundabout;
- **A38 / A4135** – removal of existing hatch marking and potentially minor carriageway widening on northbound A38 approach.

1 Introduction

1.1 Background

Mott MacDonald has been commissioned by Stroud District Council (SDC) to provide traffic modelling support in relation to the emerging Stroud Local Plan. This follows on from a commission for Gloucestershire County Council (GCC) to develop a traffic model suitable for the assessment of both the Stroud Local Plan and the Cheltenham, Gloucester and Tewkesbury Joint Core Strategy (JCS).

1.1.1 Stroud Local Plan

The current Stroud District Local Plan was adopted in November 2015 and sets out the strategy for development within the District up until 2031.

The National Planning Policy Framework states that local plans and spatial development strategies should be reviewed at least once every five years. The District Council started the process of reviewing the current Local Plan in 2017 and published a Draft Plan for Consultation in November 2019. The Draft Plan identifies the development requirements for the District for the next 20 years and sets out the Council's preferred development strategy for the period up to 2040. It is anticipated that the new Local Plan will be adopted by Winter 2021/22, following periods of stakeholder and public consultation.

1.1.2 Stroud Local Plan Traffic Modelling

The overall purpose of the traffic modelling work presented in this report is to assess the impact of the emerging Local Plan site allocations on both the local and strategic road networks, and to articulate a long-term transport investment strategy within the county and adjoining areas. The modelling work is intended to provide a cumulative assessment of the traffic impacts associated with the Local Plan site allocations, rather than providing detailed modelling analyses of individual sites.

The traffic modelling undertaken in relation to the emerging Local Plan has made use of the Gloucestershire Countywide Traffic Model (GCTM). An overview and background to the development of the GCTM is provided in section 2 of this report.

In parallel with the traffic modelling set out in this report, a related piece of work involving the development of a Sustainable Transport Strategy (STS) has been undertaken by AECOM in conjunction with SDC, GCC and Highways England. The STS has been developed alongside the traffic modelling and sets out a strategic approach to achieving mode shift, with detailed measures to be developed by sites through the planning application process. A framework has been developed to assess the potential mode shift that could be achieved by the main interventions included in the strategy, and this has been used to inform forecast demand reductions within the traffic modelling work. An overview of the STS is provided within section 6.2 of this report, with further detail provided within the Stroud Sustainable Transport Strategy report (February 2021) produced by AECOM.

In addition to their work on developing the STS, AECOM, GCC, SDC and Highways England have also worked collaboratively to identify and agree trip generation and distribution assumptions for use in the Local Plan traffic modelling exercise.

In order to assess the impact of the emerging Local Plan the following future year forecast scenarios have been undertaken and are presented in this report:

- **2040 Baseline Forecasts** (Do Minimum) – a scenario in which the proposed Local Plan housing and employment allocations are assumed not to be delivered but committed developments and transport schemes are included;
- **2040 Local Plan Forecasts** (Do Something) – scenarios in which the proposed Local Plan housing and employment allocations are assumed to be delivered, together with committed developments and transport schemes, and consisting of varying levels of mitigation as follows:
  - **Unmitigated** – no transport mitigation included so the transport network is unchanged from the Baseline scenario;
  - **Sustainable transport measures only** – inclusion of sustainable transport measures aimed at reducing highway demand;
  - **Preferred highway mitigation only** – inclusion of mitigation schemes intended to improve the performance of the highway network and to offset the impact of the Local Plan allocations;
  - **Preferred highway mitigation *and* sustainable transport measures** – inclusion of the highway mitigation schemes and the sustainable transport measures.

1.2 Forecasting Report

This report outlines the development of traffic forecasting undertaken in relation to the emerging Stroud Local Plan. The results of various future year forecast scenarios are also presented within the report.

Following this introductory section, the remainder of the report is structured as follows:

- **Section 2** summarises the development of the Gloucestershire traffic model;
- **Section 3** provides an overview of the forecast approach adopted;
- **Section 4** describes the development of the 2040 Baseline forecasts;
- **Section 5** outlines the development of the 2040 Local Plan forecasts;
- **Section 6** summarises the approach taken to develop and assess mitigation measures;
- **Section 7** presents the key findings from the various traffic forecasts undertaken; and
- **Section 8** provides a brief summary and identifies key conclusions.

2 Gloucestershire Traffic Model

2.1 Introduction

A countywide traffic model of Gloucestershire was developed in 2019 by Mott MacDonald, primarily for the purposes of assessing the Stroud Local Plan and the Cheltenham, Gloucester and Tewkesbury JCS. The specification and development of the Gloucestershire model was set out in a 'Model Specification Report' (April 2019) and a 'Local Model Validation Report' (July 2019), with an overview provided in this section of the report.

Detail on the development of forecast models is provided in subsequent sections of this document.

2.2 Model Development Background

Given the availability of the Highways England A417 Missing Link PCF Stage 2 traffic model it was decided to use this as the basis for the development of the Gloucestershire model. In particular, it was decided that A417 Missing Link traffic model was to be enhanced to enable the assessment of the JCS and Stroud Local Plan, with the updated model subsequently being used to inform and to appraise these two land use strategies.

The A417 PCF Stage 2 model was developed from the PCF Stage 1 model, which in turn was derived from Highways England's South West Regional Transport Model (SWRTM[1]). The original SWRTM has been enhanced at both A417 PCF stages to provide a more detailed local model around the A417 Missing Link and surrounding areas.

Model enhancements were primarily focused around the A417 and key alternative routes, with less need to substantially improve the original SWRTM in areas more remote from the A417 scheme. In addition, as part of enhancements made during PCF Stage 2, the urban areas of Cheltenham, Gloucester and Stroud were converted from fixed speed coding into simulation coding.

The whole of Gloucestershire is included within the simulated area of the inherited A417 model, with the network and zoning system being most detailed within the county. The A417 model is also TAG compliant, generally validates well against observed data within Gloucestershire, and was therefore considered to be an appropriate basis from which to develop a model to support the JCS and Stroud Local Plan land use strategies.

The remainder of this section of the report outlines the key features of the Gloucestershire model and identifies the main enhancements made during its development.

2.3 Key Features of the Model

In many respects, the specification and key features of the Gloucestershire model closely mirror the A417 Missing Link model, as the new model is effectively an extension to the coverage of the A417 model. The following elements remain unchanged from the A417 model:

- Modelling system;
- Model base year;

[1] The SWRTM is one of five 'regional' transport models (RTMs) developed by Highways England to provide the basis for the development and appraisal of Road Investment Strategy (RIS) and Road Investment Programme (RIP) schemes.

- Modelled time periods;
- Model segmentation (e.g. purposes and user classes);
- Extents of model simulation area;
- External buffer network;
- Calibration and validation criteria; and
- Observed traffic count and journey time data (although this has been supplemented with new local data).

Notwithstanding the above, and following a review of the existing model, the following broad enhancements have been made within the Gloucestershire model:

- Network enhancements to include additional links and more refined network coding, particularly around Stroud District and M5 J10;
- Disaggregation of model zones to improve model resolution in the Stroud and M5 J10 areas; and
- Inclusion of additional traffic count and journey time data (to supplement existing data from the A417 model) for model calibration and validation purposes.

Further details on the Gloucestershire model are set out below.

2.3.1 Modelling System and Software

The Gloucestershire model uses the same TAG-based approach adopted on both the SWRTM and the A417 models. The modelling system therefore comprises:

- Trip end model – used for estimating the number of trips generated / attracted by a specific zone;
- Variable demand model (VDM) – used for estimating how travellers will respond to changes in their travel costs; and
- Highway assignment model – used for estimating travel costs and identifying the routes travellers may choose through the road network.

The demand model utilises DIADEM software supported by Highways England's bespoke interface program (HEIDI[2]), while the highway assignment model is developed in SATURN software (version 11.4.07H).

2.3.2 Time Periods

The assignment model represents an average hour for each of four time periods for an average Monday to Friday weekday in March 2015 (excluding school holidays and bank holidays). These time periods, which remain consistent with those used in the SWRTM and the A417 Missing Link model, are:

- AM Average hour (07:00 to 10:00);
- Inter Peak (IP) Average hour (10:00 to 16:00);
- PM Average hour (16:00 to 19:00); and
- Off Peak (OP) Average hour (19:00 to 07:00).

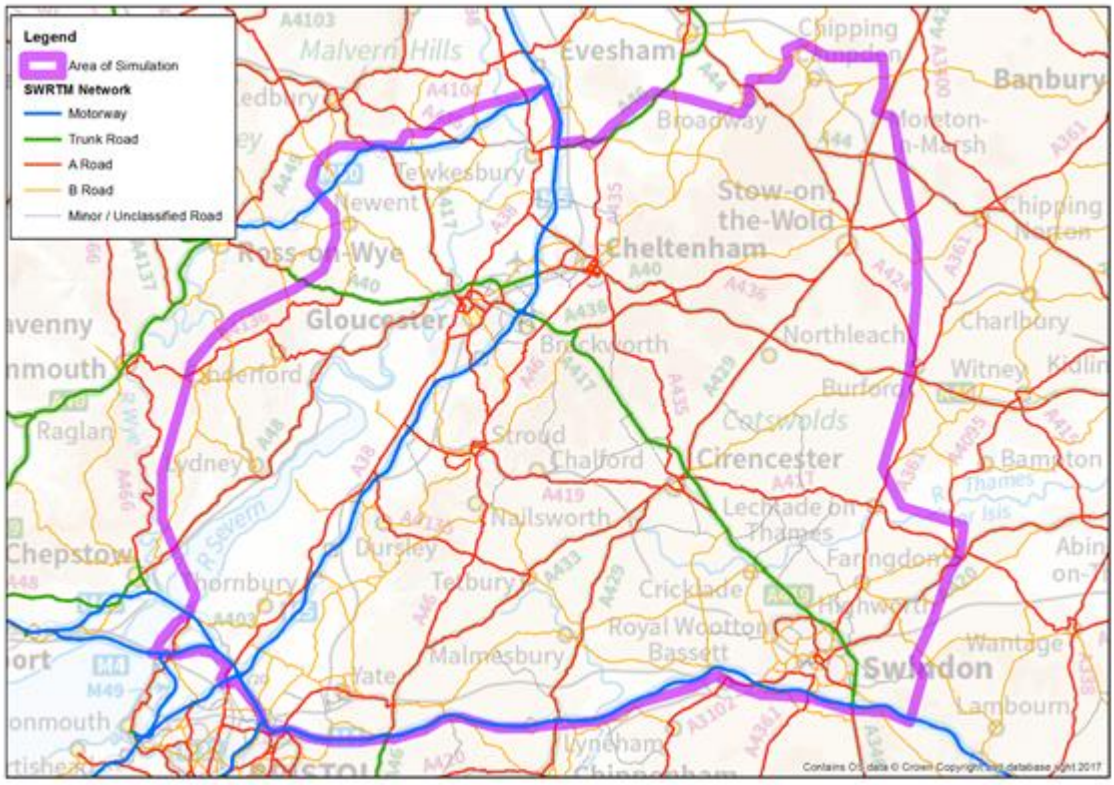
[2] Highways England Integrated DIADEM Interface

As per the parent models, only the three daytime periods are subject to calibration and validation, with the OP model simply used as an alternative method to factoring from modelled periods to daily levels.

2.3.3 Modelled Areas

The geographic extent of the fully modelled area within the Gloucestershire model has remained unchanged from the A417 Missing Link model. The extent of this area is shown in Figure 2.1.

Figure 2.1: Fully Modelled Area



As per the SWRTM and the A417 models, the network within the fully modelled area includes all motorways, A-roads, B-roads plus any minor roads that provide an important role in enabling traffic movements within the model. The network in this area is also fully simulated except for the urban areas of Swindon and parts of Bishop's Cleeve, within which fixed speed coding is used, as per the A417 model.

Whilst the extent of the area of detailed modelling has remained unchanged from the A417 model, the network and zoning within this area has been enhanced within Stroud District and around M5 J10. Detail on the network and zoning enhancements undertaken in the development of the Gloucestershire model is provided later in this section.

Outside of the fully modelled area, and in accordance with the approach adopted for both the SWRTM and A417 models, the Gloucestershire model consists of areas of fixed speed buffer coding, with varying levels of detail and network density. No changes to either the extent or coding detail within these external areas have been undertaken as part of the development of the Gloucestershire model.

2.3.4 Zoning System

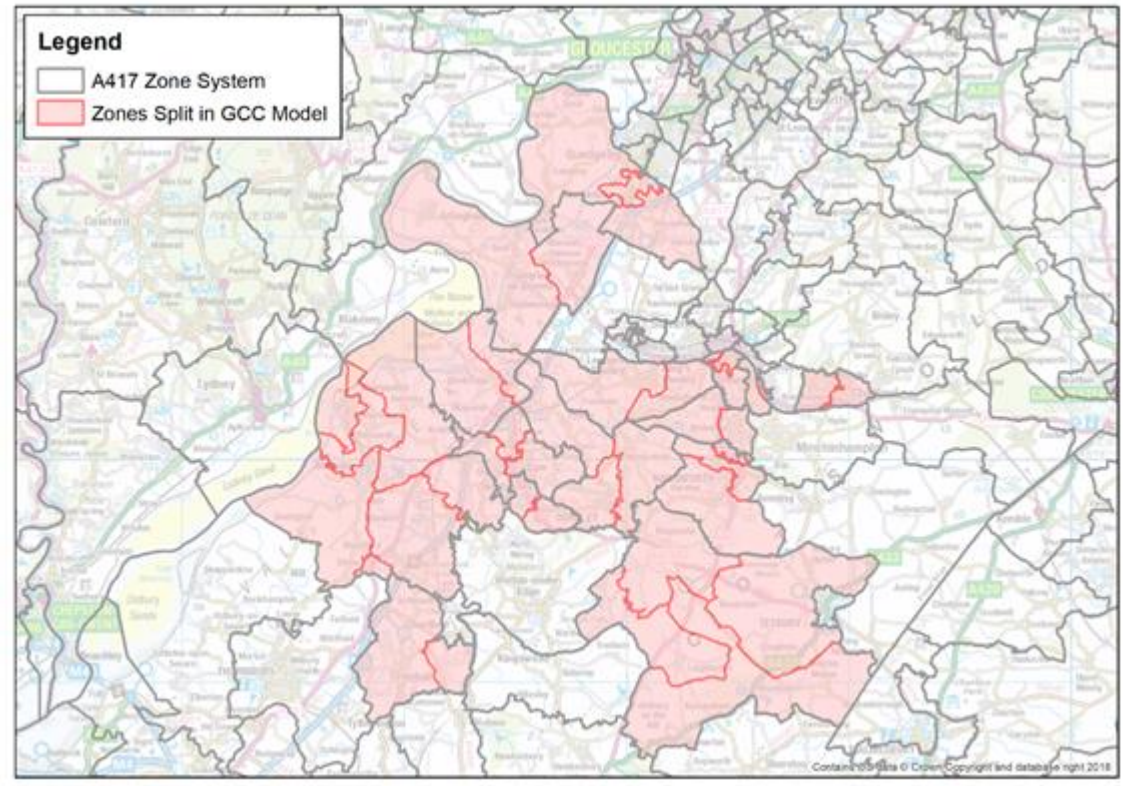
The SWRTM zone system is based on 2011 Census Output Areas (OAs), or aggregations thereof, and was originally designed to be sufficiently detailed spatially to enable trips to load onto the SWRTM network and follow representative routes on the strategic road network (SRN). The zoning system was developed to respect administrative boundaries so that zone-based outputs could be reported at a variety of levels (e.g. Census areas, District, County and Regions). There are a total of 1901 zones in the SWRTM, with 1638 of these located within the SWRTM 'Region of Focus'.

The SWRTM zone system was largely retained in the A417 Missing Link models, but with enhanced zoning definition included in the local study area. This included the disaggregation of SWRTM zones near the A417, and also in other areas, most notably in the urban areas of Cheltenham, Gloucester and Stroud. The A417 Missing Link PCF Stage 2 model consists of 1940 zones.

The zone structure for the Gloucestershire model is based on the A417 Missing Link model with some further disaggregation of zones to enable trip ends to be more precisely located within these areas. The Gloucestershire base model has a total of 1973 zones and the zoning system continues to respect the administrative boundaries, as per the SWRTM and the A417 models.

The location of zones that have been disaggregated in the Stroud area in the Gloucestershire model are shown in Figure 2.2.

Figure 2.2: Zoning Enhancements in Stroud Area



2.3.5 Network Structure

The highway network is based on the A417 Missing Link PCF Stage 2 model, with the extent of the fully modelled area remaining unchanged for the Gloucestershire model as discussed above. As discussed in section 2.3.2, the network is most detailed within the fully modelled area and is also fully simulated except for the urban areas of Swindon and parts of Bishop's Cleeve, within which fixed speed coding is used.

The highway network in the areas around Stroud and M5 J10 in the existing A417 Missing Link model has been enhanced to enable more accurate representation of local traffic movements. Network enhancements has included the incorporation of additional links with the intention that sufficient network resolution is provided to allow the model to adequately assess the M5 J10 scheme and also the emerging Stroud Local Plan.

The initial coverage of proposed additional network was originally identified through dialogue with GCC, with requirements for further additional links identified during the development of the model.

Additional network definition included in the Stroud area of the model is shown in Figure 2.3, while Figure 2.4 shows the zoning system overlaid with the modelled highway network.

Figure 2.3: Additional Network Definition in Stroud Area

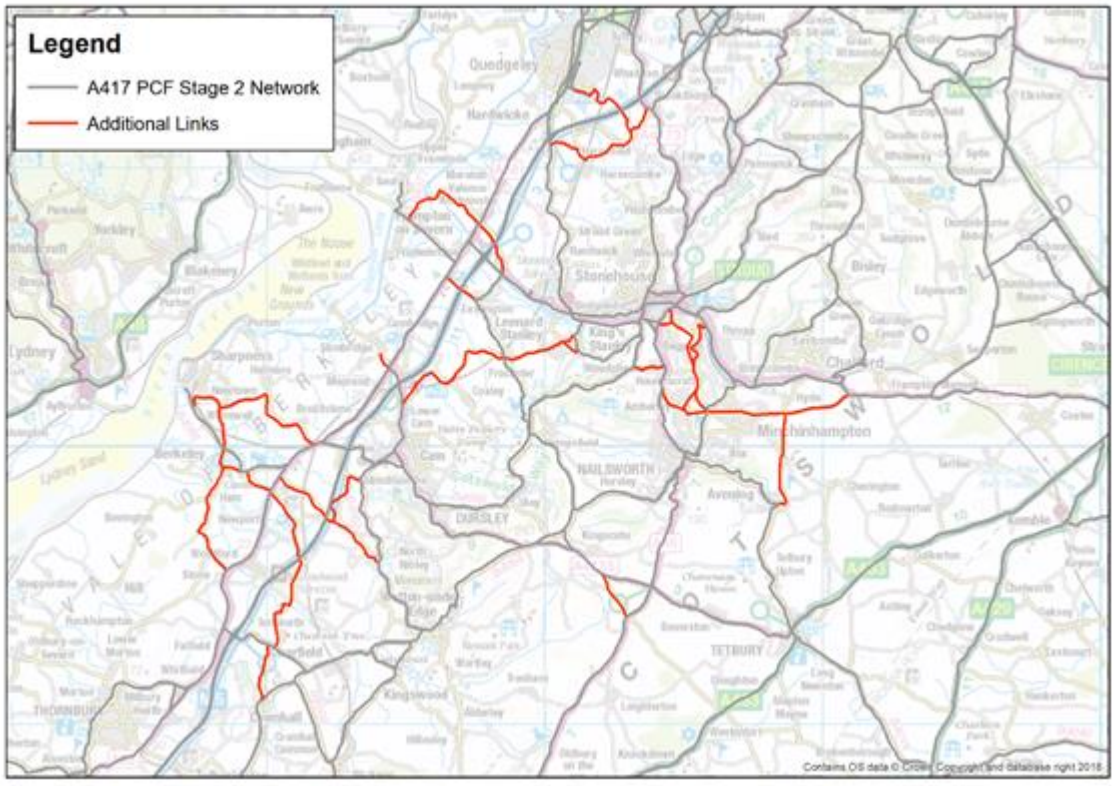
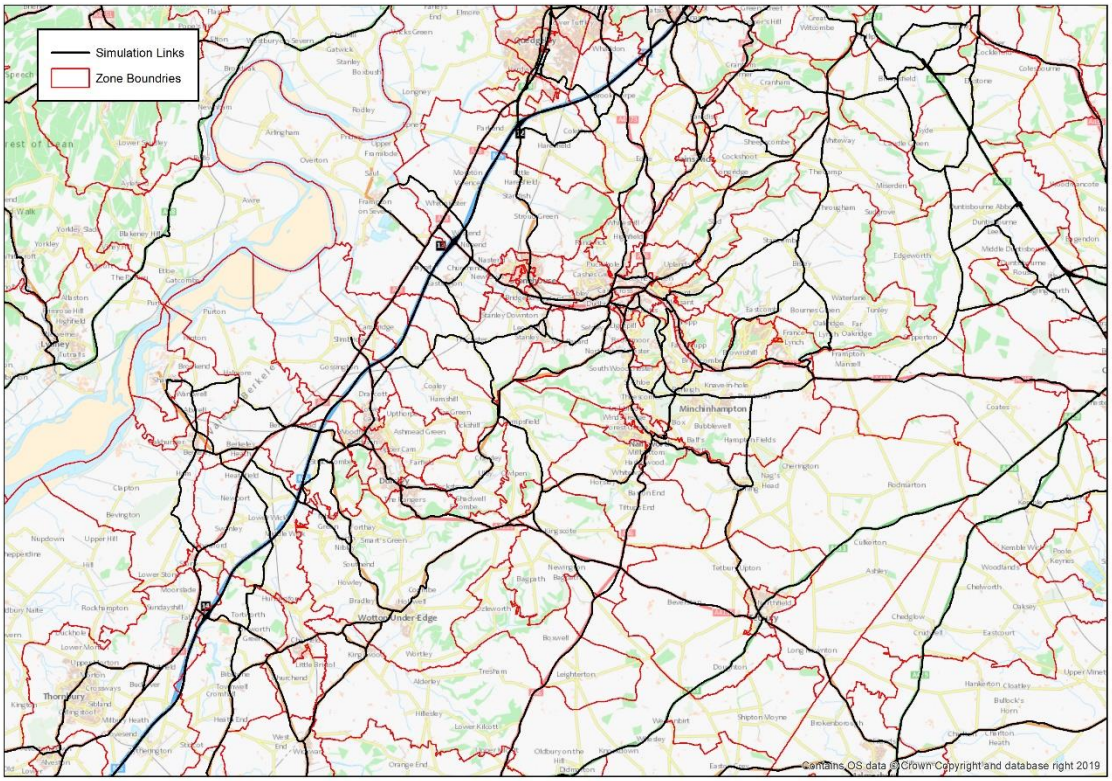


Figure 2.4: Network Structure and Zoning System in the Stroud District



2.3.6 User Classes / Segmentation

The following five user classes are included in the base year highway assignment model:

- Car – Employers' Business;
- Car – Commuting;
- Car – Other;
- Light Goods Vehicles (LGV); and
- Heavy Goods Vehicles (HGV).

LGV demand is assumed to be a mix of freight and personal business trips based on average proportions outlined in the Department for Transport's (DfT) TAG databook.

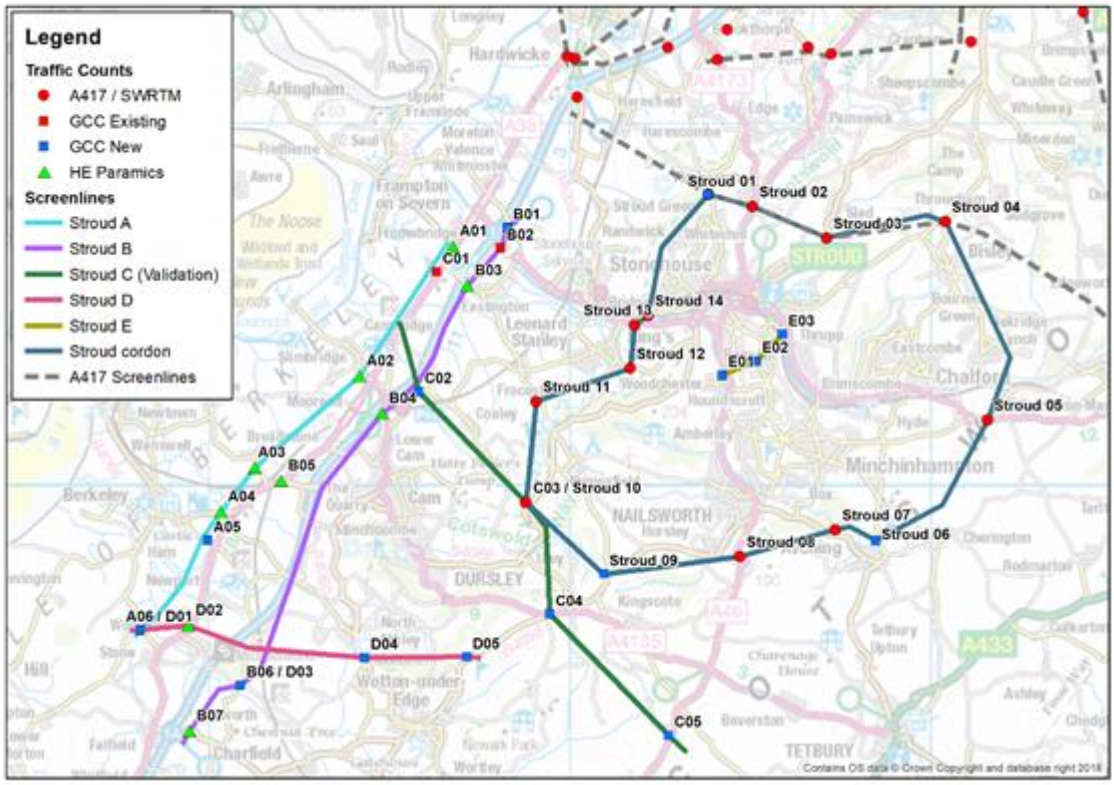
The demand model is further segmented with the Employers' Business and Other trips split into home-based and non-home-based purposes. Rail segments (for Employers' Business, Commute and Other trips) are also included within the demand model to allow the effects of mode choice between highway and rail to be represented in forecasting.

2.4 Traffic Count and Journey Time Data

Traffic count and journey time data used in the development of the SWRTM and A417 models was retained for use in the development of the enhanced Gloucestershire model.

This existing traffic count data was supplemented with additional data made available by GCC, including a selection of Automatic Traffic Counts (ATCs) and Manual Classified Turning Counts (MCTCs). This additional traffic count data has been allocated into new or revised screenlines/cordons in the Stroud area, one which has been used in model validation. The resulting screenlines in the Stroud area are identified in Figure 2.5.

Figure 2.5: Calibration and Validation Screenlines – Stroud Area



Similarly, journey time validation routes used in the SWRTM and A417 model were retained and supplemented with additional local routes around the Stroud and M5 J10 areas. Journey time data for these additional routes has been derived from DfT TrafficMaster data, as was the case with the original SWRTM and A417 routes. The journey time routes retained from the SWRTM and A417 models are shown in Figure 2.6, while Figure 2.7 presents the new routes in the Stroud area.

Figure 2.6: SWRTM and A417 Journey Time Routes

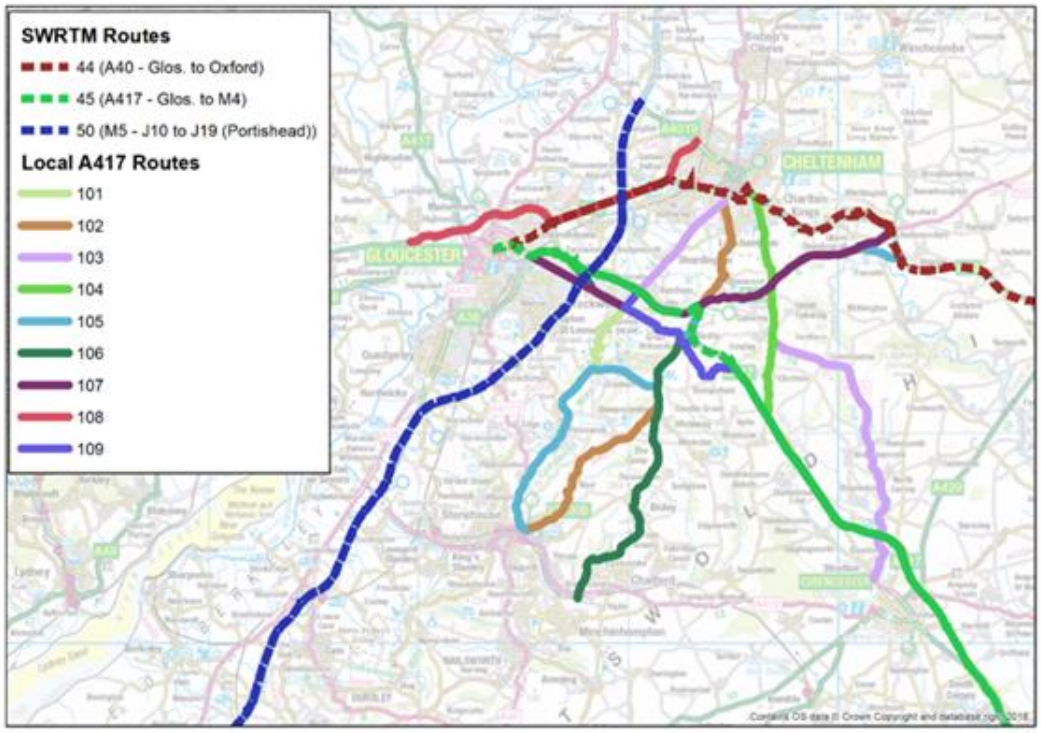
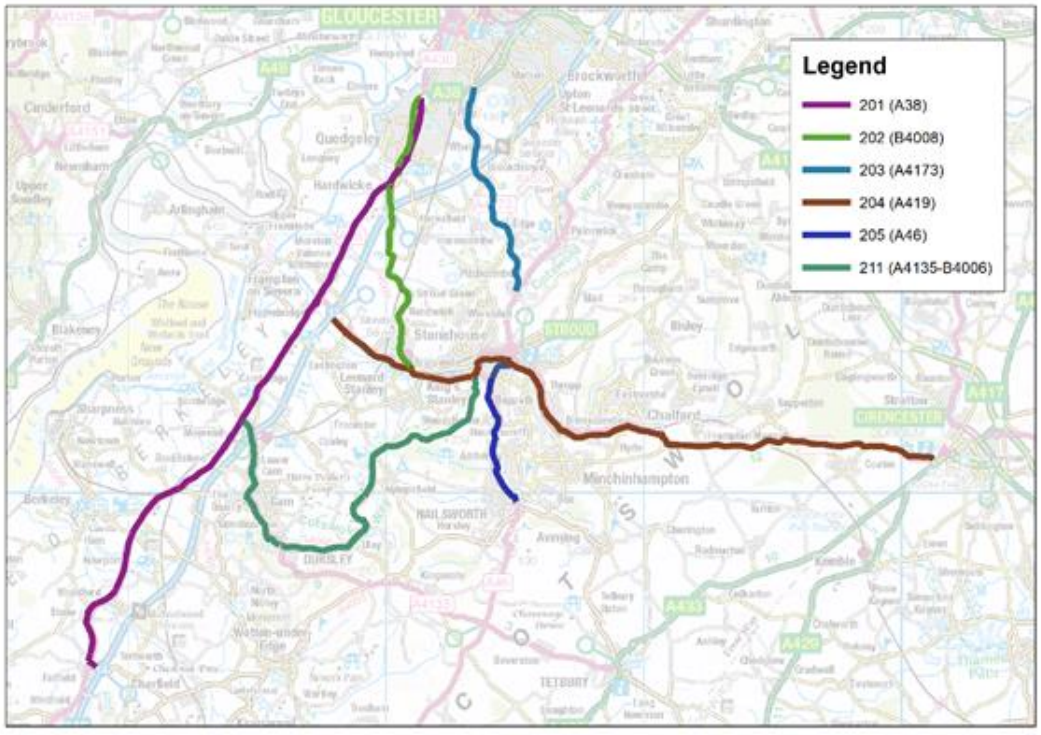


Figure 2.7: Local Journey Time Routes – Stroud Area



2.5 Convergence Criteria

2.5.1 Demand Model Convergence

In relation to demand / supply model convergence, the supply / gap measure has been adopted with a target of 0.1% as per TAG within the SWRTM Region of Focus area. In addition, a sub-area gap target, calculated for all trips that have an origin in the SWRTM Region of Focus area, of 0.2% has been adopted as per criteria used for Highways England's regional traffic models.

2.5.2 Assignment Model Convergence

Assignment model convergence is measured in two ways:

- Proximity to the equilibrium measured by a gap parameter; and
- Stability, measured by changes in flows and delays.

The criteria set out in TAG Unit M3.1 (see Table 2.1 below) has been used to assess the assignment convergence of the base year SATURN model. The assignment procedure used for the highway model is an interaction between an equilibrium assignment and junction delay calculations. The highway model uses an equilibrium assignment, distributing demand according to Wardrop's first principle of traffic equilibrium: "Under equilibrium conditions traffic arranges itself in congested networks in such a way that no individual trip makers can reduce their path costs by switching routes".

As per TAG Unit M3.1 section 3, Table 2.1 identifies the convergence measures (of proximity and stability) considered acceptable in establishing a base highway assignment model.

Table 2.1: Summary of Assignment Model Convergence Measures

Measure of Convergence	Base Model Acceptable Values
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 (P) <1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2) <1%	Four consecutive iterations greater than 98%

The TAG guidance also specifies that tighter levels of convergence may be required for scheme appraisal. Therefore, whilst not strictly necessary, the Stroud Local Plan forecast traffic models adopt a tighter set of convergence criteria, with the SATURN ISTOP parameter increased from the default of 98% to 100%. This means model convergence is achieved once at least 99.5% of links experience flow changes of less than 1% for four consecutive iterations. This has been adopted in the Stroud Local Plan modelling so that better assignment convergence can be achieved.

2.6 Summary of Model Performance

Levels of convergence in the base year assignment model have been shown to be very good, easily achieving both the criteria set by TAG and a more stringent set of criteria adopted specifically for the model. Convergence statistics for the base year highway assignment model are presented in Table 2.2.

Table 2.2: Base Assignment Model Convergence Statistics

	AM Peak				PM Peak			
Scenario	% Gap	% Flow	% Cost	Iter.	% Gap	% Flow	% Cost	Iter.
2015 Base	0.00010	99.8	99.8	25	0.00022	99.8	99.7	26

These statistics demonstrate good levels of stability within the model, which should contribute toward model robustness in forecasting. Convergence statistics from the various forecast scenarios are reported within relevant sections of this report.

Regarding the overall model calibration and validation results, the model achieves good levels of performance when compared against TAG criteria. The calibration and validation results of link flows and journey time routes all meet the relevant TAG criteria, while screenline level comparisons of modelled versus observed flows meet the 5% criteria in nearly all instances.

2.7 Fitness for Purpose

In conclusion, it is considered that the 2015 Gloucestershire base year highway assignment model calibrates and validates to within acceptable margins of the TAG criteria and therefore demonstrates a good representation of traffic behaviour in the study area, thus forming a robust basis from which future year forecasts can be developed.

It is noted, however, that the base model represents an average hour within the peak periods, rather than a single peak hour and it is therefore likely to understate highway network performance issues in the busiest hours of the day. As such, for the purpose of assessing the peak hour traffic impacts associated with the emerging Stroud Local Plan, traffic demand in the future year forecasts has been adjusted with the use of peak period to peak hour factors, which have been derived from local traffic data – this is discussed in section 4.4.2.

3 Forecasting Overview

3.1 Introduction

This section provides an overview of the approach taken in developing the future year forecast scenarios, accounting for anticipated changes to travel demand, highway network provision and travel costs. The approach adopted in the preparation of forecasts in support of the Stroud Local Plan has been developed and agreed in liaison with Stroud District Council, Gloucestershire County and Highways England. Further detail on the development of the forecast scenarios is provided in subsequent sections.

3.2 Background

The traffic forecasting undertaken in relation to the emerging Local Plan has been developed using the Gloucestershire 2015 base year traffic model, details of which were provided in the previous section of this report.

The forecast scenarios, which are identified below, are all developed from the base year model and account for proposed changes in traffic demand and supply in the modelled area. Using the VDM functionality of the Gloucestershire traffic model, the Do Minimum (or Baseline) forecast scenarios account for changes in demand resulting from variation in travel costs. The Do Something forecast scenarios also include the additional travel demand associated with the proposed Local Plan allocation sites.

As noted in the previous section, the Gloucestershire traffic model represents an average hour from the peak periods, rather than a single peak hour and it is therefore likely to understate highway network performance issues in the busiest hours of the day. In order to assess the performance of the highway network in the peak hours, local count data used in the development of the base model has been used to derive peak period to peak hour factors for the AM and PM peaks – the derivation of the peak period to peak hour factors is discussed in section 4.4.2. These factors have been applied to period-level forecast demand to create a set of uplifted demand matrices, which have been used in the Stroud Local Plan traffic forecasts.

Trip generation calculations for the proposed Local Plan allocation sites have been undertaken for the peak hours and, therefore, the Local Plan forecasts also represent the peak hours when this additional demand is incorporated – this is discussed in more detail within section 5.

Additional detail on the forecasting approach adopted is set out below and within subsequent sections of this report.

3.3 Forecast Scenarios

The proposed approach to undertaking traffic forecasts for the Local Plan identified five forecast scenarios (plus the base model) that have been produced to assess the Local Plan proposals – these scenarios are summarised in Table 3.1 below.

Table 3.1: Forecast Local Plan Scenarios

Scenario	Year	Committed schemes / Devs	Local Plan Allocations	Highway mitigation	Sustainable transport mitigation
1. Base	2015	✗	✗	✗	✗
2. Baseline / Do Minimum	2040	✓	✗	✗	✗
3. Local Plan Forecasts with no mitigation ('unmitigated')	2040	✓	✓	✗	✗
4. Local Plan Forecasts plus sustainable transport strategy (STS)	2040	✓	✓	✗	✓
5. Local Plan Forecasts plus highway mitigation measures	2040	✓	✓	✓	✗
6. Local Plan Forecasts plus highway and STS	2040	✓	✓	✓	✓

The combination of forecast scenarios identified above has allowed the effects of various mitigation measures to be better understood by providing a logical build-up of the component parts.

3.3.1 Baseline Approach

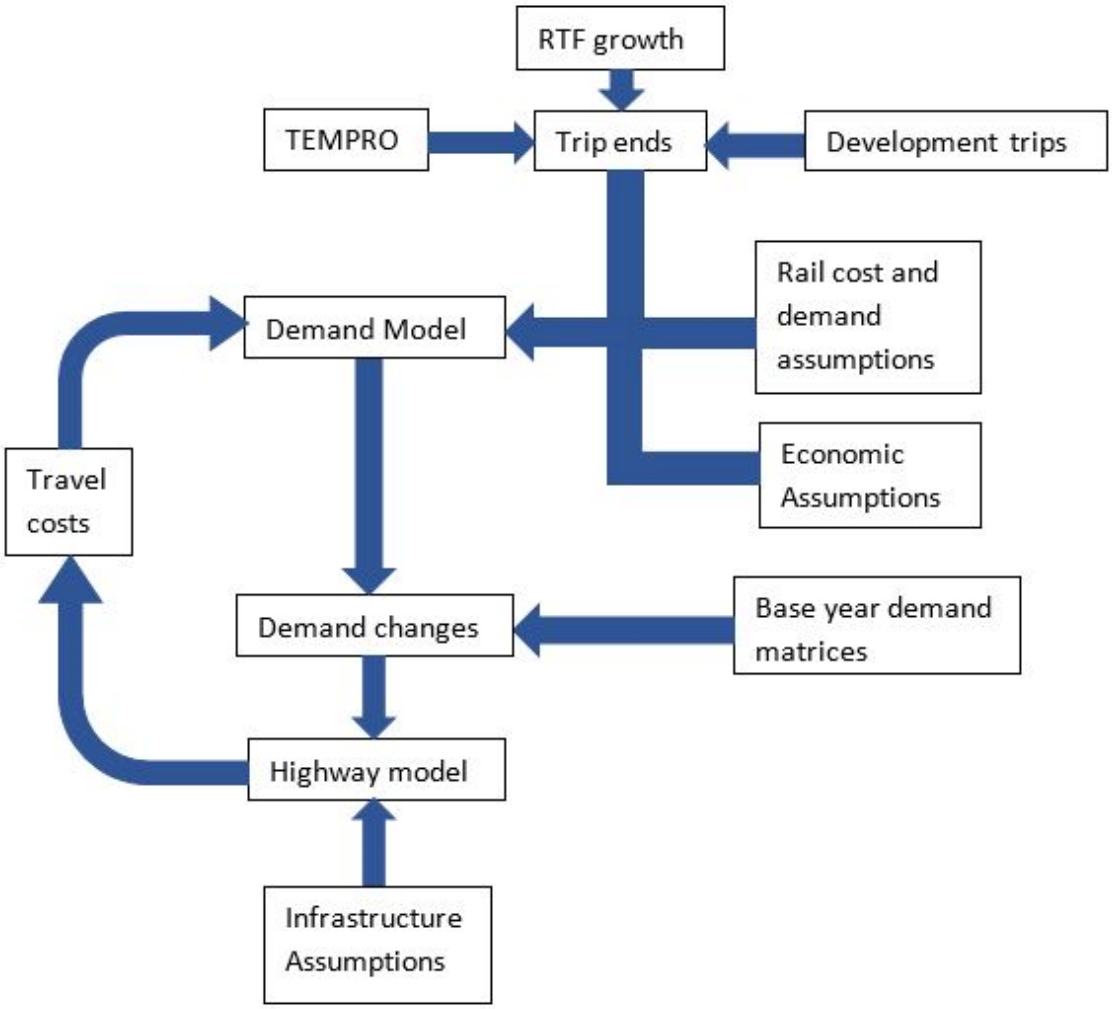
The traffic forecasts account for future proposed residential and employment changes in the local area, as well as proposed transport network changes. The approach taken for the Baseline, or 'Do Minimum', forecast scenario mirrors the approach used in the Regional Traffic Models and comprises the following:

- A set of transport network changes;
- Assumptions about changes in values of time and vehicle operating costs over time;
- A specific set of development assumptions;
- Traffic associated with the Do Minimum developments is forecast using trip rates derived from the National Trip End Model (NTEM) and distributed based on trip length patterns from representative existing zones;
- Application of NTEM growth factors as a constraint on trip growth for cars and rail;
- Application of growth of freight traffic from the Department for Transport (DfT) Road Traffic Forecasts 2018 (RTF18); and
- Application of forecast traffic growth at the primary airports and seaports within the South West region.

The transport supply and development assumptions have been determined through a process of identifying potential transport improvements and development proposals and undertaking an assessment of the likelihood of each of these proposals coming forward. Further detail on this approach is provided in sections 4.2.1 and 4.3.1.

In order to consider behavioural changes resulting from variation in travel costs, full Variable Demand Model (VDM) functionality has been employed in the Do Minimum forecasts in accordance with the DfT's Transport Appraisal Guidance (TAG) Unit M2. This demand modelling has been undertaken using Dynamic Integrated Assignment and Demand Modelling (DIADEM) software with an interface developed for use with the Regional Traffic Models, Highways England Integrated Demand Interface (HEIDI). An overview of the approach adopted in the Do Minimum forecasts is given in Figure 3.1.

Figure 3.1: Do Minimum Forecasting Process



After the VDM runs were performed, a subsequent fixed trip assignment was completed in SATURN with uplifted trip matrices to represent the AM and PM peak hours (as opposed to the peak period average hour). Section 4.4.2 provides further information on the derivation of the uplift factors.

3.3.2 Local Plan Forecasting Approach

The Stroud Local Plan, or 'Do Something', forecasts each employ fixed trip SATURN assignments to assess the impact of the proposed allocations in the Local Plan. These assignments are based on the uplifted Do Minimum forecasts and provide a clear indication of the impact of the additional traffic demand associated with the proposed Local Plan allocation sites. The approach taken for the Local Plan forecast scenarios comprises the following:

- Stroud Local Plan scenarios are modelled using a fixed trip SATURN assignment based on the uplifted post-VDM Do Minimum models;
- Trip rates and trip distributions applied to the Local Plan allocations are based directly on rates and distributions developed and agreed by the Stroud Local Plan Review Transport Group (SLPRTG);
- Local Plan development trips are modelled as an addition to the Do Minimum scenario, with overall travel demand allowed to exceed NTEM levels;
- In mitigation scenarios, various interventions and measures are applied to the network and trip matrices; and
- Local Plan development trips are modelled as separate user classes to allow impacts to be readily identified.

Further information on the development of the Local Plan forecasts can be found in section 5 and section 6.

4 Development of Baseline Forecasts

4.1 Introduction

This chapter details the approach taken to develop the future year Baseline, or Do Minimum, forecast.

4.2 Do Minimum Network Development

As part of the forecasting process, networks representing the supply and cost of transport in future years are required as a basis to assess the impact of the proposed Local Plan developments. Future year transport supply and costs relate to changes in the transport networks, such as new transport infrastructure or changes in tolls or fares. A highway network has been produced for the Do Minimum scenario with a forecast year of 2040. This network is also used in the unmitigated Local Plan scenario.

4.2.1 Supply Uncertainty Log

In accordance with TAG Unit M4, a supply Uncertainty Log has been compiled that identifies potential future transport schemes and classifies them based on the likelihood of them being delivered. The Stroud Local Plan Uncertainty Log was based on a version inherited from Highways England's A417 RIS scheme and updated following consultation with GCC. It contains the Highways England RIS schemes as well as relevant local schemes identified by GCC.

As per TAG, the transport schemes included in the Do Minimum scenarios have a likelihood of at least 'Near Certain' or 'More than likely' as defined by classifications set out in TAG and reproduced in Table 4.1 below.

Table 4.1: Transport Supply Certainty Classification

Probability	Local Authority / Development Scheme	Highways England	Network Rail
Near certain: The outcome will happen or there is a high probability that it will happen	Intent announced by proponent of regulatory agencies. Approved development proposals. Projects under construction.	PCF Stage 4 completed, scheme entering or in PCF Stage 5 (i.e. scheme consented)	GRIP Stage 5 completed, scheme entering or in GRIP Stage 6 (i.e. scheme consented)
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.	PCF Stage 2 completed, scheme entering or in PCF Stage 3 (i.e. preferred route announced)	GRIP Stage 3 completed, scheme entering or in GRIP Stage 4 (i.e. preferred option announced)
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 strategy/scheme is implemented. Development conditional upon the transport strategy/scheme proceeding.	Scheme in PCF Stage 1 or 2 (i.e. option selection)	GRIP Stage 2 completed, scheme entering or in GRIP Stage 3 (i.e. option selection)

Probability	Local Authority / Development Scheme	Highways England	Network Rail
	Or, 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 upon currently available information. Discussed on a conceptual basis. One of a number of possible inputs in an initial consultation process. Or, a policy aspiration.	Scheme in PCF Stage 0 (i.e. major road project initiated)	Scheme in GRIP Stage 1 (i.e. output definition)

Information on the local schemes, including scheme layouts and their level of certainty, has been provided by GCC. The supply Uncertainty Log is included in Appendix A. The resulting transport schemes included in the Do Minimum are presented in Table 4.2.

4.2.2 Do Minimum Network

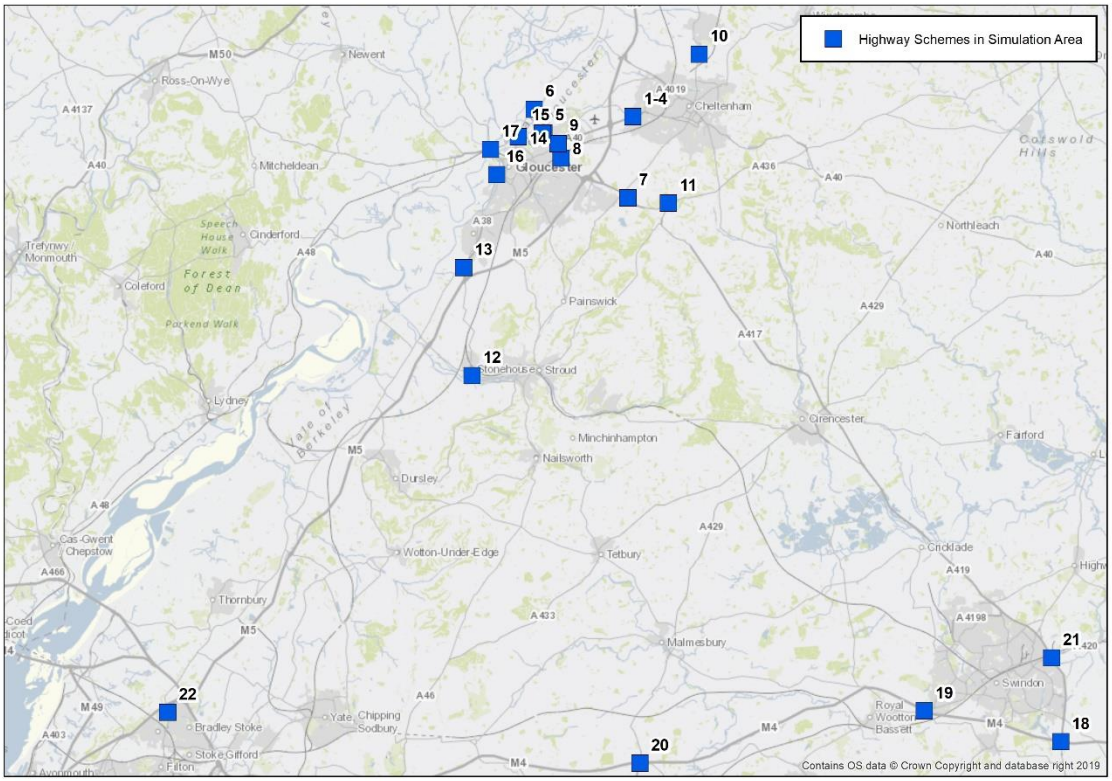
The highway networks used in the Do Minimum forecasts include schemes with sufficient levels of certainty, as outlined above. In addition, fixed speed links within the model that are not directly affected by any Do Minimum schemes have been adjusted to account for forecast changes in speed/congestion using RTF18 data (Scenario 1), applied by region, road type and time period.

The Do Minimum highway schemes in the simulation area are presented in Table 4.2 and Figure 4.1. A full list of Do Minimum schemes across both the simulation and buffer areas can be found in Appendix B. The network includes numerous schemes that are remote from the Stroud Local Plan development area and which are unlikely to have any impact within the study area. Typically, such schemes would not necessarily be included in scheme forecasts. However, given that the information on these schemes is available and compatible with the Gloucestershire traffic model, all schemes have been included in the future year forecast models.

Table 4.2: Do Minimum Highway Schemes

ID	Scheme Name
1	West Cheltenham Transport Improvement P1
2	West Cheltenham Transport Improvement P2
3	West Cheltenham Transport Improvement P3
4	West Cheltenham Transport Improvement P4
5	Innsworth Development Roundabout Improvement
6	Twigworth Development Access
7	Perrybrook Development Access
8	A417/A40 Barnwood Link
9	Elmbridge Transport Scheme, Gloucester
10	A435/Hyde Lane/Southam Lane Signalised Junction improvements
11	A417 Missing Link
12	Improvements for A419 corridor, Stonehouse
13	A38 Cross Key roundabout
14	Junction improvement A40 Longford roundabout, Gloucester
15	New A40 access roundabout
16	A430 Llanthony Rd and St Ann Way (Southwest bypass) improvement, Gloucester
17	A40 Over Roundabout improvement (phase 2), Gloucester
18	M4 J15
19	M4 J16
20	M4 J17
21	A419 White Hart junction improvement, Swindon
22	A38 M5 J16 to Aztec West, Almondsbury

Figure 4.1: Locations of Highway Schemes in the Simulation Area



Do Minimum highway schemes located within the model simulation area have been included with appropriate node/link coding reflecting the available scheme layout drawings. These schemes have been drawn in GIS to provide geospatially accurate information, before subsequently being coded into the SATURN network. Network coding principles adopted in the Gloucestershire base model have been adopted for the Do Minimum simulation schemes and largely consist of generic/default coding including saturation flows. Traffic signal timings (green splits) were initially informed from base year traffic flows and were subsequently modified following preliminary forecast model runs. Further details on the network coding principles can be found in the Gloucestershire traffic model 'Local Model Validation Report' (July 2019).

4.2.3 Travel Costs

Changes in travel costs in the forecast year are to be expected due to increases in incomes and the value of time, changes in fuel costs and improvements in vehicle efficiency. In accordance with TAG, the cost assumptions of the validated base year models have therefore been updated in the future year demand model and highway assignments. Cost changes have been calculated for the 2040 forecast year and are applicable to the Do Minimum and all Do Something scenarios. These cost changes are set out below.

Forecast Assignment Generalised Cost Parameters

Highway trip costs consist of time, distance and toll charges. These costs are combined, into a common unit, and known as 'generalised costs', which form the basis of route choices within highway assignment models. Non-time costs are converted into generalised minutes with the use of assumed Values of Time and (VOT) and Vehicle Operating Costs (VOC), which vary by

journey purpose and also by forecast year to represent changes in fuel costs and income. Changes in fuel costs, vehicle efficiency and values of time have been taken from the May 2019 version of the TAG databook. These have been used to calculate the forecast year VOT and VOC.

It should be noted that an updated version of the TAG databook was released by the DfT in July 2020, following completion of the Do Minimum forecasts. The generalised cost parameters in the new databook were compared against the May 2019 values and were shown to be only marginally different, with any changes in values generally being well below 1% - this level of change would have only a negligible impact on the forecast assignments. To ensure consistency with the base model, and to avoid unnecessarily repeating the Do Minimum forecasts, the May 2019 values have therefore been retained throughout forecasting.

Table 4.3 identifies the highway generalised cost coefficients used for 2015 and 2040 in pence per minute (PPM) and pence per kilometre (PPK).

Table 4.3: Highway Generalised Cost Coefficients

		AM		PM	
Year	Purpose	PPM	PPK	PPM	PPK
2015	Car Business	29.94	12.59	30.37	12.59
	Car Commuting	20.08	6.15	20.14	6.15
	Car Other	13.85	6.15	14.5	6.15
	LGV	21.16	13.79	21.16	13.79
	HGV	49.40	41.65	49.40	41.65
2040	Car Business	43.78	9.43	44.41	9.43
	Car Commuting	29.36	4.48	29.46	4.48
	Car Other	20.25	4.48	21.21	4.48
	LGV	30.94	12.96	30.94	12.96
	HGV	72.25	46.55	72.25	46.55

The VOC (PPK) values for cars are expected to reduce over time due to assumed fuel efficiency improvements in cars.

In addition to the assignment model generalised costs presented in Table 4.3, the generalised cost coefficients input into DIADEM are identified in Table 4.4 for cars and public transport (i.e. rail).

Table 4.4: DIADEM Cost Coefficients

Year	Purpose	Highway VOT (pence/hr)	Public Transport VOT (pence/hr)	Highway VOC (pence/km)
2015	Business	1825.26	2620.33	12.59
	Commuting	1212.78	1063.67	6.15
	Other	869.30	485.49	6.15
2040	Business	2669.16	3831.82	9.43
	Commuting	1773.49	1555.44	4.48
	Other	1271.21	709.95	4.48

Toll Charges

All toll charges have been kept fixed in real terms (i.e. tolls will rise in line with general inflation) in accordance with the methodology adopted in the A417 and SWRTM forecasts. The toll charges on the Severn Crossings have been removed in the forecast year after the abolishment of the tolls in December 2018.

Rail Time and Fares

Future year rail times and fares have been retained from the A417 Model and rezoned to fit the Gloucestershire model. The times and fares form an input to the VDM forecasting. In line with the approach adopted for the Regional Traffic Models, rail fares have been assumed to increase over time (by RPI up to 2020 and by RPI+1% thereafter).

4.3 Do Minimum Matrix Development

This section summarises the approach adopted to produce demand for use in the Do Minimum forecasts. In summary, traffic generated by proposed specific developments has been included in the forecast demand, which has been constrained to forecast National Trip End Model (NTEM) levels of growth at 'Balancing Area' level.

4.3.1 Development Uncertainty Log

An Uncertainty Log has been developed that identifies potential major developments within the study area of the model and categorises them according to their likelihood in accordance with TAG Unit M4 'Forecasting and Uncertainty'.

The Uncertainty Log was originally developed from the A417 PCF Stage 2 scheme, which included proposed new developments within the Cheltenham, Cotswolds, City of Gloucester, Stroud and Tewkesbury planning authorities. This Uncertainty Log has been updated for use in various traffic forecasts within Gloucestershire including the Stroud Local Plan, Joint Core Strategy (JCS) and M5 J10 models. It has been updated in conjunction with GCC and their consultants for the JCS and M5 J10 projects, and utilised information originated from the above local planning authorities. In addition, planned developments were also included in the local planning authority of South Gloucestershire. The development Uncertainty Log is contained in Appendix C.

The development quantum, in terms of numbers of dwellings and jobs, was provided by the local authorities or from planning documents. Housing sites of less than around 15 homes have generally been excluded, unless they form a cluster with other sites which collectively total more than 15 dwellings, or if the development is part of the proposed Local Plan. In line with the approach adopted for RTM forecasting, where job numbers were not available, an estimated value has been calculated using job density assumptions that were derived from the Housing and Communities Agency's 'Employment Density Guide' (Third Edition, 2015) and set out in Table 4.5.

Table 4.5: Job Density Assumptions

Land Use	Jobs per 100m² of Gross Floor Area (NIA – Net Internal Area)
B1 – General Offices	10.07
B2 – Industrial and Manufacturing	3.03
B8 – Storage and Distribution	1.45

The level of certainty for each development has been assigned taking advice from GCC and SDC and in accordance with the definitions of uncertainty contained in TAG Unit M4, which are reproduced in Table 4.6 below.

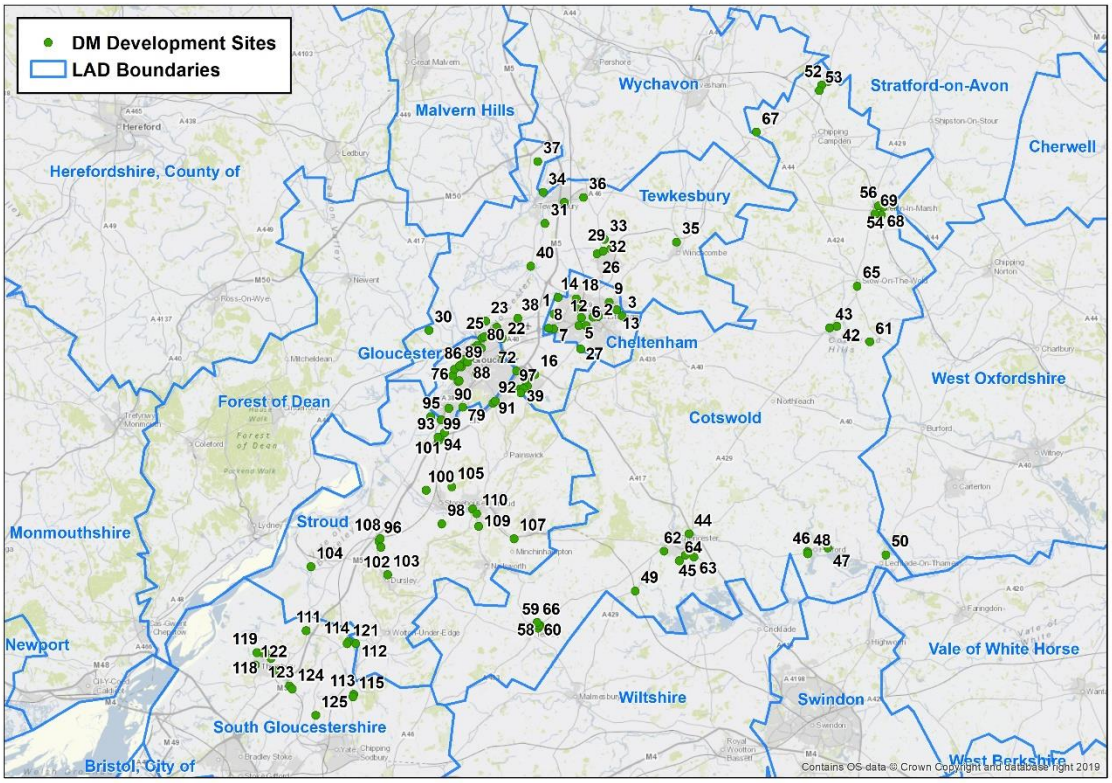
Table 4.6: Development Certainty Classification

Probability	Status
Near certain: The outcome will happen or there is a high probability that it will happen	Intent announced by proponent of 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 strategy/scheme is implemented. Development conditional upon the transport strategy/scheme proceeding. Or, 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 upon currently available information. Discussed on a conceptual basis. One of a number of possible inputs in an initial consultation process. Or, a policy aspiration.

Source: TAG Unit M4 Appendix A

Not including proposed Local Plan allocation sites, a total of 125 developments have been identified as being either ‘Near certain’ or ‘More than likely’ and, in accordance with TAG guidance, these are considered in more detail within the forecasts. The developments are summarised in Appendix D and their locations are plotted in Figure 4.2. The quantum of developments shown in Table D.1 within Appendix D only include dwellings and jobs estimated to be delivered after March 2015 (the month that the base year model is representative of).

Figure 4.2: Location of Do Minimum developments



4.3.2 Do Minimum Development Trip Generation

Trip end totals for each Do Minimum development were estimated using car driver trip rates (rates per dwelling and rates per job) derived from the National Trip End Model (NTEM) Version 7.2 at local authority level. This enabled 24-hour Production / Attraction (PA) and Origin / Destination (OD) trips by period to be calculated for each development based on the quantum of development. This is consistent with an approach devised by the RTM Forecasting Consistency Group (FCG) which was implemented in regional model forecasts and also in A417 Missing Link PCF Stage 2 forecasting.

Table 4.7 identifies the 24-hour production and attraction trip rates per residential dwelling for the home-based demand segments. There is an implied assumption in the adopted approach that the residential end of HBEB and HBW trips does not act as an attraction and therefore these cells are zero/blank in the following table.

Table 4.7: NTEM Car Driver Trip Rates Per Dwelling

	HBEB 24 hr		HBW 24 hr		HBO 24 hr	
	Production	Attraction	Production	Attraction	Production	Attraction
Cheltenham	0.057	-	0.434	-	0.644	0.099
Cotswold	0.075	-	0.441	-	0.768	0.105
Gloucester	0.059	-	0.453	-	0.667	0.101
South Glos.	0.070	-	0.480	-	0.755	0.102
Stroud	0.072	-	0.461	-	0.758	0.106
Tewkesbury	0.070	-	0.457	-	0.737	0.105

Table 4.8 presents the trip rates per job for the home-based segments. Table 4.9 and Table 4.10 present trip rates per job for non-home-based employers' business (NHBEB) and non-home-based other (NHBO) segments respectively. The trip rates presented in each of the tables are for the full period in question (i.e. 24 hours for home-based trips and period total for the non-home-based trips).

Table 4.8: NTEM Car Driver Trip Rates Per Job (Home-Based Segments)

	HBEB 24 hr		HBW 24 hr		HBO 24 hr	
	Production	Attraction	Production	Attraction	Production	Attraction
Cheltenham	-	0.044	-	0.298	-	0.460
Cotswold	-	0.054	-	0.362	-	0.612
Gloucester	-	0.051	-	0.337	-	0.503
South Glos.	-	0.052	-	0.375	-	0.427
Stroud	-	0.057	-	0.366	-	0.485
Tewkesbury	-	0.054	-	0.369	-	0.355

Table 4.9: NTEM Car Driver Trip Rates Per Job (Non-Home-Based Employers' Business)

	AM Peak		Inter Peak		PM Peak	
	Orig.	Dest.	Orig.	Dest.	Orig.	Dest.
Cheltenham	0.011	0.010	0.036	0.035	0.011	0.010
Cotswold	0.013	0.013	0.046	0.044	0.013	0.013
Gloucester	0.012	0.012	0.040	0.041	0.013	0.012
South Glos.	0.012	0.012	0.043	0.041	0.012	0.012
Stroud	0.013	0.014	0.045	0.047	0.013	0.014
Tewkesbury	0.013	0.013	0.042	0.043	0.012	0.013

Table 4.10: NTEM Car Driver Trip Rates Per Job (Non-Home-Based Other)

	AM Peak		Inter Peak		PM Peak	
	Orig.	Dest.	Orig.	Dest.	Orig.	Dest.
Cheltenham	0.040	0.037	0.099	0.105	0.039	0.040
Cotswold	0.048	0.047	0.143	0.142	0.058	0.059
Gloucester	0.042	0.042	0.109	0.119	0.041	0.044
South Glos.	0.042	0.043	0.102	0.105	0.041	0.039
Stroud	0.042	0.044	0.113	0.114	0.043	0.045
Tewkesbury	0.036	0.038	0.097	0.087	0.036	0.032

Each development was allocated an existing model zone, based on its location and proposed access points. Where appropriate, larger developments were disaggregated across multiple zones to provide more realistic trip loading patterns.

4.3.3 Do Minimum Development Trip Distribution

Trip ends associated with Do Minimum developments have been distributed using the Highways England Donor Distribution Tool (HEDDiT), which was developed for Highways England for use in the regional traffic models.

HEDDiT applies a distribution to the development trip ends based on trip length patterns from representative 'donor' zones. The output from HEDDiT is a matrix of development trips, which are used in the production of the future year reference matrices used in the Do Minimum VDM forecasts.

Checks of the output development matrices have shown that the input trip ends reconcile well with the output matrices, which confirms that HEDDiT has distributed all development trips. In addition, trips associated with a selection of developments have been analysed in SATURN and indicate that the distribution patterns appear sensible.

4.3.4 National Trip End Model

Forecast trip ends from NTEM Version 7.2 were used to derive trip end growth factors at model zone level, via an NTEM to model zone correspondence list. The growth factors have been derived as Origin and Destination factors (or Production and Attraction factors for Home-Based trips) for each of the demand segments required for input into the Variable Demand Model.

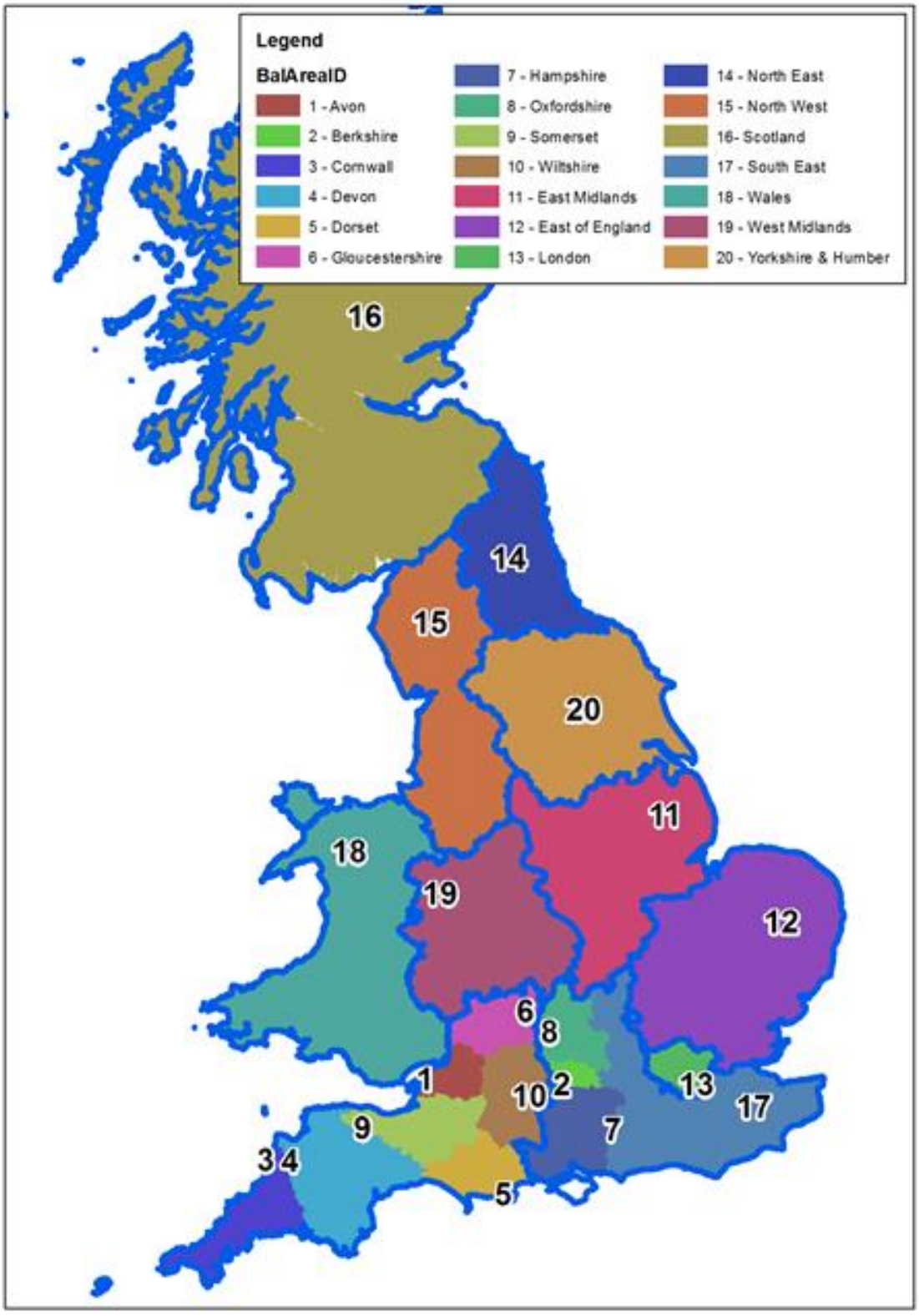
The growth factors have been derived for car vehicle trips and rail trips separately and allow one to factor from the 2015 base year to the forecast year of 2040. The factors relate to car available trips only and are derived and applied at model zone level. Output growth has been reviewed and compared to NTEM. The results of this comparison are presented in section 0.

As stated previously, total growth has been constrained to NTEM at Balancing Area level. In total there are 20 Balancing Areas, which consist of counties within the SWRTM 'Region of Focus' and regions outside of this area, as summarised in Table 4.11 and Figure 4.3.

Table 4.11: Balancing Area Definitions

Balancing Area ID	Balancing Area
1	Avon
2	Berkshire
3	Cornwall
4	Devon
5	Dorset
6	Gloucestershire
7	Hampshire
8	Oxfordshire
9	Somerset
10	Wiltshire
11	East Midlands
12	East of England
13	London
14	North East
15	North West
16	Scotland
17	South East
18	Wales
19	West Midlands
20	Yorkshire and Humber

Figure 4.3: Balancing Area Definition



TEMPRO Alternative Assumptions

A review of the development uncertainty log identified some districts where the proposed additional households and/or jobs exceeded the amount of growth assumed in NTEM forecasts.

Table 4.12 summarises NTEM assumptions regarding growth in households within each district of Gloucestershire (excluding Forest of Dean) and provides a comparison against the development quanta derived from the Uncertainty Logs. Table 4.13 presents the equivalent information for jobs. The cases where the Uncertainty Log increase exceeds the NTEM increase are in underlined red italicised text.

Table 4.12: Additional Households in NTEM and Uncertainty Log (2015 and 2040)

District	NTEM Households			Additional Households in U/Ls (2015 to 2040)
	2015	2040	Growth	DM
Cheltenham	52,579	61,950	9,372	2,564
Cotswold	37,541	42,442	4,901	*5,088*
Gloucester	53,001	64,024	11,023	3,711
Stroud	**49,413**	**58,939**	**9,525**	**4,249**
Tewkesbury	37,267	47,565	10,299	*11,900*

Table 4.13: Additional Jobs in NTEM and Uncertainty Log (2015 and 2040)

District	NTEM Jobs			Additional Jobs in U/Ls (2015 to 2040)
	2015	2040	Growth	DM
Cheltenham	72,461	79,848	7,387	*8,219*
Cotswold	49,894	54,948	5,055	1,003
Gloucester	72,466	80,831	8,365	1,031
Stroud	**56,688**	**63,263**	**6,575**	**2,616**
Tewkesbury	52,210	57,903	5,694	*6,991*

As such, forecasts were prepared that utilised the 'alternative assumptions' facility in TEMPRO software, which enables developments from the Uncertainty Log to be excluded from the NTEM growth factors. This eliminates the potential for 'double counting' of demand associated with proposed Do Minimum developments and therefore allows a potentially more subtle adjustment to be made to the forecasts to bring them into line with the NTEM forecasts at the county level.

By comparing forecast trip ends in the 2040 Baseline scenario to the 2015 Base model, the resulting change in demand can be identified and used to demonstrate how growth in the forecast model compares with the national forecasts provided by NTEM. Table 4.14 summarises growth in trip ends within the Gloucestershire simulation area for the Baseline (DM) compared to NTEM.

Table 4.14: Do Minimum Trip End Growth vs NTEM

	NTEM			DM		
	Employers' Business	Commute	Other	Employers' Business	Commute	Other
AM Origins	1.18	1.14	1.22	1.21	1.15	1.22
AM Destinations	1.17	1.14	1.22	1.16	1.13	1.20
PM Origins	1.16	1.12	1.20	1.15	1.13	1.22
PM Destinations	1.17	1.13	1.20	1.16	1.15	1.22

In general, the outturn growth applied in the Do Minimum forecast are very similar to those assumed by NTEM. This is to be expected as overall growth in the Do Minimum is constrained to levels forecast in NTEM.

4.3.5 National Transport Model

Trip end growth factors for LGVs and HGVs have been derived using Road Traffic Forecast (2018) data (Scenario 1), which is based on output from the DfT's National Transport Model. Table 4.15 shows the RTF18 growth factors used for a forecast year of 2040 at regional level for LGVs and HGVs. In the absence of RTF18 forecasts for Scotland, growth factors for the North East region have been adopted as a proxy for Scotland.

Table 4.15: RTF18 LGV and HGV Growth Rates

Region	LGV	HGV
East Midlands	1.40	1.02
Eastern England	1.38	1.12
London	1.44	1.01
North East	1.40	1.00
North West	1.38	1.02
South East	1.40	1.13
South West	1.37	1.00
West Midlands	1.42	1.03
Yorks & Humber	1.39	1.03
Wales	1.39	1.02
Scotland*	1.40	1.00

Source: Regional Traffic Forecasts, 2018 (Scenario 1)

* The North East has been used as a proxy for Scotland

4.3.6 Airport and Ports Growth

Although remote from the main study area of the model and therefore likely to have a negligible impact on traffic flows, the future year scenarios take into account forecast changes in demand at airports and seaports in the South West region as this forms part of the methodology established in the SWRTM and A417 models. Airport passenger demand and seaport demand are both fixed within the VDM forecasts undertaken.

Future year forecast airport passenger trip matrices for car trips were produced using the same methodology used to create the base year matrices for the SWRTM, which was also adopted during A417 PCF Stage 2 forecasting. This utilises DfT National Air Passenger Allocation

Model (NAPALM) data, which forecasts (for 2021, 2031 and 2041) the total annual air passenger trips between 455 zones and each of the four airports explicitly included within the SWRTM (Bournemouth Airport, Bristol Airport, Exeter Airport and Southampton Airport). The future year airport passenger trips are added to the forecast demand after the application of general growth rates discussed above.

Forecast traffic growth at the three seaports explicitly included in the SWRTM (Bristol/Avonmouth, Portsmouth and Southampton) has been provided from the RTM Forecasting Consistency Group. This includes an assumption of zero growth in car trips at all ports. In addition, growth in HGV trips of 1.02%, 2.23% and 2.48% per annum were assumed for Bristol, Portsmouth and Southampton respectively. An England-wide growth factor, derived from RTF18 data, for LGV traffic at the seaports was also assumed as per the RTM forecasts.

4.4 Do Minimum Assignments

This section describes the model runs undertaken as part of the Do Minimum forecast. As previously stated, the Do Minimum forecasting process consists of the following:

- A full VDM run using HEIDI/DIADEM;
- Applying a global peak period to peak hour uplift factor on the post-VDM demand matrices; and
- Performing a fixed trip assignment in SATURN using the uplifted matrices.

4.4.1 Variable Demand Model (VDM) Runs

As stated previously in section 3.3.1, a Do Minimum VDM run has been undertaken to capture travel demand changes resulting from variation in travel costs. The VDM runs were performed in DIADEM, making use of Highways England's HEIDI software.

Demand model parameters were derived from realism tests on the calibrated base model. Table 4.16 summarises the VDM parameters / model responses and hierarchy.

Table 4.16: VDM Parameters / Model Response and Hierarchy

Parameter / Setting	Data Source	Notes
Segmentation		
Modelled time slices	AM 07:00-10:00, IP 10:00-16:00, PM 16:00-19:00 hours, OP 19:00-07:00	AM, IP, PM travel costs derived from average period hour calibrated assignments. OP travel costs derived from uncalibrated assignment of mobile phone data (MPD) derived OP matrix to IP network to represent free-flow conditions.
Time period factors	AM=3, IP=6, PM=3, OP=12	Simple calculation consistent across all movements and purposes as average period demand is assigned
Assigned User classes	From assignment models: Car Employers Business, Car Commute, Car Other, Light Good Vehicles, Heavy Good Vehicles	

Parameter / Setting	Data Source		Notes
VDM Segments	Segment	Segment ID	Fixed elements relate to 'special zones' which include unique travel patterns that are not subject to VDM response. This may be a port or airport where 'Other' (passengers) and Employers Business are not subject to VDM responses.
	Home-Based Employers Business	1	
	Home-Based Commute	2	
	Home-Based Other	3	
	Non-Home-Based Employer's Business	4	
	Non-Home-Based Other	5	
	Fixed – Employers Business	6	
	Fixed – Commute	7	
	Fixed - Other	8	
	Light Good Vehicles (fixed)	9	
	Heavy Good Vehicles (fixed)	10	
Model Parameters			
Model type	Home-Based	Incremental PA	
	Non-Home-Based	Incremental OD	
	Goods	Fixed	
	Special Generators	Fixed	
Model responses and hierarchy	(Macro) Time of Day Choice Mode Choice Distribution		Distribution is singly constrained for Employer's Business and Other, doubly constrained for Commute.
Logit parameters: lambda, theta	Median TAG		Confirmed through realism testing
Distribution Intra-zonal cost calculation	DIADEM Default values (ρ=0.5, minimum cost=5)		
Cost coefficients (VOTs etc.)	TAG with distance based VOT		
Cost damping parameters and specification	Damped utility by function of distance		
Occupancy factors	TAG (and varying by distance for Other trip purposes)		
Demand Matrices			
Road Matrices	Home-based (24hr PA)	NTEM growth factors to calibrated base assignment matrices (split using mobile phone data (MPD) and transposed, then aggregated to 24-hour using PA Outbound and Return proportions)	
	Non-home-based (hourly OD)	NTEM growth factors to calibrated base assignment matrices (split using MPD)	
	Goods (hourly OD)	RTF growth factors to calibrated base assignment matrices	

Parameter / Setting	Data Source		Notes
	Special Generators	Specific growth factors to calibrated base assignment matrices (with extraction of demand for specific zones and demand segments)	
Public transport	NTEM growth factors to base matrices (combination of Moira and NRTS assigned to demand segments)		
Cost Matrices			
Reference SATURN UFS files			Extracted from SATURN road assignment.
Rail costs skims for reference and forecast	Base	Time Skims provided from the RTMs	Extracted from National Rail network and then compressed to Model zone system.
	Forecast		
Rail fare skims for reference and forecast	Base	In Vehicle Time Skim applied to distance-based fare function provided from the RTMs	
	Forecast		
PA Data			
Outbound proportions	DIADEM Manual (from NTS) Proportions applied for Employers Business for all sectors		
Return proportions (by time period for each demand segment, sector movement, and mode)	MPD derived proportions used for Work and Other for 7 sectors, as per SWRTM, based on origin trip ends Proportions adjusted to reflect assignment matrix proportions with outbound/return split based on initial values for each time period		
Tour proportions	Default values provided in DIADEM from NTS data, which are then furnessed within DIADEM application to match defined Outbound and Return proportions (see above)		
DIADEM Parameters			
Algorithm	Fixed Step Length (0.5, as per base model calibration)		
Convergence	Target GAP of 0.1% for entire model and 0.2% for simulation area (sub-area)		

4.4.1.1 Demand Supply Convergence

The VDM convergence statistics for the Do Minimum are shown in Table 4.17.

Table 4.17: VDM Convergence Statistics

Year	Scenario	Full model GAP %	Sub-area GAP %	Cost (% <5%)	Flow (% <5%)	Number of loops
2040	Do Minimum	0.08	0.12	100	100	8

The Do Minimum VDM process converged after 8 DIADEM loops after achieving a full model GAP lower than 0.1% and a sub area GAP lower than 0.2%. This satisfies TAG criteria with respect to demand supply convergence and demonstrates a good level of stability within the demand model.

4.4.1.2 Summary of VDM Impacts

The impact of the VDM, in terms of changes in highway and rail demand patterns, is presented and discussed in more detail within Appendix E but, in summary, the overall volume of demand remains similar between the pre-VDM and post-VDM scenarios. The number of inter-sectoral highway trips increases as a result of VDM responses, whilst intra-sectoral highway trips reduce

slightly, with these trip patterns arising from the changes to the generalised costs between the base and forecast years, which makes longer trips more attractive.

The forecasts also indicate that there is a decrease in overall rail demand as a result of VDM responses. This indicates that there is a mode shift from rail to highway between the reference and post-VDM demand and is likely to be a result of the inclusion of several significant highway improvement schemes in the forecast models.

4.4.2 Uplifted Fixed Trip Assignments

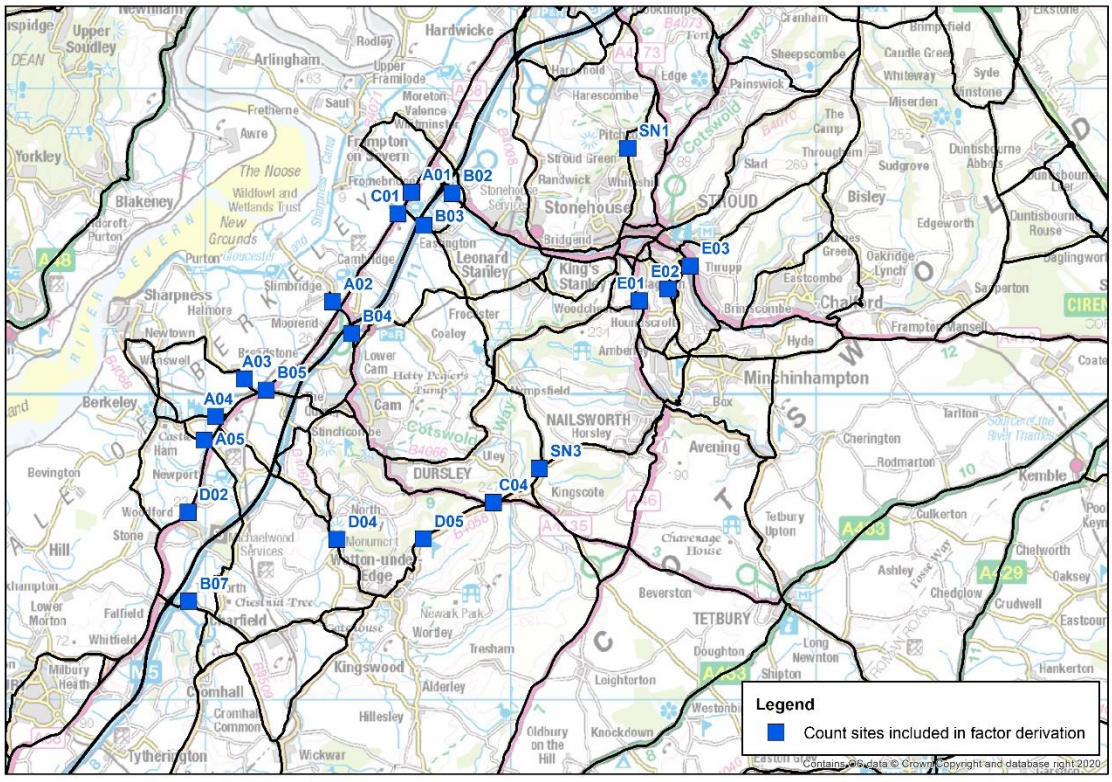
4.4.2.1 Peak Hour Uplifts

As noted previously, the Gloucestershire traffic model mirrors both the A417 and South West Regional models in representing the following weekday daytime periods:

- average AM peak period hour (07:00-10:00);
- average hour in the inter peak period (10:00-16:00); and
- average PM peak period hour (16:00-19:00).

In the first instance, VDM forecasts therefore represent average hour assignments which would be likely to understate highway network performance issues in the peak hours. To address this, traffic data from 20 count sites used in the development of the Gloucestershire base model has been used to derive peak period to peak hour factors for the AM and PM peaks. Figure 4.4 identifies the location of the count sites used to derive the factors.

Figure 4.4: Count sites included in the derivation of period to hour factors



Average hour and peak hour two-way traffic flows at each site are presented in Appendix F.

The factors derived from the count data are identified below:

- AM period (07:00 – 10:00) to busiest AM hour = 1.176; and
- PM period (16:00 – 19:00) to busiest PM hour = 1.164.

The above factors are average values based on combined data from all of the sites identified above. Figure 4.5 and Figure 4.6 show how equivalent up-lift factors for individual sites compared to the global average values.

Figure 4.5: Difference between individual site factor and global uplift factor (AM)

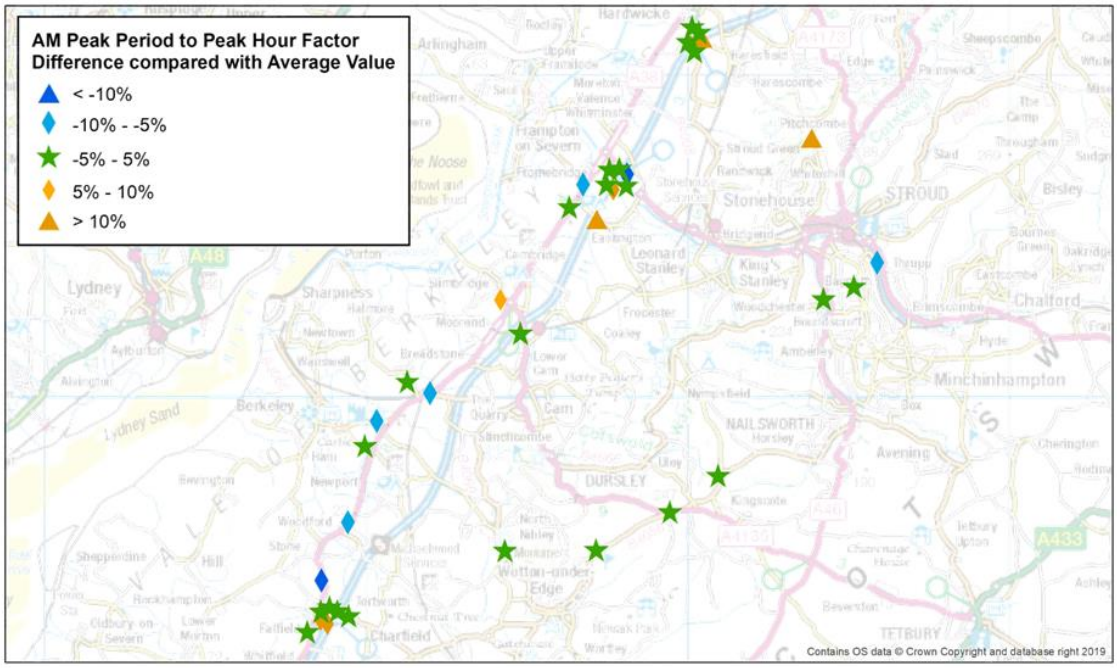
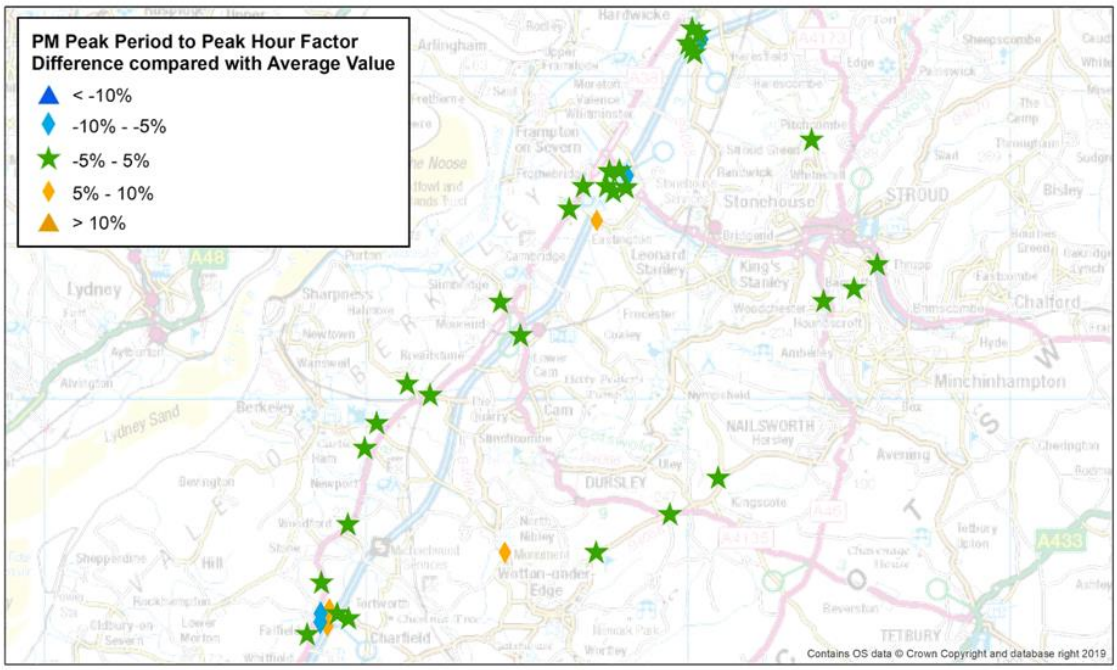


Figure 4.6: Difference between individual site factor and global uplift factor (PM)



The post-VDM peak period demand matrices were uplifted using the average peak period to peak hour factors listed above, and subsequently assigned onto the Do Minimum network by means of fixed assignments in SATURN – these represent the peak hour Do Minimum assignments.

4.4.2.2 Do Minimum Assignment Model Convergence

The post-VDM assignment model convergence statistics for the Do Minimum forecast scenario are presented in Table 4.18.

Table 4.18: Do Minimum Assignment Model Convergence Statistics

	AM Peak				PM Peak			
Scenario	**% Gap**	**% Flow**	**% Cost**	**Iter.**	**% Gap**	**% Flow**	**% Cost**	**Iter.**
Do Minimum	0.00081	99.7	98.9	70	0.0013	99.8	98.5	43

The assignment model convergence ‘gap’ is below the recommended TAG value of 0.1% by a substantial margin (values lower than this target mean that the model has better convergence). The measurement of flow change also exceeds the TAG criteria of 98%.

It can be concluded that the Do Minimum forecast assignments satisfy the convergence criteria set out in TAG Unit M3.1 and are therefore well converged in both peak hours.

Results from the 2040 Do Minimum model forecasts are presented and discussed within section 7.

5 Development of Local Plan Forecasts

5.1 Introduction

This chapter details the approach taken to develop the future year Stroud Local Plan, or 'Do Something', forecasts that include demand associated with proposed Local Plan allocations.

The initial Do Something forecast scenarios do not include any form of sustainable transport or highway mitigation and hence are referred to as an 'unmitigated' scenario. Both network and matrix development will be covered in detail as well as a section describing model assignments.

5.2 Unmitigated Local Plan Network Development

The network used for the unmitigated Local Plan forecast is essentially identical to the Do Minimum network. The only difference arises from the inclusion of three additional user classes, which have been used to allocate and assign car demand generated by the proposed Local Plan allocation sites. Table 5.1 lists the name and purpose of the Local Plan user classes.

Table 5.1: Additional Local Plan User Classes

User Class	User Class Name	Purpose
6	Local Plan – Business	Employers' Business
7	Local Plan – Commuting	Commute
8	Local Plan – Other	Other

User classes 6 to 8 use the same generalised costs as user classes 1 to 3 as they share common purposes. The separation of Local Plan and general traffic allows traffic impacts due to the presence of Local Plan developments to be readily identifiable.

5.3 Unmitigated Local Plan Matrix Development

The following section discusses the development of additional travel demand associated with the proposed Local Plan allocation sites. Ultimately, the proposed Local Plan demand is added on top of the uplifted Do Minimum matrices to create Local Plan matrices that are assigned in SATURN.

5.3.1 Local Plan Development Sites

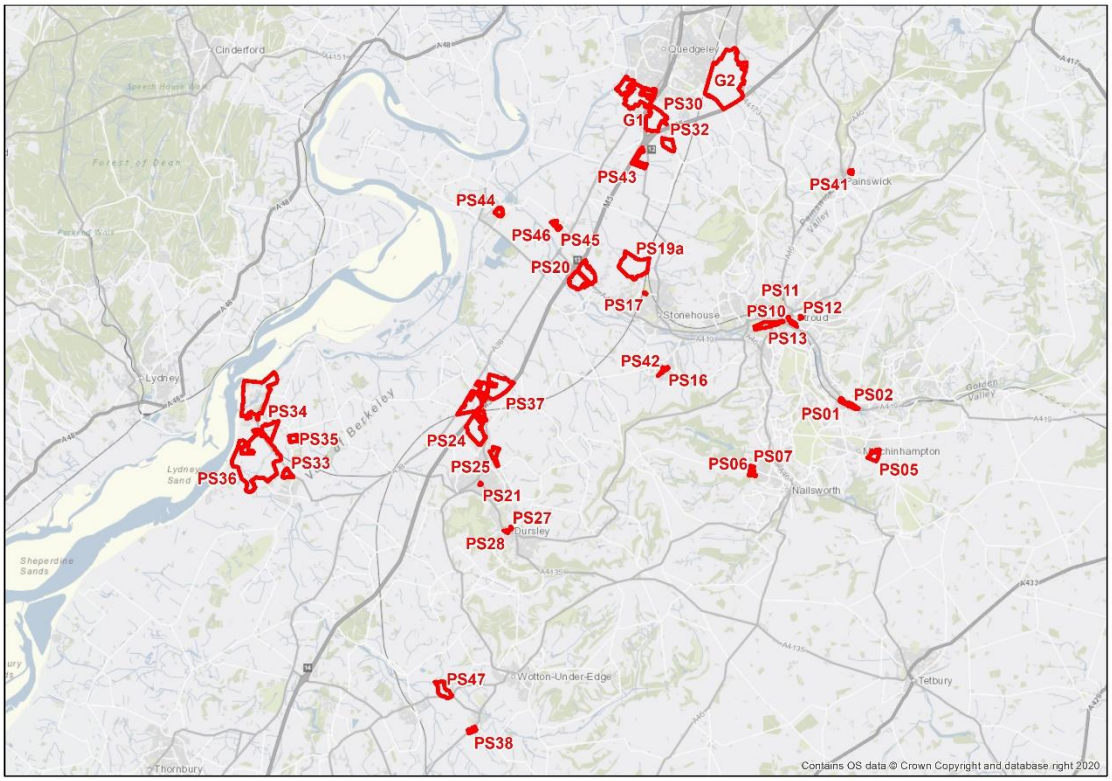
Stroud District Council have identified 35 sites on which various residential and employment developments will be introduced by 2040 as part of the Draft Local Plan.

Following consultation with the District Council and a review of the Draft Local Plan (November 2019), development quanta, in the form of residential dwellings and employment floorspace, were identified. Table 5.2 shows the allocation sites included in the Local Plan forecasts and identifies the number of households and employment land associated with each site. Figure 5.1 shows the location of each allocation site.

Table 5.2: Local Plan Developments

Site ID	Site Name	Number of Dwellings	Employment site area (hectares)
G1	South of Hardwicke	1200	-
G2	Land at Whaddon	2500	-
PS01	Brimscombe Hill	40	-
PS02	Brimscombe Port	150	-
PS05	East of Tobacconist Road	80	-
PS06	The New Lawn, Nailsworth	80	-
PS07	North Nympsfield Road	25	-
PS10	Railway land / car parks, Cheapside	75	-
PS11	Merrywalks Arches, Merrywalks	25	-
PS12	Police station / Magistrates court, Parliament Street	45	-
PS13	Central river / canal corridor	120	-
PS16	South of Leonard Stanley Primary School	25	-
PS17	Magpies site, Oldends Lane	10	-
PS19a	Northwest of Stonehouse	650	5
PS20	M5 Junction 13	-	10
PS21	Land adjacent to Tilsdown House	15	-
PS24	West of Draycott	700	-
PS25	East of River Cam	180	-
PS28	Land off Prospect Place	10	-
PS30	Hunts Grove extension	750	-
PS32	South of M5 / J12	-	5
PS33	Northwest of Berkeley	120	-
PS34	Sharpness Docks	300	7
PS35	Land at Focus School, Wanswell	70	-
PS36	New settlement at Sharpness	2400	10
PS37	New settlement at Wisloe	1500	5
PS38	South of Wickwar Road	50	-
PS41	Washwell Fields	20	-
PS42	Land off Dozule Close	15	-
PS43	Javelin Park	-	9
PS44	Northwest of Whitminster Lane	30	-
PS45	Land west of Upton's Gardens	10	-
PS46	Land west of School Lane	30	-
PS47	Land west of Renishaw New Mills	-	9

Figure 5.1: Location of Local Plan Developments



Source: Stroud District Local Plan Review (SDC, November 2019)

Six new 'point zones' have been added to the Gloucestershire base network to allow traffic from the following proposed allocation sites to access the network at suitable points:

- Land at Whaddon (G2);
- Northwest of Stonehouse (PS19a);
- M5 Junction 13 (PS20);
- Hunts Grove extension (PS30); and
- New Settlement at Wisloe (PS37) (two point zones were used for this site).

It was necessary to include point zones for these sites as existing geographic zones did not provide accurate traffic loading locations onto the modelled network. By including these sites as point zones, it enabled more precise zone loading onto the network. Elsewhere, traffic associated with the proposed Local Plan sites access the network from suitable existing model zones.

5.3.2 Local Plan Trip Generation

Trip generation for Local Plan sites has been based on vehicle trip rates that were developed and agreed collaboratively between GCC, SDC, Highways England and AECOM. The agreed trip rates are primarily based on rates that have been used previously in the assessment of individual developments in the relevant local area.

Unlike the NTEM derived trip rates used to undertake trip generation for the Do Minimum development sites, the rates used for the Local Plan sites are specific to the AM and PM peak hours.

To reflect the different characteristics of areas throughout the study area, trip rates were defined and agreed for the following five geographic areas:

- Gloucester Fringe;
- Stroud Valleys;
- Stonehouse;
- Cam and Dursley; and
- Berkeley

Using trip rate area to model zone system correspondence, rates were applied to the quantum of development for each Local Plan site in order to calculate the total trips arriving and departing the sites in each period. Table 5.3 shows residential trip rates used in the trip generation calculation, while Table 5.4 shows the trip rates used for employment sites.

Table 5.3: Residential Local Plan Development Vehicle Trip Rates per Dwelling

	AM Peak		PM Peak	
Trip Rate Area	Arrivals	Departures	Arrivals	Departures
Gloucester Fringe	0.169	0.418	0.387	0.219
Stroud Valleys	0.140	0.408	0.397	0.226
Stonehouse	0.140	0.408	0.397	0.226
Cam & Dursley	0.105	0.508	0.316	0.192
Berkeley including Sharpness	0.176	0.457	0.425	0.174

Table 5.4: Employment Local Plan Development Vehicle Trip Rates per 100m^2 of GFA

		AM Peak		PM Peak	
Trip Rate Area	Land Use	Arrivals	Departures	Arrivals	Departures
Gloucester Fringe	B1	1.469	0.282	0.209	1.258
	B2	0.388	0.180	0.091	0.326
	B8	0.072	0.026	0.032	0.087
Stonehouse	B1	1.469	0.282	0.209	1.258
	B2	0.388	0.180	0.091	0.326
	B8	0.072	0.026	0.032	0.087
Cam and Dursley including Wisloe	B1	1.469	0.282	0.209	1.258
	B2	0.388	0.180	0.091	0.326
	B8	0.072	0.026	0.032	0.087
Berkley including Sharpness	B1	2.071	0.296	0.207	1.576
	B2	0.388	0.180	0.091	0.326
	B8	0.072	0.026	0.032	0.087

The above trip rates were applied to the quantum of development for each proposed Local Plan site in order to calculate the total trips arriving and departing the allocation sites in each peak hour. Employment trip rates specifically relate to Gross Floor Area (GFA) by employment land use class, while the proposed Local Plan allocations only identify total employment site areas.

The exception to this is the M5 Junction 13 allocation where assumed GFA splits by employment class were supplied. Elsewhere, site areas were converted to GFA on the assumption that total floor area equates to 40% of total site area. In cases where more detailed information on specific land use proportions was not available, it was assumed that floor area would be equally split between B1, B2 and B8 classes.

At sites containing employment land uses and/or a secondary school(s) in addition to housing, 'internalisation factors' were applied to the residential trips to account for trips remaining internal to the site (e.g. trips between home and employment or schools). Making use of secondary data sources such as the National Travel Survey and following professional judgement, internalisation factors were developed and agreed by GCC, SDC, Highways England and AECOM. The following reductions to account for internalisation were agreed:

- Employment (greater than 5 hectares) included within the allocation site = 10% reduction in residential trip generation in both peak hours; and
- Secondary school(s) included within the allocation site = 8% reduction in residential trip generation in the AM peak only.

Table 5.5 shows the resulting total percentage of internal trips applied to relevant sites. In each case, the number of trips generated is reduced by the percentage of internal trips. The internalisation factors are only applied to residential trips to avoid the potential for double counting.

Table 5.5: Percentage of Internal Vehicle Trips at Local Plan Developments

Development	AM Peak	PM Peak
Land at Whaddon	8%	0%
New settlement at Sharpness	18%	10%
New settlement at Wisloe	10%	10%

The number of trips generated by each Local Plan site can be found in Appendix G. Table 5.6 presents trip generation associated with the 10 highest trip generating sites.

Table 5.6: Vehicle Trips Generated by Local Plan Developments (Top 10 Trip Generating Developments)

Development	Site Ref.	AM Peak		PM Peak	
		Arrivals	Departures	Arrivals	Departures
New settlement at Sharpness	PS36	684	966	962	641
Land at Whaddon	G2	389	961	968	548
New settlement at Wisloe	PS37	270	718	449	371
South of Hardwicke	G1	203	502	464	263
M5 Junction 13	PS20	581	119	88	500
Northwest of Stonehouse	PS19a	220	298	280	258
Sharpness Docks	PS34	127	314	290	164
Hunts Grove extension	PS30	289	184	158	238
West of Draycott	PS24	74	356	221	134
Javelin Park	PS43	231	59	40	201
Other / remaining sites	n/a	530	632	530	567
TOTAL	**n/a**	**3597**	**5108**	**4450**	**3885**

5.3.3 Local Plan Trip Distribution

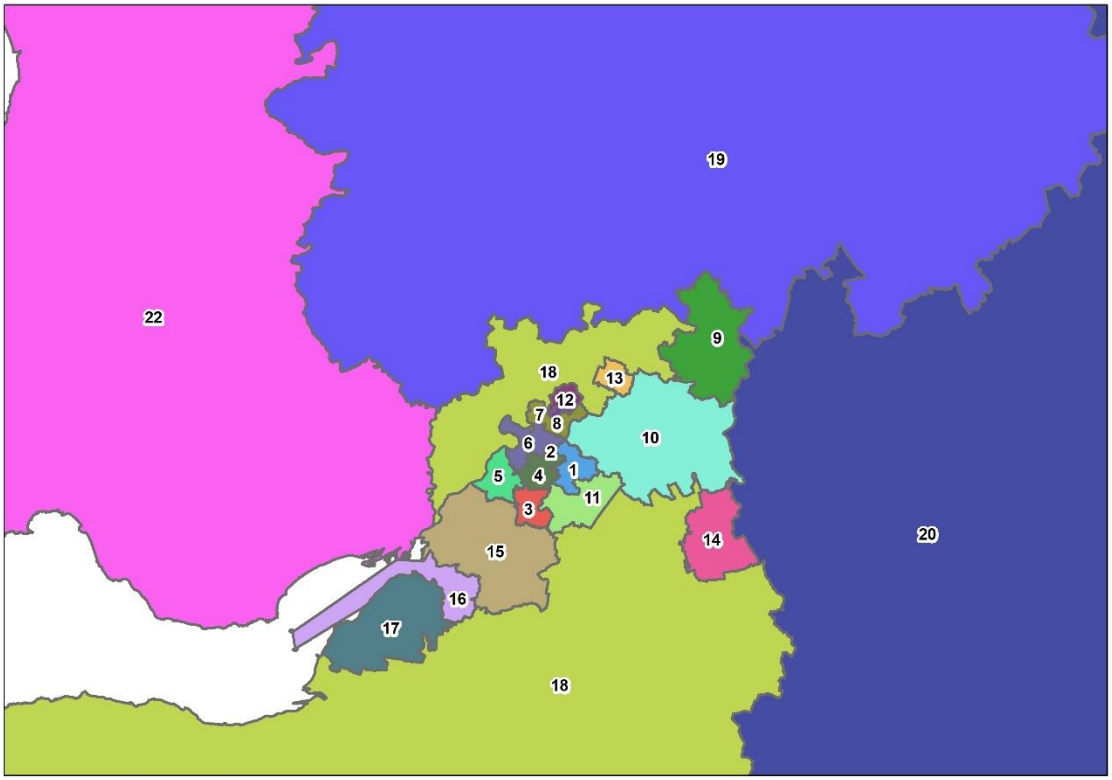
The distribution of trips associated with the proposed Local Plan allocation sites has been based on distributions developed and agreed between GCC, SDC, Highways England and AECOM. The development of distributions was informed by Census Journey to Work data and made use of professional judgement.

Assumed trip distributions were based on a selection of 'distribution areas', as shown in Table 5.7 and Figure 5.2.

Table 5.7: Distribution Areas

ID	Area
1	Stroud Valleys
2	Stonehouse
3	Wotton-under-Edge
4	Cam & Dursley
5	Berkeley
6	Stroud - Gloucester Rural 1 (Severn Vale)
7	Stroud - Gloucester Rural 2 (Gloucester Fringe)
8	Gloucester Fringe
9	Cotswold North (Bourton-on-the-Water)
10	Cotswold Central (Cirencester)
11	Cotswold South (Tetbury)
12	Gloucester
13	Cheltenham
14	Swindon
15	South Gloucestershire
16	City of Bristol
17	North Somerset
18	South West
19	Midlands / North (Via M5)
20	South East
21	North West
22	Wales

Figure 5.2: Distribution Areas



For each proposed Local Plan development, the number of trips generated has been distributed at an STS area level according to the assumed distributions presented in Appendix H. The trips are further disaggregated to the model zone level using employment and residential populations and model zone to STS area correspondences.

The output of the trip distribution calculation is a matrix of residential and employment trips between model zones containing Local Plan developments and all other model zones. The residential and employment trips are summed together to give a trip matrix that represents total Local Plan trips across all purposes.

Example distribution plots of Local Plan trips associated with the following sites are included in Appendix I:

- Land at Whaddon;
- New Settlement at Sharpness & Sharpness Docks;
- South of Hardwicke;
- Hunts Grove Extension;
- West of Draycott & East of River Cam;
- Northwest of Stonehouse;
- Settlement at Wisloe;
- M5 Junction 13;
- South of M5 Junction 12 & Javelin Park; and

- Land west of Renishaw New Mills.

The distribution of the total combined Local Plan allocation traffic across the network is shown in Figure 5.3 and Figure 5.4 for the AM and PM periods respectively.

Figure 5.3: Distribution of traffic associated with Local Plan allocations (AM Peak)

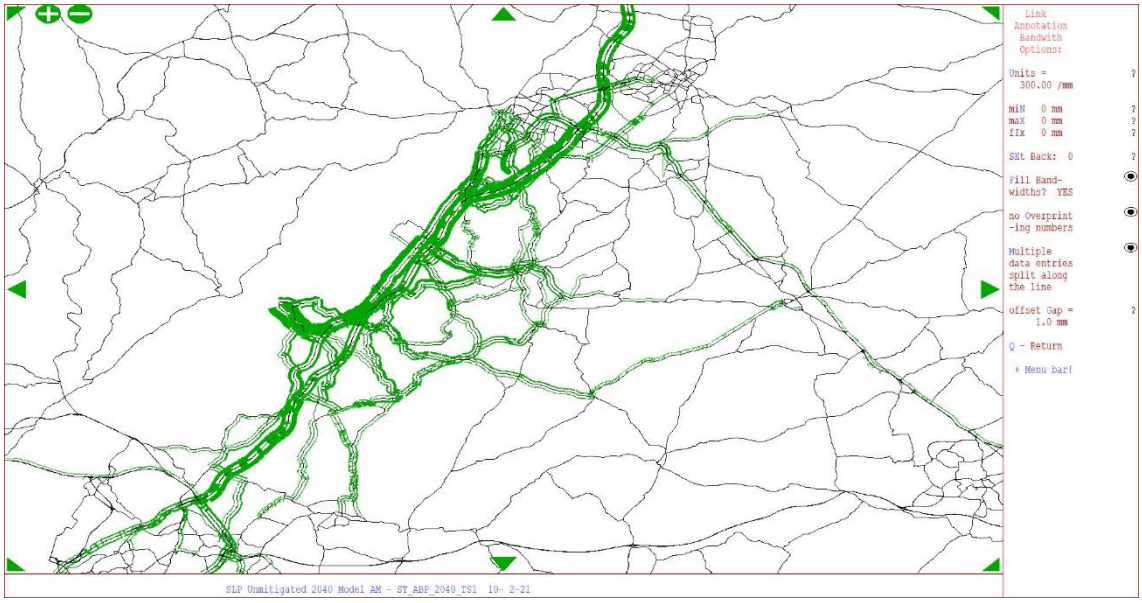
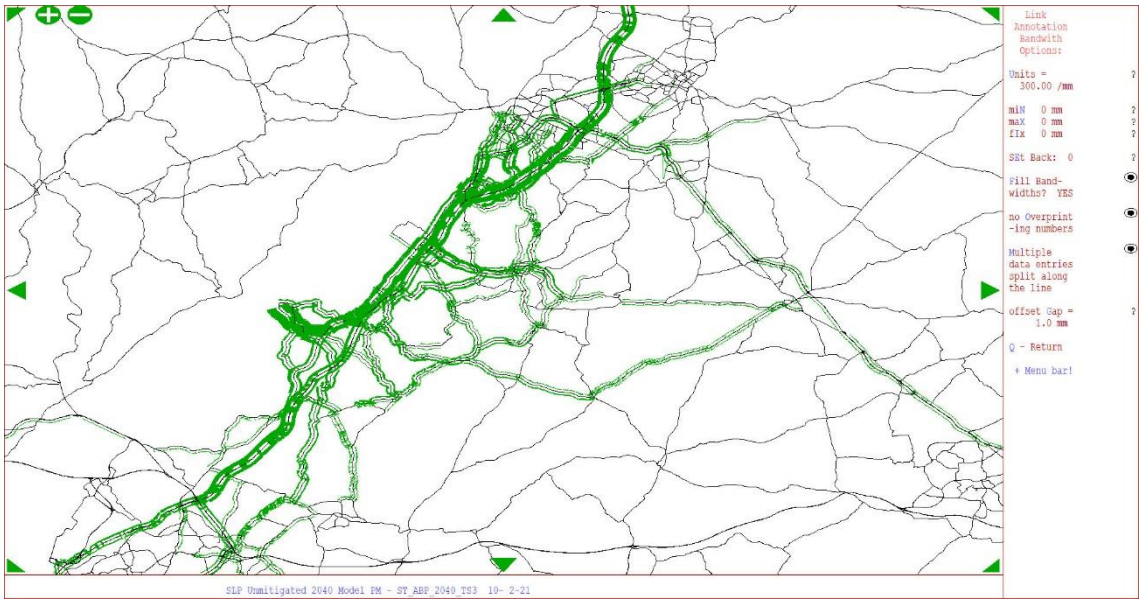


Figure 5.4: Distribution of traffic associated with Local Plan allocations (PM Peak)



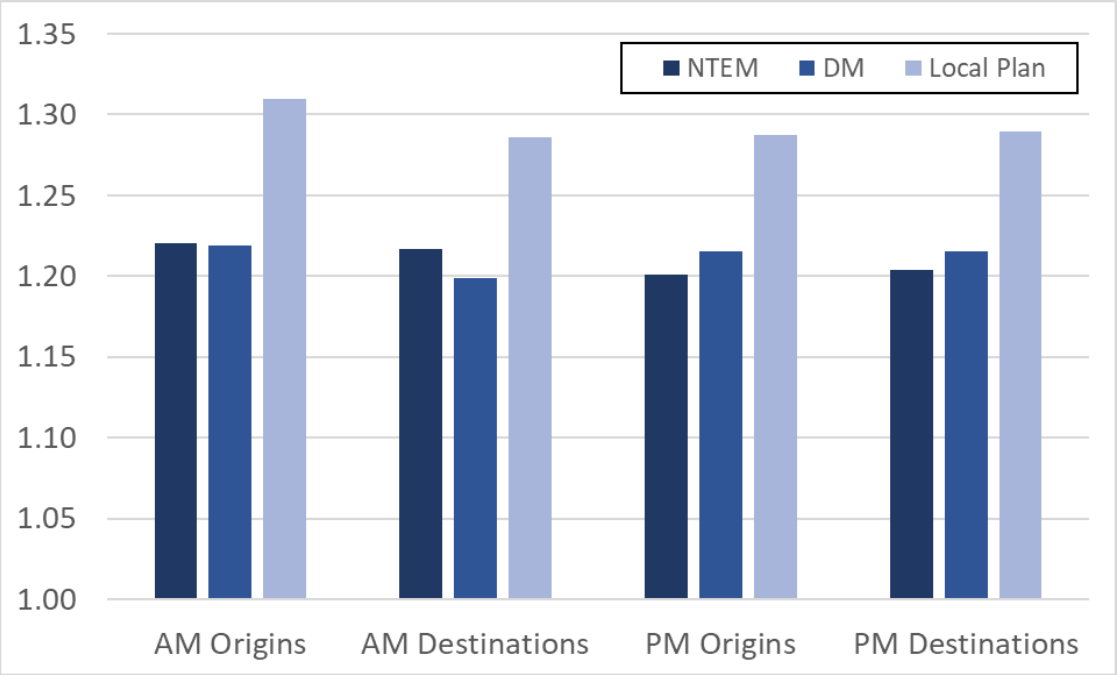
The overall traffic impact assessment detailed within the remainder of this report is based on the cumulative impact of vehicle trips associated with all of the proposed Local Plan allocation sites

combined. Whilst example trip distribution plots are provided in Appendix I for a selection of individual allocation sites, it should be noted that detailed analyses of site specific traffic impacts has not been undertaken as part of the Local Plan traffic modelling at this stage.

5.4 Matrix Growth Versus National Forecasts

A comparison of growth between the 2015 Base and 2040 forecast scenarios (Baseline and Unmitigated Local Plan) has been undertaken to illustrate how growth in the forecast models compare with national forecasts. Figure 5.5 summarises growth in trip ends within the Gloucestershire simulation area for the Baseline (DM) and unmitigated Stroud Local Plan scenarios compared to NTEM. The Car 'Other' trip purpose is presented in the chart, with equivalent information for the other assignment trip purposes presented in Appendix J.

Figure 5.5: Trip End Comparison vs NTEM (Car, Other)



The growth rates calculated for the Do Minimum are very similar to those predicted by NTEM. As previously discussed, this is to be expected as overall growth in the Do Minimum is constrained to levels forecast in NTEM. The growth rates for the unmitigated Local Plan scenario are noticeably higher compared to NTEM. This is due to the presence of additional demand in the form of Local Plan developments.

A comparison of overall traffic growth was also undertaken between the model and RTF18. Again, this was carried out for traffic increases between the 2015 Base, the 2040 Baseline/Do Minimum and 2040 unmitigated Local Plan scenarios. For each modelled scenario, the total pcu.kms were extracted from all simulation links to gain an indication of the volume of traffic - it is common for the presence of motorways to skew the values of traffic growth factors and it is for this reason that links on the M4 and M5 were removed from the analysis.. Growth in traffic within the modelled scenarios are compared against RTF18 growth factors for cars in the South West region – this comparison is presented in Table 5.8 (derived growth factors are the same across the AM and PM peaks).

Table 5.8: RTF18 & Model Growth Factors (cars)*

Scenario	Growth Factor
RTF18	1.26
Do Minimum	1.29
Unmitigated Local Plan	1.36

*Excludes Motorways

The Do Minimum growth factor is similar to the RTF value as expected due to the NTEM growth constraint. Again, an increase in growth factor is observed in the unmitigated Local Plan scenario. This is a result of the additional demand brought about by the Local Plan developments.

5.5 Unmitigated Local Plan Assignments

The distributed Local Plan traffic has been split by purpose to allow for different values of time and vehicle operating costs to be accounted for in the highway assignments. The trip purpose splits used were derived from the TAG data book and are shown in Table 5.9.

Table 5.9: Purpose Splits (Car Trips)

Purpose	AM Peak	PM Peak
Employers' Business	0.07	0.05
Commute	0.38	0.33
Other	0.55	0.62

Source: TAG Data Book (May 2019)

As discussed previously, the distributed Local Plan traffic by purpose forms user classes 6 to 8 of the unmitigated trip matrices. These were added onto the uplifted Do Minimum matrices to create a trip matrix for each peak hour that represents the total highway demand for the unmitigated Local Plan scenario. Total demand in this scenario therefore exceeds forecast growth in NTEM.

The unmitigated Local Plan matrices were assigned to the network described in section 5.2 in a fixed trip assignment using SATURN. As shown in Table 5.10, the Unmitigated Local Plan model assignments satisfy the convergence criteria set out in TAG Unit M3.1.

Table 5.10: Unmitigated Local Plan Assignment Convergence Statistics

	AM Peak				PM Peak			
Scenario	% Gap	% Flow	% Cost	Iter.	% Gap	% Flow	% Cost	Iter.
Unmitigated Local Plan	0.001	99.7	98.2	64	0.00096	99.6	98.5	64

The unmitigated Local Plan forecast model results have been used to inform the development potential highway mitigation measures and are discussed within section 7.

6 Development of Local Plan Mitigation and Mitigated Forecasts

6.1 Introduction

Following the completion of the 2040 Do Minimum and unmitigated Local Plan assignments, the forecast models were reviewed in collaboration with GCC, SDC and Highways England. This initial review was informed by comparing the forecast network performance in the Do Minimum and unmitigated Local Plan scenarios, and was largely based on figures such as those included within Appendix N to Q that identify total junction delays and the ratio of flow Volume to Capacity (V/C) on links. Tabulated model results, such as those presented in Appendix M, were also used to inform this review. This initial review identified significant increases in junction delays and link V/Cs in the unmitigated Local Plan scenario and therefore identified a clear requirement for mitigation measures to reduce the impact of traffic growth associated with the proposed Local Plan.

This chapter details the approach taken in developing, and subsequently assessing, both sustainable and highway mitigation measures. Results from mitigated Local Plan forecasts are presented and discussed in section 7.

6.2 Sustainable Transport Strategy

6.2.1 Overview

A Sustainable Transport Strategy (STS) has been developed by AECOM in collaboration with SDC, GCC and Highways England. The STS sets out a strategic approach to achieving mode shift, with detailed measures to be developed by sites through the planning application process.

As part of the development of the STS, a framework has been produced to assess potential mode shift that could be achieved by the main interventions included in the strategy. The framework includes the following parameters:

- Indicative scale of cost of implementation;
- Description of the trips and routes that will be influenced by the intervention (i.e. trips generated by strategic sites and origin-destination trips of background traffic); and
- Forecast percentage reduction in car trips attributed to each intervention.

A copy of the framework is provided for reference at Appendix K. The framework of potential mode shifts has been proposed by AECOM and developed in an iterative process through reviews by Mott MacDonald, GCC, Highways England and SDC, prior to approval by all parties for inclusion within the traffic modelling.

In developing this framework, there is a balance to be struck between the robustness of traffic generation reductions that can be achieved, along with the risks of under-assessing traffic impacts, and the strong focus on sustainable transport needed to address the Climate Emergency. There is a shared vision with the highways authorities that the STS needs to be ambitious and maximise investment in sustainable travel. GCC and Highways England consider that the STS mitigation scenario includes aspirational targets for mode shift and that the results should be considered in that context.

Interventions within the STS are targeted towards a specific development or key movement corridor (e.g. A38). Therefore, each intervention will yield reductions in car trips along those specific routes and between destinations. The exception to this is a “blanket” 6% reduction in all development trips. This will be achieved through a combination of Travel Planning, internalisation, reducing the need to travel and facilitating home working. The combination of these measures will differ between sites, with each site expected to demonstrate through the planning process how they will achieve a blanket mode shift/traffic reduction in addition to targeted measures as set out within the STS framework.

The routes affected directly by each intervention have been defined. Buffers (e.g. 800m, 2km) have been included along each route to account for an appropriate catchment area, and this has been used to define zones within the SATURN model where reductions have been applied. For some zones where population centres fall partly within and partly outside of a buffer zone, half of the car trip reduction has been applied. Again, zones where reductions are applied have been agreed with all parties.

Percentage reductions have been based on professional knowledge and experience of the development and implementation of sustainable travel measures, and have been agreed with the highways authorities. For some interventions, a two-tier percentage reduction has been defined. A robust, i.e. lower level, assumption has been made for the purposes of the “STS mitigation” modelling scenario to avoid the risk of over-assessing mode shift, and a maximum reduction has been defined which represents a higher level ‘aspirational’ mode shift target for the intervention.

It is recognised that some interventions that are related to a specific development are likely to contribute towards a reduction in background car traffic for similar trips. In these cases, two distinct percentage reductions have been defined (i.e. development trips and background traffic). Where there is overlap on the effect of development measures on background trips, e.g. multiple developments contributing to improvements to sustainable transport on particular corridors, a single percentage reduction is applied in one row to avoid double counting. Considering the high level of development trips likely to be funnelled along each corridor due to the situation of major development sites, and the ambition for sustainable mitigation, a “high investment” scenario has been modelled along each corridor reflecting opportunity for significant cumulative investment.

The success of interventions will also be influenced by disincentives to driving, such as congestion, parking availability and charges.

6.2.2 Estimated Reduction in Car Trips

Table 6.1 identifies the estimated reduction in total car trips that results from the implementation of the STS. Values within the table are presented separately to show reductions in trips associated the Local Plan developments directly and also reductions to baseline/background trips.

Table 6.1: Assumed reduction in car trips associated with STS

Trip Type	AM Peak	PM Peak
Local Plan development trips	743	717
Baseline / Background trips	508	550
Total reduction	**1,251**	**1,267**
Total unmitigated Local Plan trip generation	**8,706**	**8,335**

Compared to the total unmitigated trip generations associated with the Local Plan sites, the assumed total reduction in car trips arising from the STS equate to around a 15% reduction in trips.

6.2.3 Local Plan with STS Forecast Model

Having adjusted the unmitigated Local Plan demand to account for the reductions in car trips associated with the STS, the resulting demand matrices were assigned onto the 2040 unmitigated highway network. Assignment model convergence statistics for this scenario are shown in Table 6.5 (see section 0).

To provide an understanding of the scale of traffic reduction arising from the STS across the highway network, Figure 6.1 and Figure 6.2 show the difference in flows between the unmitigated and 'STS-only' mitigated versions of the Local Plan forecasts for the AM and PM peak hours respectively. Links shown in Blue indicate a decrease in traffic as a result of the STS measures, while Green links denote flow increases.

Figure 6.1: Changes in traffic flows associated with STS, AM Peak

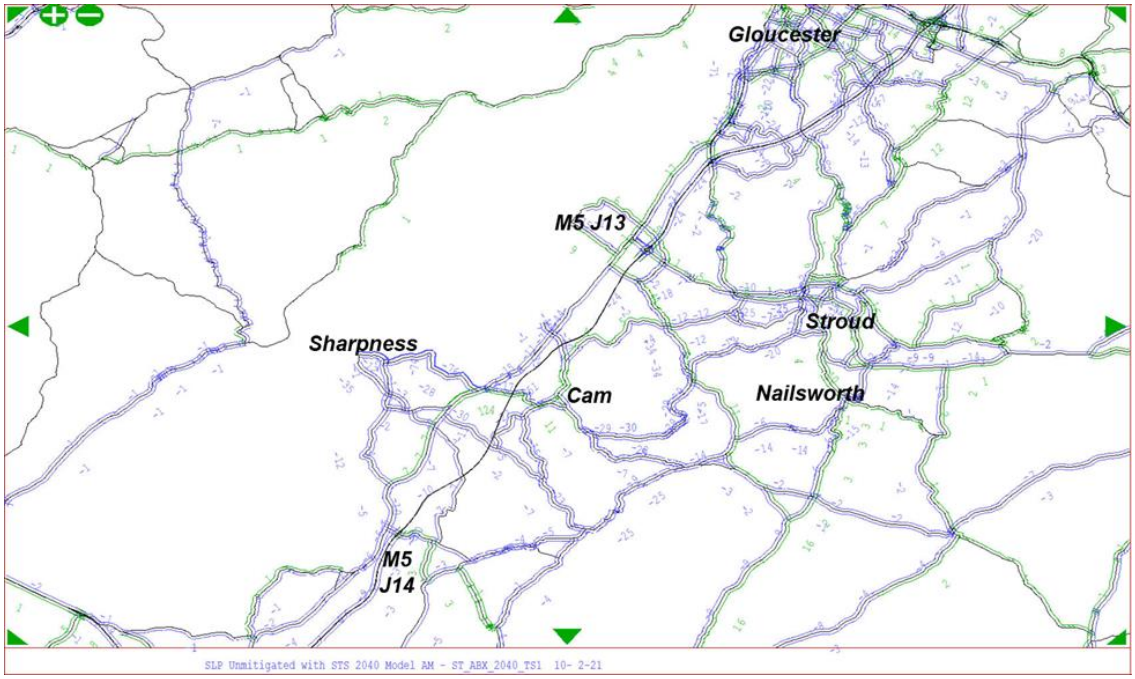
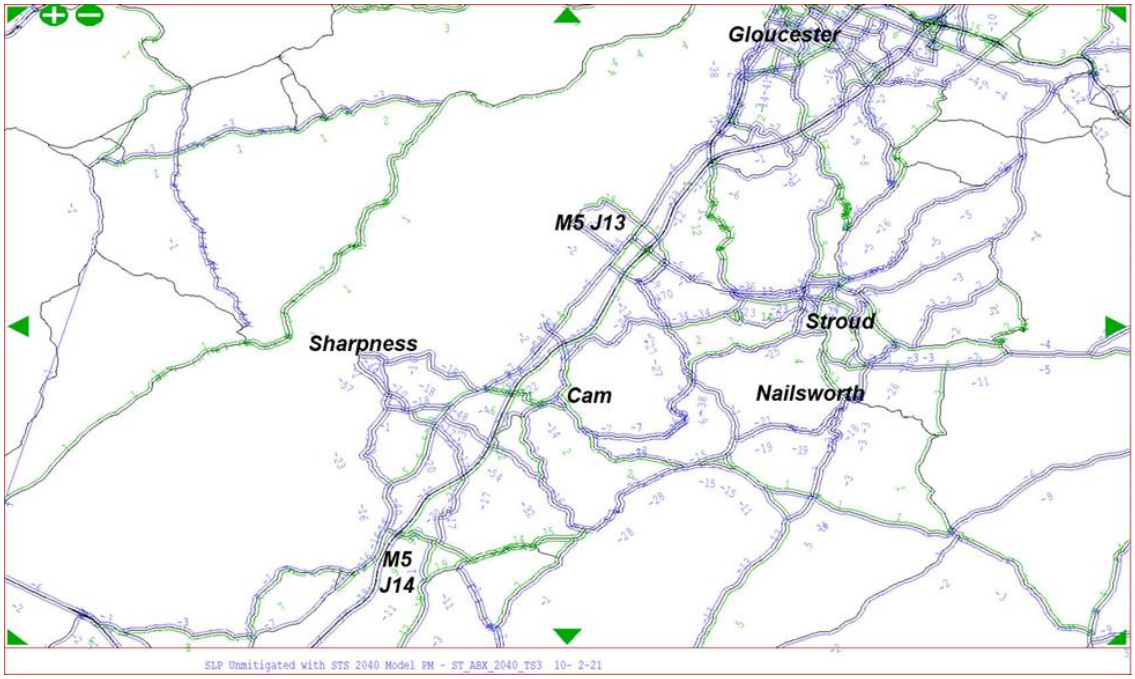


Figure 6.2: Changes in traffic flows associated with STS, PM Peak



Reductions in traffic flows arising from the STS measures are noted to be widespread across the network and, along a limited number of links, amount to as much as between 50 and 100 fewer vehicle movements. Flow reductions of less than 20 vehicles along a link are, however, more commonly seen.

A review of the network performance in this forecast scenario has identified that, although the sustainable transport measures are shown to reduce overall levels of car trips, substantial capacity and congestion issues are forecast to remain on the unmitigated highway network.

It is apparent that, whilst having the potential to play an important role in reducing the impact of the proposed Local Plan development, the sustainable transport measures alone are unlikely to be sufficient to adequately mitigate impacts on the highway network and they should be considered as complementary to highway mitigation options. As such, subsequent presentation and commentary on traffic model forecast results focuses on scenarios that include highway mitigation (see section 7 and associated Appendices).

6.3 Preferred Package of Highway Mitigation

6.3.1 Overview

In collaboration with GCC, SDC and Highways England, the performance of the highway network in the unmitigated Local Plan forecast was reviewed, and compared against the Do Minimum scenario. The purpose of this review was to inform the development of a preferred package of highway mitigation that would be effective in reducing the impact of traffic growth associated with the proposed Local Plan.

The preferred package of highway capacity improvements is intended to represent a strategic approach to mitigating the impact of the proposed Local Plan development sites. At this early stage, the highway mitigation strategy identifies the main locations and broad scale of likely

interventions required and provides a starting point for the development of detailed schemes related to particular developments as they come forward through the planning process.

6.3.2 Identification of Problem Locations

The process of identifying particular “problem locations” on the network was undertaken with the main underlying intention of capturing the most significant areas of congestion on the forecast networks.

In the first instance, a long-list of locations was drawn up, informed by a review of total delays at junctions (SATURN nodes) and the ratio of flow Volume to Capacity (V/C) on approach links in the unmitigated Local Plan scenario.

In order to obtain a manageable and sensible number of locations, a short-list of pinch-points, initially consisting of 29 locations, was developed and agreed with GCC. Whilst no specific performance metrics or thresholds were adopted in the development of the short-list, this process was informed by a review of the unmitigated network performance and included an element of professional judgement to ensure the pinch-points covered a range of locations throughout Stroud District. The process also considered the forecast distribution of traffic associated with the Local Plan developments. Importantly, the short-list was developed with the primary purpose of ensuring the most significant areas of congestion were included – in many instances these locations are already well documented as representing key highway constraints, and include Junctions 12 and 14 on the M5, St Barnabas and Cross Keys Roundabouts in Gloucester and the A419 corridor through Stonehouse.

It was acknowledged that the short-list is not an exhaustive list of every location forecast to experience operational issues as a result of the Local Plan, but, on balance, it was deemed that they represented the most problematic or notable junctions at which mitigation should be considered.

It should also be noted that some of the locations on the short-list are not forecast to become an issue directly as a result of the Local Plan proposals. Several locations are forecast to experience large amounts of congestion even without the proposed Local Plan allocations, though the inclusion of additional traffic demand is clearly likely to further exacerbate operational problems. Examples of this include the M5 J12 and J14 and St Barnabas Roundabout.

6.3.3 Development of Highway Mitigation

The forecast performance of the highway network around each of the 29 short-listed junctions was reviewed in detail and associated high-level concept highway improvement measures were developed and agreed for testing following consultation with GCC, SDC and Highways England.

An iterative approach was adopted to develop a set of preferred highway mitigation measures, with refinements made following initial assignments and review by GCC, SDC and Highways England representatives. For example, preliminary model assignments indicated that at some locations, such as the M5 J12 and J14, the initially assumed scale of improvements would not be sufficient to accommodate forecast levels of traffic demand and larger scale schemes would be necessary.

In addition, following preliminary model assignments, it became apparent that the initial proposed improvements around the Sharpness area would contribute to additional congestion at the junction of the B4066 with Alkington Lane and mitigation has therefore also been included at that location (annotated as Junction ID30).

Appendix L outlines the assumed scale and type of mitigation at each of the 30 "problem locations[4]". For each short-listed site in Appendix L, a summary of junction performance in the unmitigated scenario is noted, along with an indication of the broad scale of mitigation likely to be required. The highway mitigation measures broadly fall into three categories:

- Signal optimisation;
- Approach widening; and
- Junction redesign / new junction form (e.g. conversion from priority-controlled junction to signalised junction).

Using professional judgement and knowledge of costs associated with similarly sized schemes elsewhere, an indicative scale of cost for each proposed improvement scheme has also been identified. Given the early stage of option development at each location, and in the absence of detailed designs, survey information (e.g. surveys of statutory undertakers' equipment, topographical surveys, ground condition surveys etc) and a full understanding of other potential constraints, the estimated costs are subject to a large degree of uncertainty. To acknowledge this uncertainty, each scheme has been allocated into one of five broad cost bands, as summarised in Table 6.2.

Table 6.2: Highway Mitigation Cost Bands

Cost Band Category	Indicative Cost Band	Example Scheme Descriptions
1 – Very low	Nominal cost	• New / revised road markings only • Signal re-optimisation only
2 – Low	<£250k	• Limited widening on junction approach(es) • Simple conversion to signal control (without significant kerb realignments)
3 – Medium	£250k to £2.5m	• Widening on junction approach(es) • New junction form – i.e. signalisation, roundabouts
4 – High	£2.5m to £10m	• Significant increase in junction scale
5 – Very high	>£10m	• Grade-separation

It should also be noted that proposed improvements at several locations would require third party land.

There were also some junctions at which increasing highway capacity was considered inappropriate because, for example, it would encourage traffic to use unsuitable routes such as minor country lanes. These locations are noted below and within Appendix L.

The location of improvement schemes included in the highway mitigation scenarios is identified in Figure 6.3, with further detail on the types of improvement summarised in Table 6.3.

[4] Consisting of the original 29 short-listed locations, plus the B4066 / Alkington Lane junction.

Figure 6.3: Highway Mitigation Locations

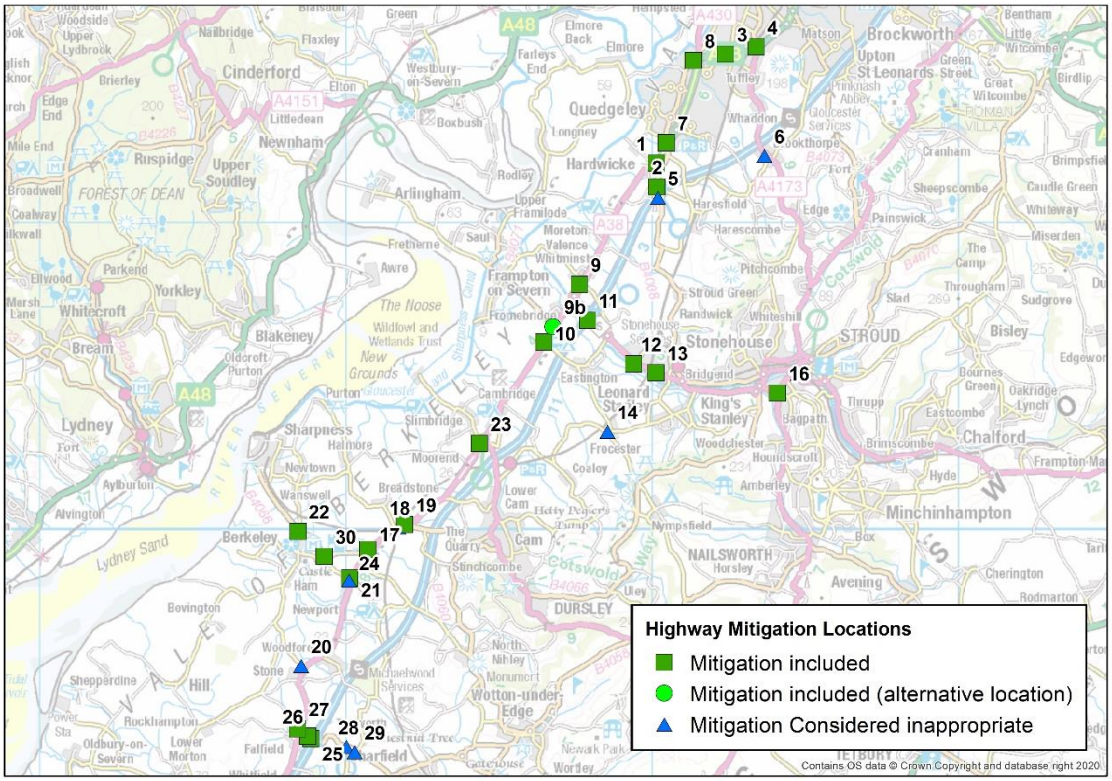


Table 6.3: Highway Mitigation Measures

ID	Junction	Improvements			Indicative Cost Band
		Signals	Approach Widening	New Junction Design	
1	A38 Cross Keys Roundabout	A38 EB approach signalised Signal timings optimised	A38 SB approach widened to 3 lanes	-	4 – High
2	M5 J12	All approach arms signalised Signal timings optimised	-	New grade-separated all-movements interchange	5 – Very high
3	A38 / Epney Road	Signal timings optimised	Both A38 approaches widened to include 2 ahead lanes and 1 right turn lane	-	3 – Medium
4	St Barnabas Roundabout	-	-	All approaches widened by one lane Circulatory east of Stroud Rd widened to 3 lanes	4 – High
5	B4008 / Stonehouse	Junction signalised	-	-	2 – Low
6	A4173 / Brookthorpe	No capacity improvements included to avoid potential further increases in traffic using the identified rat-run through Haresfield.			N/A
7	B4008 / A38 NB off-slip	Signal timings optimised	-	-	1 – Very low
8	A38 / A430 / B4008 Cole Avenue	Signal timings optimised	A430 SB approach widened to 3 ahead lanes Nearside flare on the A38 EB approach lengthened A38 WB Approach widened to include 2 lanes for left turners	-	4 – High
9	A38 / Grove Lane	Signalise nearby junction of A38/B4071	-	-	3 – Medium
10	A38 at Claypits	Signal timings optimised	Both A38 approaches widened to include 2 ahead lanes	-	3 – Medium
11	M5 J13	All approach arms signalised Signal timings optimised	-	-	3 – Medium
12	A419 / Oldends Roundabout	-	A149 widened to 2 lanes in each direction between Oldens and Chipmans Platt roundabouts	-	4 – High
13	A419 / Boakes Drive roundabout	-	Both A419 approaches widened	-	2 – Low
14	Bath Road / Peter's Street (Frocester)	No capacity improvements included to avoid potential further increases in rat-running traffic between Leonard Stanley / King's Stanley and the A38			N/A
15	A419 / Bath Road (Stroud)	No improvements included			N/A
16	A46 / Dudbridge Hill	Signal timings optimised	Dudbridge Hill Approach widened to 3 lanes	-	3 – Medium
17	A38 / B4066	Junction signalised	Nearside flares added on A38 NB and B4066 approaches	-	3 – Medium
18	A38 / Breadstone	No capacity improvements included to avoid potential further increases in traffic routing through Breadstone			N/A
19	A38 / B4066 Berkeley Road	Junction signalised	-	-	3 – Medium
20	A38 at Stone	No capacity improvements to avoid potential further increases in rat-running traffic on the minor route between Berkeley and Stone			N/A
21	A38 / Alkington Lane	Junction signalised	-	-	3 – Medium
22	B4066 / Station Road	-	Widening on B4066 approach	-	2 – Low
23	A38 / A4135	-	A38 NB approach widened to 2 lanes	-	2 – Low
24	A38 / Wick Road	No improvements included as network improvements are introduced at nearby junctions			N/A
25 & 26	M5 J14	Signals timings optimised	-	New grade-separated all-movements interchange	5 – Very high
27	A38 / B4509	-	-	Current junction replaced by a roundabout B4509 dualled between the A38 and M5	4 – High
28	B4509 / Tortworth Road (south)	No improvements included as network improvements are introduced at nearby M5 Junction 14 and the A4509 / A38 junction			N/A
29	B4509 / Tortworth Road (north)	No improvements included as network improvements are introduced at nearby M5 Junction 14 and the A4509 / A38 junction			N/A
30	B4066 / Alkington Lane	Junction signalised	-	-	3 – Medium

As noted above, the potential highway mitigation schemes that have been assessed using the traffic model are conceptual in nature and further work would be required to progress them through to a deliverable solution.

In particular, further consideration would need to be given to the feasibility and design of each scheme on a case-by-case basis. This would need to take into full account the particular constraints of each site, noting that at this initial stage of development only limited information has been considered when establishing these conceptual scheme options. In developing the mitigation options further, due account would typically need to be taken of the following types of constraints, noting that this is not necessarily an exhaustive list:

- Land ownership;
- Presence of underground or overhead statutory undertakers' equipment;
- Ground conditions;
- Presence and condition of existing structures;
- Grade / level differences; and
- Environmental constraints.

Appropriate investigations, including site visits, surveys, consultation with landowners etc, would be required to properly identify and understand such constraints.

In effect, each scheme would need developed to the satisfaction of the relevant highway and planning authorities, including any appropriate design and assessment requirements, which may involve further detailed traffic and junction modelling.

6.4 Local Plan Mitigation Assignments

Following the implementation of various mitigation measures, the following scenarios were identified, each with varying levels of mitigation:

- Local Plan with sustainable transport measures (STS) only (see section 6.2.3);
- Local Plan with preferred highway mitigation only; and
- Local Plan with preferred highway mitigation *and* sustainable transport measures (STS).

Table 6.4 summarises the network and matrix versions used in each scenario.

Table 6.4: Networks and Matrices Used in Mitigation Scenarios

Scenario	Network	Trip Matrix / Demand
Local Plan with sustainable transport measures only	Baseline / unmitigated	Local Plan with sustainable transport mitigation
Local Plan with preferred highway mitigation	Preferred highway mitigation	Local Plan excluding sustainable mitigation (unmitigated)
Local Plan with preferred highway mitigation and sustainable transport measures	Preferred highway mitigation	Local Plan with sustainable transport mitigation

As with the Do Minimum and unmitigated Local Plan scenarios, trip matrices were assigned to the networks in a fixed trip assignment using SATURN.

As shown in Table 6.5, each of the mitigated Local Plan model assignments satisfy the convergence criteria set out in TAG Unit M3.1.

Table 6.5: Mitigated Local Plan Assignments Convergence Statistics

Scenario	AM Peak				PM Peak			
	% Gap	% Flow	% Cost	Iter.	% Gap	% Flow	% Cost	Iter.
Do Something with sustainable transport measures only	0.00099	99.6	98.2	64	0.0012	99.6	98.7	64
Do Something with preferred highway mitigation	0.001	99.6	97.8	56	0.0012	99.6	98.5	56
Do Something with preferred highway & STS mitigation	0.001	99.8	98.2	51	0.0068	99.5	98.8	79

Forecast model results for the Local Plan scenarios including highway mitigation are presented and discussed within section 7.

7 Forecast Results

7.1 Introduction

This chapter presents the outputs of the model forecasts with accompanying commentary regarding the effectiveness of the mitigation strategies assessed. It should be noted that the commentary purposely does not identify key constraints at specific mitigation locations because, at this initial stage in scheme development and as discussed previously, these are largely unknown and can only be reliably identified through appropriate investigations, such as site visits and surveys.

To recap, the following forecast Local Plan scenarios have been undertaken and are referenced within this section:

- **Unmitigated** – no transport mitigation included so the transport network is unchanged from the Baseline scenario;
- **Sustainable transport measures only** – inclusion of sustainable transport measures aimed at reducing highway demand;
- **Preferred highway mitigation only** – inclusion of mitigation schemes intended to improve the performance of the highway network and to offset the impact of the Local Plan allocations; and
- **Preferred highway mitigation *and* sustainable transport measures** – inclusion of the highway mitigation schemes and the sustainable transport measures.

As discussed in section 6.2.3, it was concluded that the sustainable transport measures alone are unlikely to be sufficient to adequately mitigate impacts on the highway network and they should be considered as complementary to highway mitigation options. As such, the presentation and commentary on modelling results in this section focus on the scenarios that include highway mitigation.

7.2 Overview

The traffic forecasts indicate that the various locations across the highway network will begin to experience significant capacity issues and delays in the 2040 Baseline (i.e. without Local Plan) scenario – most notable locations include M5 J12, M5 J14, St Barnabas and Cross Keys roundabouts in Gloucester, the A419 corridor in Stonehouse and junctions in Stroud town centre.

The inclusion of travel demand associated with the Local Plan allocation sites is forecast to further exacerbate problems at these locations and, more generally, introduces issues elsewhere across the local and strategic highway networks. In particular, potential problems arise in the immediate vicinity of the proposed sites. Additionally, further issues are forecast to develop along significant stretches of the A38 corridor in Gloucestershire and on access routes around Sharpness.

As discussed in the previous section, a package of sustainable transport interventions and indicative highway capacity improvements at key ‘pinch-points’ has been developed and assessed using the traffic model. Although some residual capacity issues remain within the network, overall, the forecasts demonstrate that the impacts of the proposed Local Plan sites can be largely mitigated, and that the highway network can operate at similar levels of performance to the 2040 Baseline situation.

Further detail on the forecast results are provided in the remainder of this section and within relevant appendices.

7.3 Presentation of Model Forecasts

As explained previously, following a review of the 2040 Baseline and unmitigated Local Plan forecasts, a total of 29 key "problem locations" were identified as representing the most problematic or notable junctions at which mitigation should be considered. In addition, following initial model assignments, a proposed improvement scheme has also been identified for the B4066 / Alkington Lane junction.

The following key output results from the 2040 Baseline and forecast Local Plan models for these 30 locations have been tabulated and are provided in Appendix M:

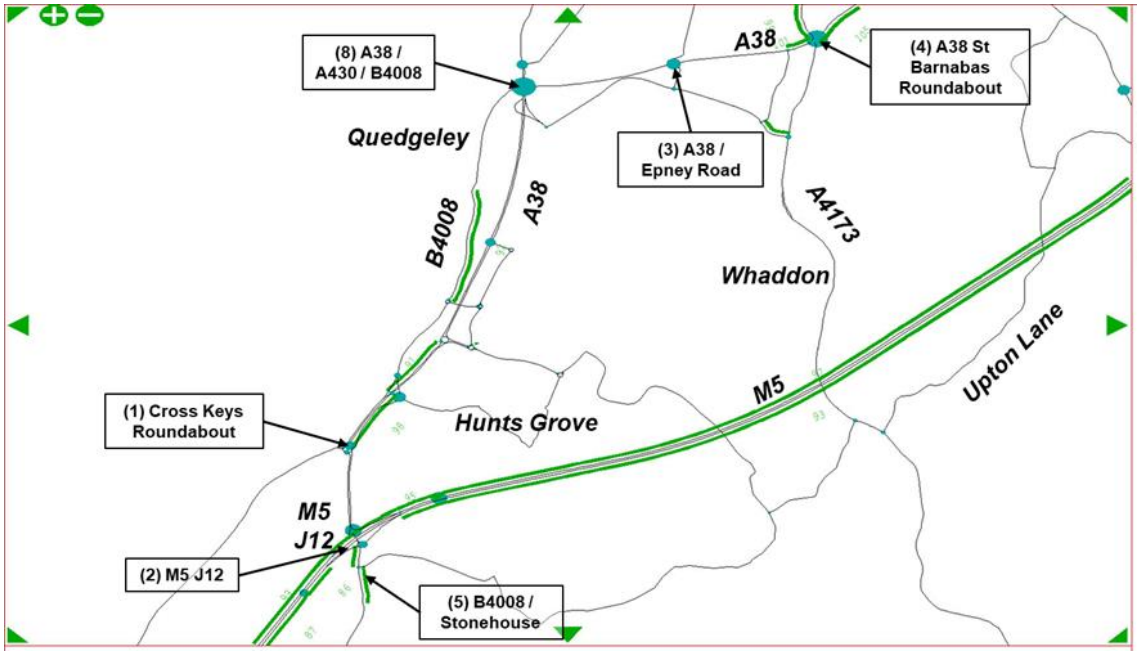
- Maximum flow Volume over Capacity ratio (V/C) on approach links at each location;
- Maximum delay on approach links at each location; and
- Maximum queue length on approach links at each location.

The tabulated data is accompanied by a series of figures that also identify link V/C and node delays throughout the network. These graphical outputs are included as separate appendices for each of the following four areas of the model:

- M5 J12 and Gloucester – Appendix N;
- M5 J13, Stonehouse and Stroud – Appendix O;
- Sharpness / Berkeley – Appendix P; and
- M5 J14 – Appendix Q.

An example model output graphic, in this case for the M5 J12 and Gloucester area in the 2040 Baseline AM peak, is presented in Figure 7.1 below.

Figure 7.1: Example model output graphic – Link V/C and Node Delays



Further analysis and commentary on forecasts impacts is provided below for the four areas of the model identified above.

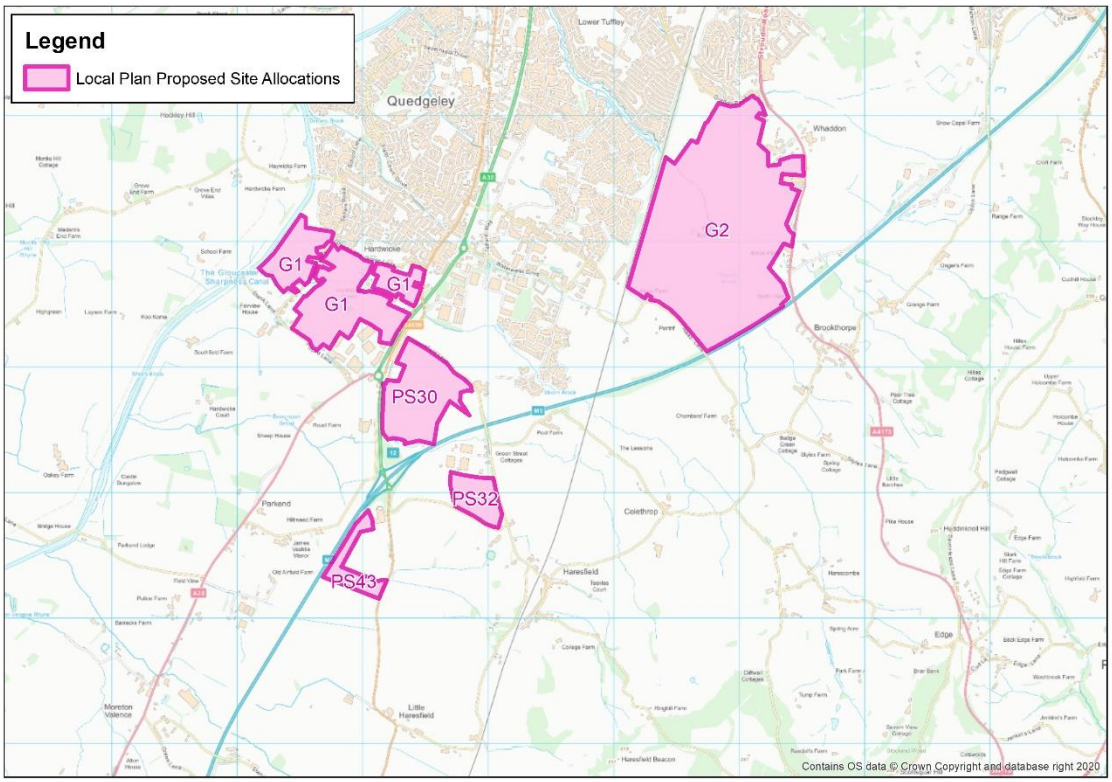
7.4 M5 J12 and Gloucester

7.4.1 Overview

The draft Local Plan includes significant housing and employment allocations within this area, as identified below and shown in Figure 7.2:

- G1 – South of Hardwicke – 1200 dwellings;
- G2 – Land at Whaddon – 2500 dwellings;
- PS30 – Hunts Grove Extension – 750 dwellings;
- PS32 – South of M5 J12 – 5 ha employment land; and
- PS43 – Javelin Park – 9 ha employment land.

Figure 7.2: Local Plan Allocation Sites – M5 J12 and Gloucester



The forecast changes in traffic flows in this area as a result of the Local Plan development allocations are identified in Figure 7.3 and Figure 7.4 for the AM and PM peak hours respectively. These present traffic flow differences between the 2040 Do Minimum and the unmitigated Local Plan scenarios – links shown in Green indicate an increase in traffic as a result of the Local Plan, while Blue links denote flow reductions. The thicker the shading, the larger the magnitude of flow change. The red numbers indicate key locations and are used for reference purposes within the following sections.

Figure 7.3: M5 J12 & Gloucester – Local Plan Traffic Flow Impacts – AM Peak

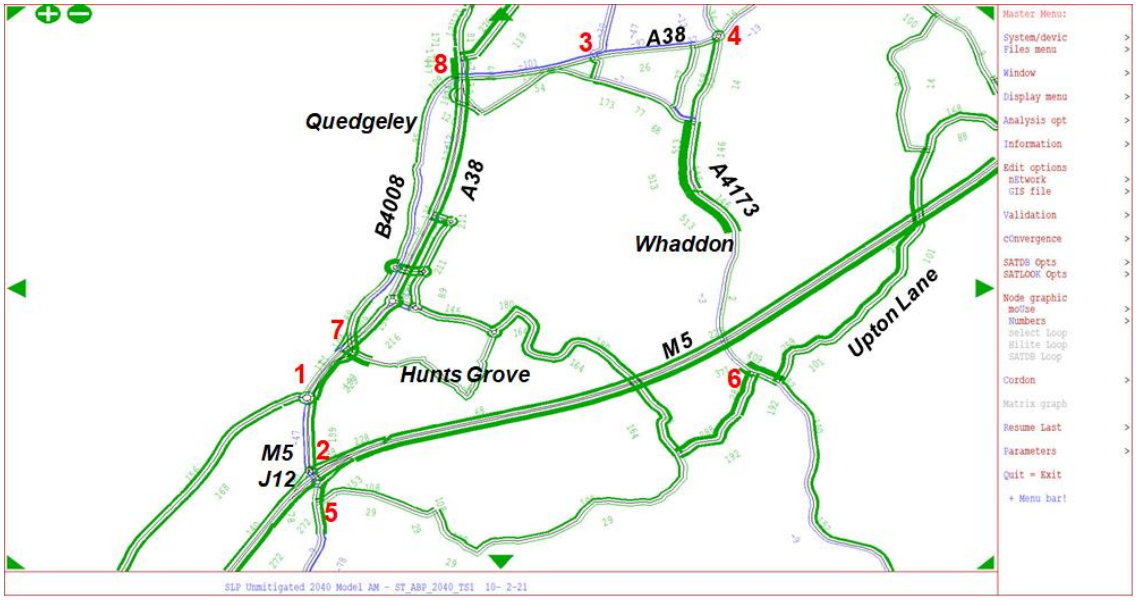
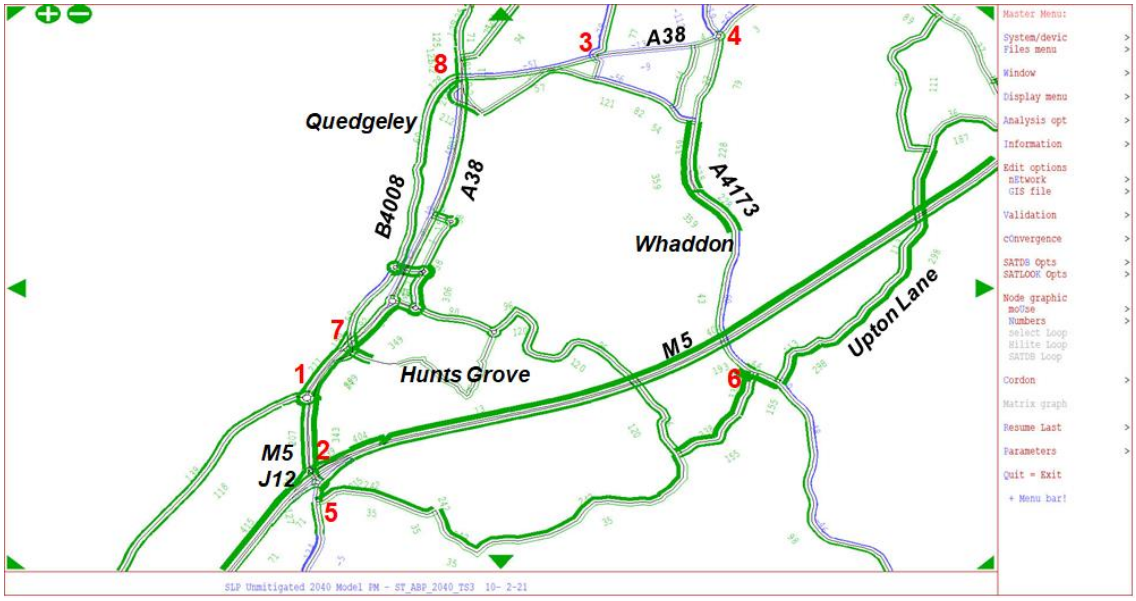


Figure 7.4: M5 J12 & Gloucester – Local Plan Traffic Flow Impacts – PM Peak



The additional traffic generated by Local Plan sites in this area is forecast to result in capacity issues at a selection of locations, including junctions along the A38 Gloucester ring road and key junctions providing access to the M5 motorway.

A notable consideration in this area is the poor highway connectivity between the proposed Whaddon site and the M5, with Junction 12 providing the closest motorway access point for this development. The forecast models show that the most direct route to the M5 from Whaddon is provided through Haresfield to the south of the motorway – this route consists of relatively minor

country roads and routes through rural settlements. A more appropriate route would be along the A4173 and A38, but this route is less direct and is shown to experience capacity constraints at various locations.

A review of model outputs (contained in Appendix M and Appendix N) within this area identified the following key "problem locations", which are subject to further discussion below:

- ID1 – Cross Keys Roundabout;
- ID2 – M5 Junction 12;
- ID3 – A38 / Epney Road;
- ID4 – A38 St Barnabas Roundabout;
- ID5 – B4008 / Stonehouse;
- ID6 – A4173 / Brookthorpe;
- ID7 – Bristol Road / B4008; and
- ID8 – A38 / A430 / B4008.

7.4.2 ID1 – Cross Keys Roundabout

This junction represents a key location on the main route connecting Gloucester and the M5 and A38 to the south. Traffic associated with Local Plan sites at Hunts Grove and South Hardwicke will use this junction to access routes to the south, including the M5 motorway. This junction is already subject to a proposed improvement scheme, which would involve the inclusion of traffic signal control on the A38 southbound and B4008 approaches – this scheme is included in the Baseline forecast scenario.

Whilst this junction is forecast to experience some capacity issues in the 2040 Baseline scenario, this is significantly compounded by the inclusion of the Local Plan traffic. Capacity issues in the unmitigated Local Plan forecasts are particularly prominent in the AM peak, with the V/C on the A38 southbound approach forecast to exceed 100% and the circulatory carriageway at the B4008 also reaching 100%.

The highway mitigation scheme assessed at this location involves widening of the A38 southbound approach, inclusion of signals on the A38 northbound approach and general re-optimisation of signal timings throughout. The inclusion of this mitigation scheme in the forecast scenarios has largely resolved capacity issues at the junction and is shown to mitigate most of the impacts arising from the Local Plan allocations. Knock-on impacts resulting from the proposed improvements at M5 J12 (see below) are forecast to exacerbate issues at Cross Keys in the PM peak to an extent and further consideration may be required in the development and refinement of mitigation in due course.

7.4.3 ID2 – M5 Junction 12

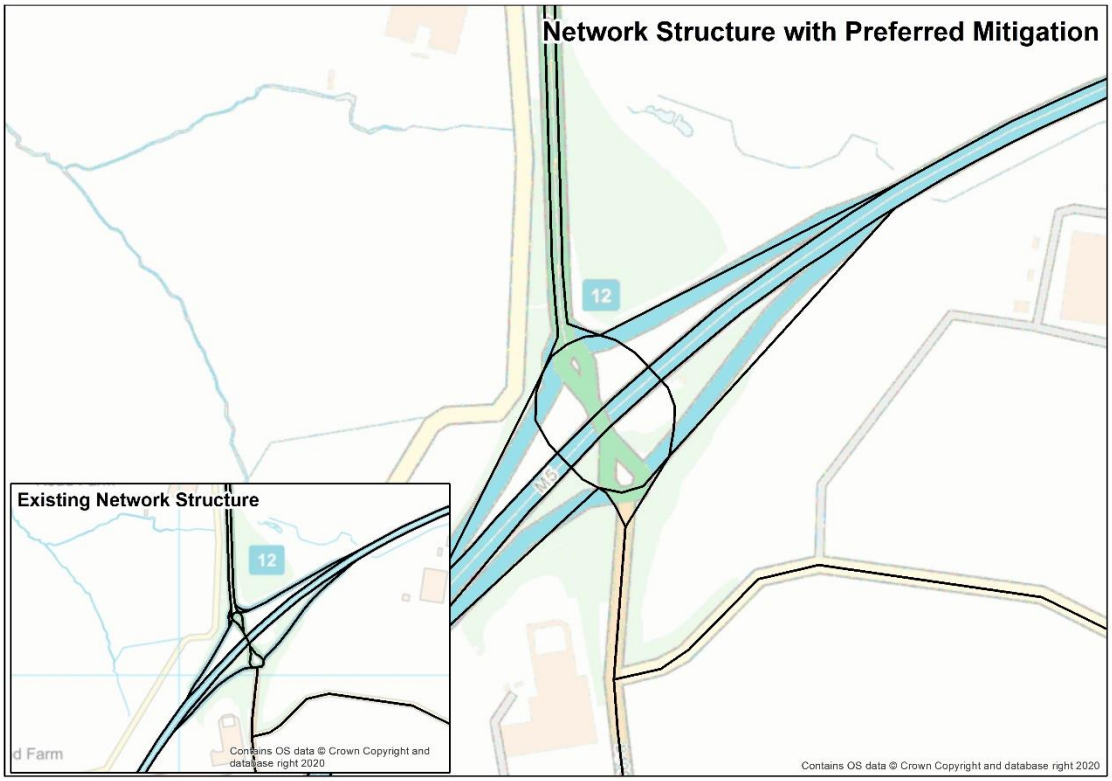
This junction provides the main connection to the Strategic Road Network to/from the south of Gloucester. It was converted to an 'all-movements' interchange in the early-2000s with the inclusion of north-facing slip roads. It currently consists of a single overbridge with signal-controlled junctions formed with the B4008 and M5 slip-roads on either side of the motorway. It is understood that the junction experiences operational issues during peak periods. A potential improvement scheme has already been developed that would increase queuing capacity on the southbound off-slip but it would be unlikely to offer substantial increases in vehicle throughput or capacity at the junction.

With its existing layout the junction is shown to experience capacity issues in the 2040 Baseline scenario, with both B4008 approaches operating with V/Cs of around 100% in the peak hours. The inclusion of Local Plan traffic further exacerbates these problems and the V/C on the northbound B4008 approach is forecast to reach as high as 110% in the PM peak.

Initial forecast assignments were undertaken assuming widening of the northbound link on the overbridge and re-optimisation of signal timings but results from these tests indicated that the junction would continue to experience significant capacity problems. In some respects, the knock-on impacts arising from improvements elsewhere in the network (e.g. at Cross Keys Roundabout, see above) were shown to result in a further deterioration of overall junction performance at the motorway junction.

As such, a more significant improvement scheme, consisting of a new all-movements grade-separated junction and incorporating two overbridges, has also been assessed. Following a review of further preliminary assignments, traffic signal control was also included on each approach at the junction. Figure 7.5 identifies the assumed indicative arrangement for the mitigation scheme at this location.

Figure 7.5: Indicative Mitigation Scheme at M5 J12



The junction is forecast to operate satisfactorily in 2040 with the preferred mitigation scheme. Signal timings were optimised to ensure minimal queuing on the M5 off-slips to reduce the risk of blocking back onto the mainline and, as a result, the non-motorway links are forecast to operate above 90% but with small amounts of queuing and delay. This represents a major improvement compared to the unmitigated scenario and results in the junction operating at least as well as the 2040 Baseline situation.

7.4.4 ID3 – A38 / Epney Road

This is a four-arm signal-controlled junction located on the A38 Gloucester ring-road, with Epney Road forming the minor approach arms at the junction and providing access to adjacent residential areas.

The junction is forecast to operate within capacity in the 2040 Baseline scenario, but the addition of Local Plan traffic results in the junction exceeding capacity and experiencing large delays in both peak hours.

The assumed highway improvement scheme at this location included widening along the A38 to provide two ahead lanes, which would be assumed to merge back into a single lane an appropriate distance away from the junction.

Whilst some residual capacity issues remain in the AM peak, the mitigation scheme is forecast to improve junction performance and significantly reduce total delays and queues compared to the unmitigated scenario. Overall junction operation with highway mitigation included is broadly comparable with the 2040 Baseline situation, indicating such a scheme could offset the impact of Local Plan traffic at this location. It is also noted that the inclusion of sustainable transport mitigation results in a further improvement at the junction, with the maximum V/C on approach links reducing to below 100%.

7.4.5 ID4 – A38 St Barnabas Roundabout

St Barnabas Roundabout is a key junction on the southern section of the A38 Gloucester ring-road. It is also located on the main north-south route (A4173) between Gloucester and Stroud, onto which the Whaddon Local Plan site would be connected.

The roundabout is forecast to experience capacity issues in the 2040 Baseline scenario, with V/Cs on both A38 approaches exceeding 100% in the AM peak and all arms close to or above 100% in the PM peak. The addition of Local Plan traffic is forecast to exacerbate issues at the junction. For example, in the AM peak, the V/C on the A4173 approach is forecast to increase from below 85% in the Baseline to above 100% with the inclusion of Local Plan demand.

GCC provided details of a potential improvement scheme at the junction, which provides an enlarged roundabout with widening on the A38, A4173 and B4072 approaches. This scheme has been included in the highway mitigation scenario.

Some residual capacity issues remain at this location, particularly in the AM peak, with the inclusion of highway mitigation but the junction experiences a much-improved performance even compared to the 2040 Baseline situation.

7.4.6 ID5 – B4008 / Stonehouse

This priority-controlled junction is located around 180m south of M5 J12 and is adjacent to the proposed Javelin Park (9 hectares) and South of M5 / J12 (5 hectares) Local Plan employment land allocations. It is also located along a potential route between the Whaddon site and M5 J12.

It is forecast to operate within capacity in the 2040 Baseline scenario, but operational issues emerge with the inclusion of Local Plan associated demand. With no highway mitigation in place, the minor arm (Stonehouse) exceeds capacity in the AM peak, largely as a result of the increase in opposing traffic along the B4008. Major issues are also forecast in the PM peak, though this is primarily associated with queuing blocking back from the motorway junction.

The highway mitigation assessed at this location involved the signalisation of the junction to enable minor arm traffic to access the B4008. This is seen to resolve capacity issues in the AM peak but, as noted above, queuing back from M5 J12 would continue to impact the performance of this junction in the PM peak unless the motorway junction was also substantially improved. With the grade-separated junction included at M5 J12 in the preferred mitigation scenario, the B4008 / Stonehouse junction begins to operate satisfactorily in both peak hours. Delays at the junction are significantly reduced with the implementation of mitigation at this location.

As noted previously, the minor road through Haresfield is shown to provide an attractive route between the Whaddon site and the M5. It is understood that this route is unlikely to be suitable for large volumes of traffic and the removal of delays on the minor road at this junction may further encourage rat-running traffic through Haresfield. Consideration will therefore need to be given to managing demand for through-traffic along this route.

7.4.7 ID6 – A4173 / Brookthorpe

This three-arm mini-roundabout in Brookthorpe is forecast to exceed capacity and experience large increases in delays in the PM peak with the inclusion of Local Plan associated demand. The V/C on the minor arm in this period is shown to exceed 100%, whilst the northbound A4173 approach is also operating at, or slightly above, 100%.

Following liaison with GCC, it was considered that mitigation at this location would be likely to further encourage the use of the minor route through Haresfield by traffic accessing the M5 at Junction 12, which was not considered desirable. As such, highway capacity improvements at this junction were not assessed in the Local Plan modelling. It is noted, however, that highway mitigation schemes elsewhere (e.g. at St Barnabas and Cross Keys Roundabouts) help to reduce the volume of traffic using the route through Haresfield. Furthermore, the inclusion of sustainable transport mitigation measures contributes to an additional slight improvement at this junction with all approaches operating below 100% in the PM peak and overall delays reduced.

7.4.8 ID7 – Bristol Road / B4008

This junction is formed by the northbound off-slip from the A38 and the B4008 at Hardwicke. At present, the B4008 overbridge across the A38 is one-way southbound only, which enables vehicles turning left from the A38 off-slip to simply join the B4008 northbound unopposed. Right-turning traffic from the slip-road are required to give-way. In association with the initial phases of the consented Hunts Grove development, this layout is due to change to enable two-way traffic flow along the B4008 and to introduce traffic signal control at the junction. This layout has been included in the future year forecast scenarios.

The junction was forecast to experience a large increase in delays in the Local Plan unmitigated PM peak scenario. This was wholly mitigated via the re-optimisation of signal timings, which enabled the junction to work comfortably within capacity in both peak hours.

7.4.9 ID8 – A38 / A430 / B4008

This location represents a main gateway junction in the south of Gloucester, and it was expanded in the late-2000s as part of the A430 Gloucester South West Bypass scheme.

The junction is generally forecast to operate satisfactorily in the AM peak in all modelled scenarios, but link V/Cs begin to exceed 100% and delays increase significantly in the PM peak with the inclusion of Local Plan traffic.

It is noted that the junction is already very substantial with numerous lanes on all approaches and there is likely to be limited scope for any significant further capacity enhancements, short of

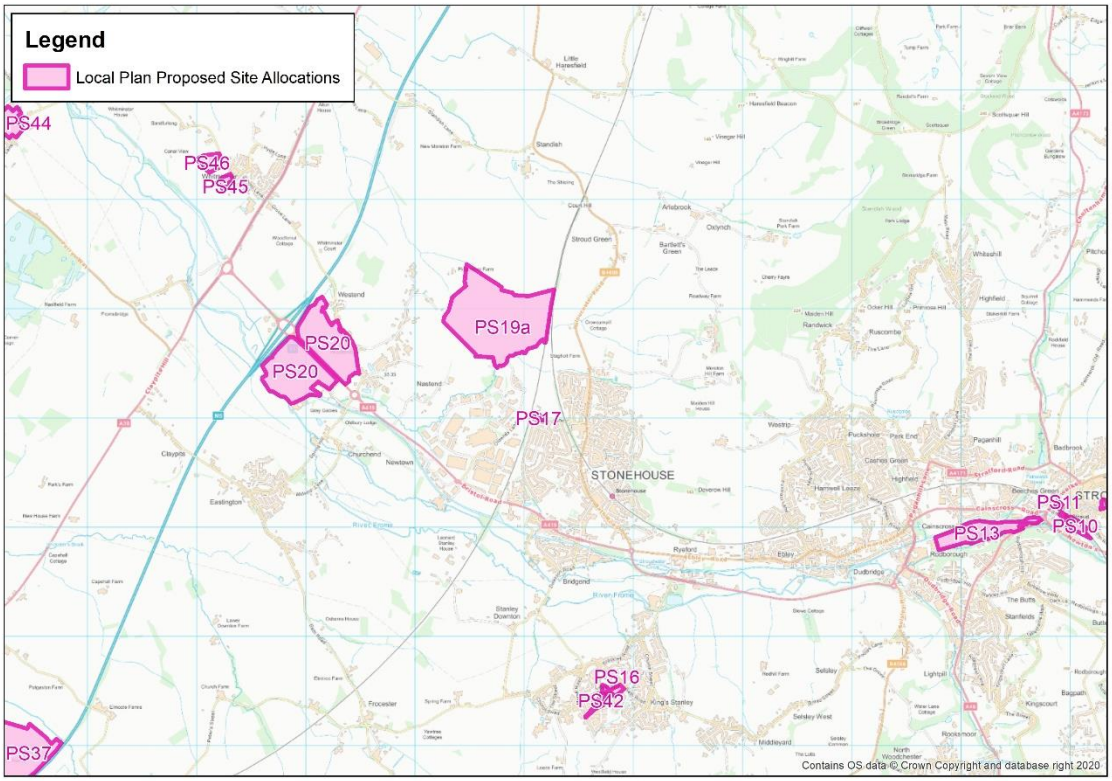
grade-separation. However, the potential for further targeted widening on three of the approach arms has been identified and assessed in the highway mitigation scenario. This would include the provision of a third ahead lane for A430 southbound traffic, and longer left-turn flares on the B4008 eastbound and A38 westbound approaches. The inclusion of this indicative improvement scheme, and associated signal timing re-optimisation, is forecast to bring the maximum link V/Cs back to below 90% and to reduce delays back to levels comparable with the 2040 Baseline scenario.

7.5 M5 J13, Stonehouse and Stroud

7.5.1 Overview

Figure 7.6 identifies the location of proposed allocation sites within the vicinity of M5 J13 and Stonehouse.

Figure 7.6: Local Plan Allocation Sites – M5 J13, Stonehouse and Stroud



The largest draft allocation sites within this area of the network consist of the following locations, which are clustered around J13 and Stonehouse:

- PS20 – M5 Junction 13 – 10 ha employment land; and
- PS19a – Northwest of Stonehouse – 650 dwellings and 5 ha employment land.

There is also a selection of proposed smaller sites located around Stroud town centre, Minchinhampton, Leonard's Stanley, Frampton-on-Severn and Whitminster.

Furthermore, whilst not in the immediate vicinity of M5 J13 or Stonehouse, the major sites at Wisloe, West of Draycott and Sharpness are likely to affect this area, particularly as Junction 13 provides the most direct route to the north and the Strategic Road Network from these sites.

The forecast changes in traffic flows in this area as a result of the Local Plan development allocations are identified in Figure 7.7 and Figure 7.8 for the AM and PM peak hours respectively.

Figure 7.7: M5 J13, Stonehouse & Stroud – Local Plan Traffic Flow Impacts – AM Peak

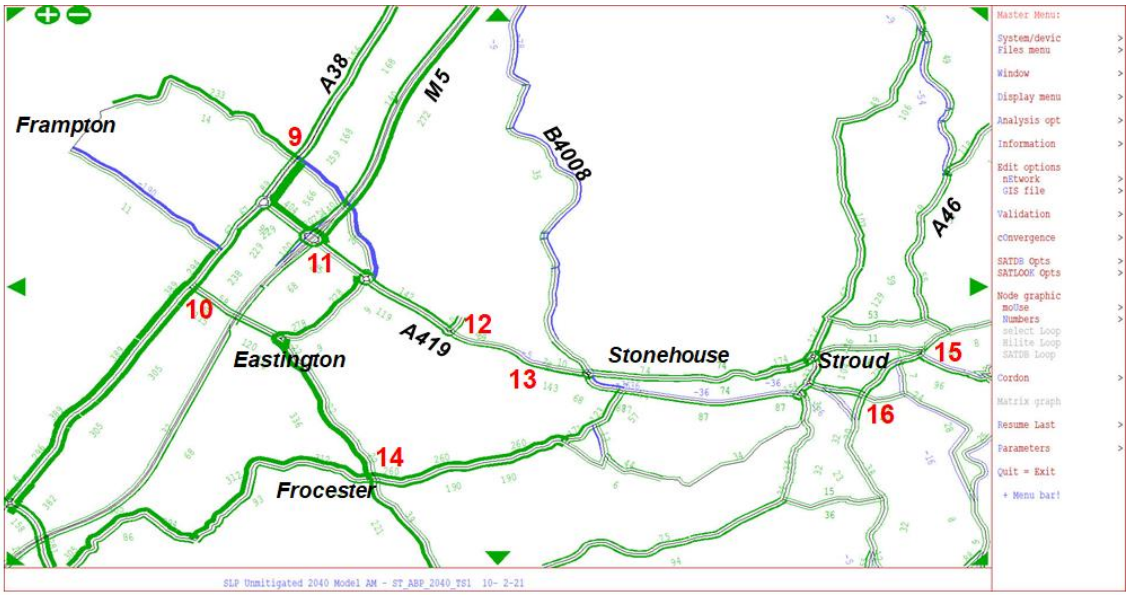
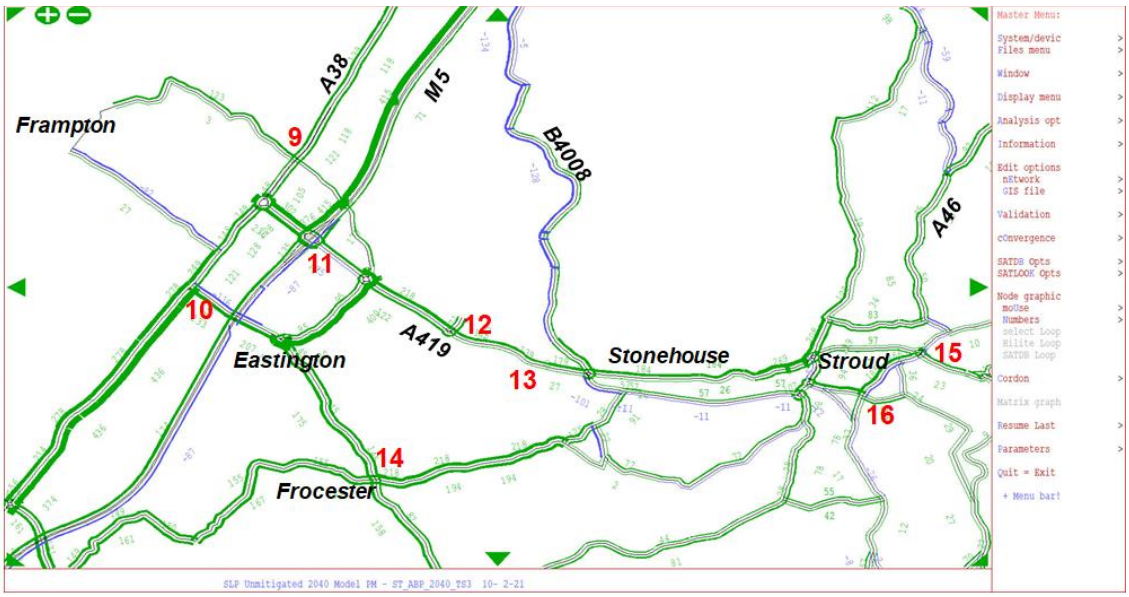


Figure 7.8: M5 J13, Stonehouse & Stroud – Local Plan Traffic Flow Impacts – PM Peak



The forecast flow increases along the A38 are notable in both peak hours and reflect the importance of this route in providing access to the north and the M5 motorway from major sites at Wisloe, West of Draycott and Sharpness.

There is also a large flow increase forecast along the minor route through Frocester – in part, this is driven by the lack of available capacity along the A419 corridor between Stroud, Stonehouse, the M5 and the A38.

The following key "problem locations" were identified based on a review of model outputs and following liaison with GCC:

- ID9 – A38 / Grove Lane;
- ID10 – A38 at Claypits;
- ID11 – M5 Junction 13;
- ID12 – A419 / Oldends Roundabout;
- ID13 – A419 / Boakes Drive Roundabout;
- ID14 – Bath Road / Peter's Street (Frocester);
- ID15 – A419 / Bath Road (Stroud); and
- ID16 – A46 / Dudbridge Hill (Stroud).

These locations are subject to further discussion below.

It is also worth noting that, in addition to the above junctions, there are locations along the A38 on which link capacities are forecast to be reached or exceeded. This has the potential to result in a breakdown of traffic flow along links, in addition to issues at junctions themselves. Consideration may need to be given to link capacities and measures to increase capacity to accommodate additional demand associated with the Local Plan allocations.

7.5.2 ID9 – A38 / Grove Lane

Access from Frampton-on-Severn onto the A38 is forecast to become capacity constrained in the AM peak once Local Plan demand is assigned onto the network. Although only relatively small residential allocations are proposed in Frampton and Whitminster, increases in traffic flows along the A38 restricts the capacity for vehicles turning out of the side-roads. Whilst larger delays are forecast at the Grove Lane junction with the A38 (at Whitminster), the nearby B4071 Perry Way junction also exceeds capacity in the AM peak. Both junctions are currently priority-controlled and are forecast to operate with side-road V/Cs of at least 110%.

Following liaison with GCC, it was agreed that improving the Grove Lane junction would be likely to further encourage Frampton traffic to use this route to access the A38, rather than the more appropriate B4071 connection. It was therefore decided to focus mitigation at the B4071 junction, with the intention of reducing demand along Grove Lane. The assessed mitigation at the B4071 Perry Way junction with the A38 has involved the addition of traffic signals.

The inclusion of traffic signals at the B4071 junction with the A38 is forecast to significantly improve the performance of the Grove Road junction, which operates with V/Cs of less than 90% in both peak hours.

The addition of sustainable transport measures, on top of the highway mitigation at the B4071 junction, is forecast to reduce traffic volumes along the A38 and results in further improvements at both the Grove Lane and Perry Way junctions.

7.5.3 ID10 – A38 at Claypits

This three-arm signalised junction is forecast to operate within capacity in the 2040 Baseline scenario, but encounters capacity issues in both peak hours with the inclusion of Local Plan demand.

In the Local Plan unmitigated scenario, both the A38 approaches operate at, or close to, 100% capacity. Whilst there was some spare capacity on the minor arm, following an initial review, it was apparent that re-optimisation of signal timings would be insufficient to wholly address problems and therefore widening both A38 approaches to provide two ahead lanes was assessed as part of the highway mitigation.

The assessed highway mitigation is shown to significantly reduce delays and queues at the junction. Whilst some capacity issues in this area are forecast to remain with the inclusion of the improvement scheme, they relate to link capacities rather than capacity at this junction.

Further consideration of link capacity improvements may therefore be necessary – the section of the A38 between the A4135 and A419/M5 J13 in particular is forecast to operate close to assumed capacity.

7.5.4 ID11 – M5 Junction 13

The inclusion of Local Plan demand is forecast to increase the maximum approach link V/C to above 90% at M5 Junction 13. In the AM peak, the southbound off-slip is forecast to reach 90% of its capacity, thus increasing the risk of queues potentially blocking back to the mainline of the motorway.

An indicative improvement scheme consisting of the signalisation of each approach arm has been identified and formed the basis of the Local Plan mitigation forecasts. These forecasts have indicated that such a scheme would be capable of accommodating Local Plan demand, with link V/Cs below 90% and the motorway off-slips operating more comfortably within capacity. Whilst it is noted that SATURN models are not necessarily the ideal tool for accurately assessing queue lengths, the queues on the M5 off-slips are forecast to be minimal and comfortably accommodated on the slip-roads. The longest queues are forecast on the circulatory links at the junction, and these are also shown to be accommodated without blocking back.

7.5.5 ID12 – A419 / Oldends Roundabout

The Local Plan unmitigated model assignment identified that the V/C on the eastbound A419 approach at this roundabout increased to above 100% in the AM peak, compared to around 90% in the Baseline scenario.

A detailed review of the model in this area showed that the junction itself is forecast to operate with reasonable levels of spare capacity but that the link capacity on the A419 is exceeded with the addition of Local Plan traffic. As such, the assessed highway mitigation in this area assumes the widening of the A419 to two-lanes in each direction between Chipman's Platt Roundabout and Oldends Roundabout.

The above highway mitigation along the A419, coupled with the sustainable transport mitigation, is forecast to result in this section of the route operating within capacity in both peak hours.

7.5.6 ID13 – A419 / Boakes Drive Roundabout

The A419 approaches to this compact roundabout are forecast to operate with V/Cs of around 100% in the peak hours following the inclusion of Local Plan demand. The junction itself represents a constraint on capacity, though it is also noted that link capacity on this section of the A419 is also likely to become an issue in the forecast years.

The highway mitigation measures included within the forecasts assume widening of the A419 entries at the roundabout and are shown to significantly reduce delays and queuing on the main road. It is noted, however, that some residual capacity issues are forecast to remain in this area and are primarily associated with the link capacity of the A-road.

Additional link capacity improvements, similar to those assumed on the section between Chipman's Platt Roundabout and Oldends Roundabout, should therefore be considered.

7.5.7 ID14 – Bath Road / Peter's Street (Frocester)

This crossroads junction is located along a minor route connecting Stroud in the east with Draycott and the A38 in the west. With the inclusion of Local Plan traffic, this minor route is forecast to experience large increases in traffic flows that would result in capacity issues at the junction in Frocester. Increased traffic flows along this route are partly a result of capacity constraints along the A38 and the A419 corridors.

Following liaison with GCC, it was agreed that increasing capacity at this junction, and along this route in general, was undesirable as it would further encourage traffic to route along minor country roads. As an alternative, it was considered that capacity improvements along the A38 and A419 corridors would have the potential to reduce traffic demand on this minor route.

Whilst some residual capacity issues are forecast to remain at this junction in the AM peak with the inclusion of A38 and A419 improvements (described elsewhere within this section), there is a notable improvement in operation in the PM peak. The inclusion of sustainable transport mitigation is also forecast to reduce demand at this location and therefore reduce the maximum link V/Cs.

7.5.8 ID15 – A419 / Bath Road (Stroud)

It is forecast that this junction, located close to the middle of Stroud town centre, will experience capacity issues in the 2040 Baseline scenario with maximum approach link V/Cs reaching to around 100% in the peak hours. A further deterioration in performance is forecast in the Local Plan scenarios, with V/Cs, delays and queues increasing on approach links.

Several physical constraints, including level differences, existing structures and the proximity to the Thames and Severn Canal, are likely to make highway capacity improvements difficult to deliver in this location. Moreover, following liaison with GCC, it was agreed that providing additional highway capacity within the town centre of Stroud is not a preferred option and, as such, no highway mitigation at this location has been put forward or assessed at this time.

7.5.9 ID16 – A46 / Dudbridge Hill (Stroud)

The addition of Local Plan associated demand onto the highway network is forecast to result in capacity issues at this signalised junction in Stroud. The junction is forecast to operate satisfactorily in the 2040 Baseline scenario, but the maximum approach arm V/C reaches levels of around 100% with the inclusion the Local Plan traffic demand.

An indicative junction improvement scheme that involves widening the eastbound Dudbridge Hill approach to three lanes was provided by GCC and has been included in the Local Plan mitigation scenarios. This scheme has been shown to enable the junction to work within capacity in the AM peak, but some residual capacity issues remain in the PM peak.

7.6 Sharpness

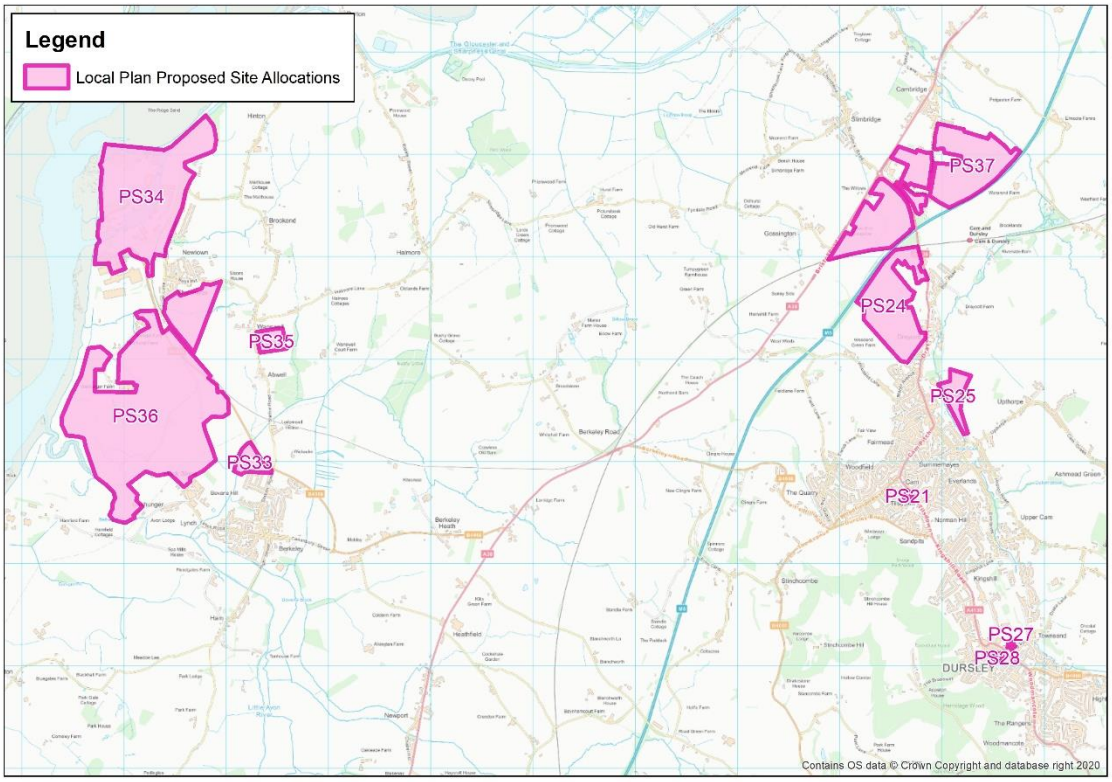
7.6.1 Overview

The draft Local Plan includes various housing and employment allocations in the Sharpness area, with the most substantial identified below and shown in Figure 7.9:

- PS34 – Sharpness Docks – 7 ha employment land and 300 dwellings; and
- PS36 – New settlement at Sharpness – 10 ha employment land and 2400 dwellings.

Furthermore, whilst not in the immediate vicinity of Sharpness, the major sites at Wisloe (PS37) and West of Draycott (PS24) are likely to affect this area, particularly as the A38 provides the most direct route to the south and potentially on to the Strategic Road Network at M5 Junction 14.

Figure 7.9: Local Plan Allocation Sites – Sharpness Area



The forecast changes in traffic flows in the area around Sharpness as a result of the Local Plan development allocations are identified in Figure 7.12 and Figure 7.13 for the AM and PM peak hours respectively.

Figure 7.10: Sharpness Area – Local Plan Traffic Flow Impacts – AM Peak

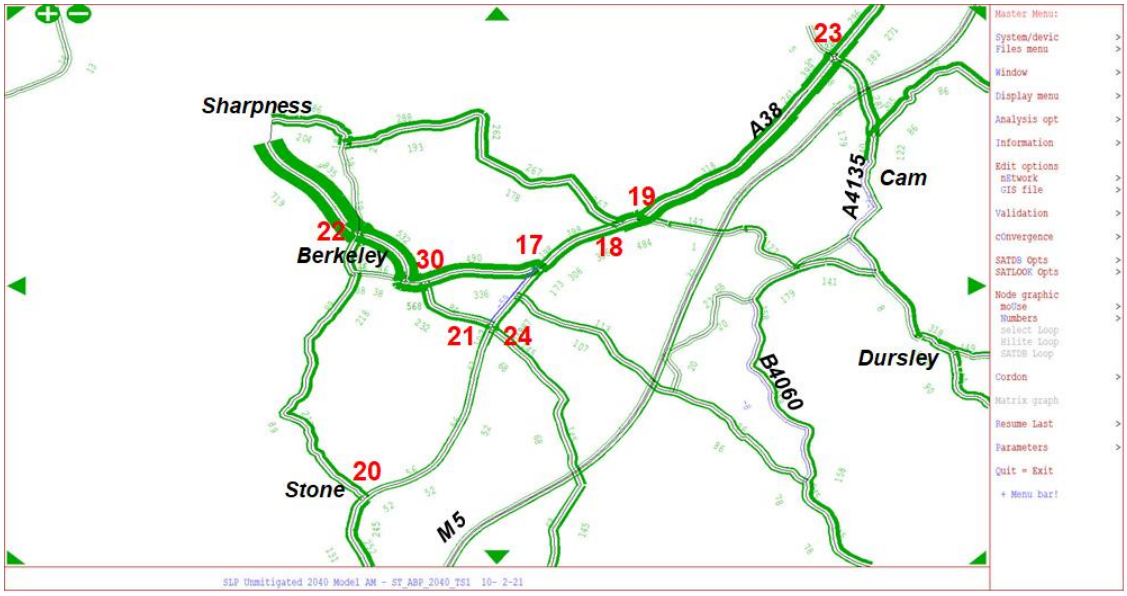
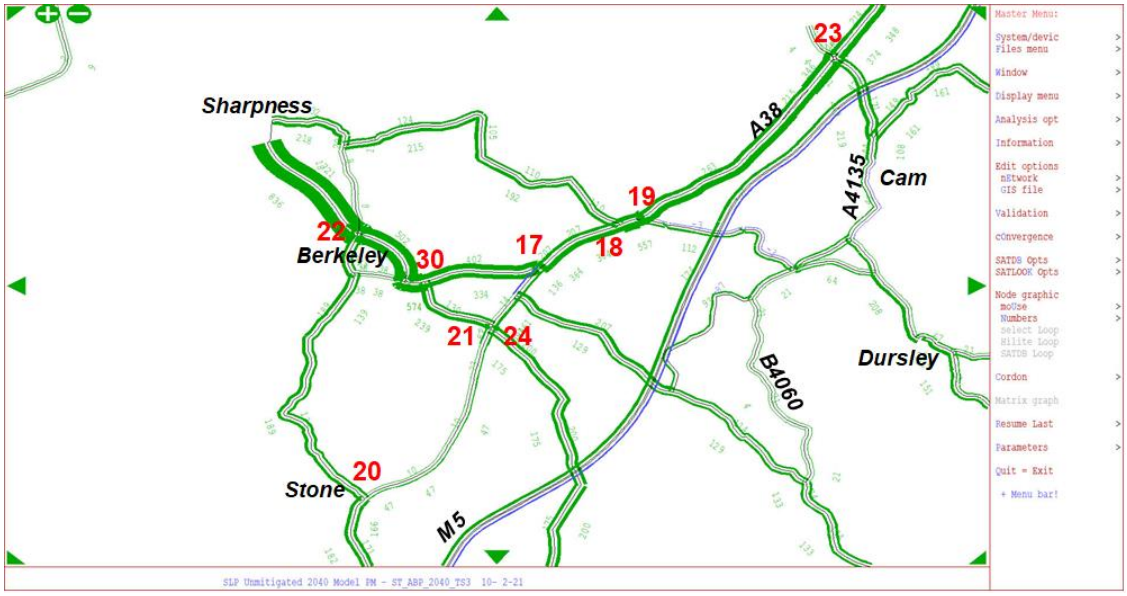


Figure 7.11: Sharpness Area – Local Plan Traffic Flow Impacts – PM Peak



Large traffic flow increases are apparent on the various routes connecting Sharpness and Berkeley with the A38. Whilst the increases are greatest on the more substantial B4066 connection, flow increases are also notable on the alternative routes, including the relatively minor routes through Stone to the south and Breadstone to the north.

Flow increases along the A38 are largest to the north of Sharpness, partly reflecting the proximity of the Wisloe and West of Draycott allocation sites. This is also indicative of the forecast significant congestion at M5 Junction 14 (see following section), which encourages

some traffic to route to/from the south via alternative routes, such as the minor Tortworth Road, rather than using the A38 to the south of Sharpness.

7.6.2 ID17 – A38 / B4066

The B4066 represents the main highway link between the A38 and the settlements at Sharpness and Berkeley and this give-way junction currently provides the main access onto the A38.

The junction is forecast to operate comfortably within capacity in the 2040 Baseline scenario, but the addition of Local Plan associated traffic is shown to result in capacity issues, particularly in the AM peak when the B4066 approach V/C exceeds 100% without mitigation. The morning peak is most notably affected as outbound trips generated by the residential developments attempt to access the A38 under give-way control.

Highway mitigation at this location is assumed to involve the addition of traffic signals with limited widening on the B4066 to accommodate a flare on approach to the junction. With this improvement scheme in place, the junction operates within capacity with a maximum approach link V/C of less than 80% in both peak hours. It is considered that improvements at this location are essential to provide safe and efficient access onto the A38 and also to reduce the volume of traffic that may attempt to route to the A38 via less appropriate minor routes in the local area.

7.6.3 ID18 – A38 / Breadstone

This give-way junction is located approximately 1.2km to the northeast of the B4066 junction discussed above and provides an alternative connection with the A38 for traffic routing to and from Sharpness. Without highway mitigation, the forecasts indicate large increases in traffic using this route.

However, the route between Sharpness and Breadstone is of a relatively low standard, passes minor settlements and residential properties and it is not considered appropriate to accommodate substantial increases in traffic. As such, and following liaison with GCC, it was considered that mitigation at this junction is not considered desirable to avoid further encouraging traffic to use this route. Concentrating highway mitigation at the more appropriate B4066 junction should help to alleviate pressure on the Breadstone route and junction with the A38.

It is noted that the link capacity along the A38 in this locality is forecast to become an issue with the inclusion of the Local Plan allocation sites. Further consideration of link capacity improvements along the A38 may therefore be necessary.

7.6.4 ID19 – A38 / B4066 Berkeley Road

The B4066 provides a direct connection between the A38 and Cam and Dursley, and this junction is forecast to experience capacity issues in both peak hours with the inclusion of Local Plan development traffic. Capacity constraints and delays are notable on the B4066 minor approach arm but also on A38 northbound approach, which results from the main road link capacity becoming an issue.

Mitigation at this location is focused on improving capacity for the minor arm by including traffic signals at the junction, thus enabling traffic from the B4066 to access the main road. In this regard, the scheme is forecast to substantially improve the situation with the link V/Cs on the B4066 reducing to acceptable levels.

The assumed scheme does not, however, address link capacities along the A38 and further consideration to link improvements may therefore be necessary.

7.6.5 ID20 – A38 at Stone

The minor road connecting Berkeley with the A38 at Stone (via Ham) provides a relatively direct route for traffic traveling between Sharpness, Berkeley and the south.

The unmitigated Local Plan forecast indicates that large flow increases on this route will occur in the future as traffic seeks to avoid the major delays at the alternative accesses onto the A38. These increases are shown to increase the minor approach arm link V/C to above 100% in the AM peak.

However, the route between Berkeley and Stone is also of a relatively low standard and it is not considered desirable for it to experience large increases in traffic volumes. Following liaison with GCC, it was therefore considered appropriate to concentrate highway mitigation at the B4066 and Alkington Lane junctions with the A38 rather than at this location to avoid further encouraging traffic to use the minor route to/from Stone.

7.6.6 ID21 – A38 / Alkington Lane

In a similar manner as that explained for the B4066 / A38 junction (section 7.6.2), the junction of the A38 with Alkington Lane is forecast to experience significant capacity issues with the inclusion of Local Plan traffic, particularly in the AM peak. The Alkington Lane approach is shown to increase to above 100% in the morning and to above 95% in the PM peak.

The assumed highway mitigation at this location involves the inclusion of traffic signals, along with an element of widening on the Alkington Lane approach, though it is noted that this may require some third party land. This scheme is shown to significantly improve the performance of the junction, with all approach arms operating below 85% in both peak hours.

7.6.7 ID22 – B4066 / Station Road

This roundabout junction is shown to operate comfortably within capacity in the 2040 Baseline scenario but begins to approach capacity in the AM peak hour with the inclusion of Local Plan traffic. Whilst not yet exceeding absolute capacity, delays are markedly greater than in the Baseline situation.

A small amount of widening on the eastbound B4066 has been assumed within the highway mitigation scenarios to demonstrate whether the junction could be capable of accommodating the additional traffic associated with the major allocation sites in this area. The forecast results illustrate that a relatively minor capacity enhancement should be sufficient to accommodate forecast demand in this locality.

7.6.8 ID23 – A38 / A4135

Located in the immediate vicinity of the proposed Wisloe allocation site, this roundabout junction is forecast to exceed capacity in the AM peak when Local Plan traffic is added onto the network.

Large increases in traffic are forecast along the A38 in this area as traffic generated by the Local Plan sites use the route to travel to and from the north. As a result, in the unmitigated Local Plan scenario, the A38 northbound approach experiences an approach arm V/C of above 100%.

A review of the existing roundabout layout indicates that some minor widening on the A38 approach appears feasible and has been assumed within the preferred highway mitigation

scenario. Widening this approach to two lanes at the entry to the roundabout is shown to significantly improve junction performance, with the link V/C and delays brought back to similar levels to those seen in the 2040 Baseline scenario.

7.6.9 ID24 – A38 / Wick Road

Wick Road represents a potential alternative to the A38 for traffic travelling in a north-south direction in this part of Stroud District. Travelling from the north, traffic is able to use Wick Road and subsequently Tortworth Road (see section 7.7.4) to access the B4509 and the B4508 near Charfield.

In the unmitigated Local Plan scenario, traffic is forecast to use this route as it attempts to avoid delays along the A38/B4509 route to and from the M5 Junction 14. In the PM peak hour, this resulted in the Wick Road approach operating with a link V/C close to 100%.

It was considered that improving access between Wick Road and the A38 would be likely to further encourage traffic to use this inappropriate route, which includes sections of very narrow carriageway. Following correspondence with GCC it was therefore agreed to not allow for mitigation at this junction.

However, with capacity enhancements along the A38 route to/from the B4509 and the M5, Wick Road is sufficiently relieved of demand so that the minor arm begins to operate comfortably within capacity in both peak hours.

7.6.10 ID30 – B4066 / Alkington Lane

As noted previously, this junction was not identified as one of the original 29 “problem locations” but it became apparent from preliminary forecast assignments that it would experience substantial capacity issues when other local bottlenecks, such as at the A38 / Alkington Lane, were addressed by proposed capacity improvements.

A potential mitigation scheme involving the signalisation of the northern end of Alkington Lane (at its junction with the B4066) has therefore been assumed within the preferred highway mitigation package. A signal-controlled layout is shown to operate within capacity in the Local Plan scenarios, with the inclusion of sustainable transport measures contributing to all approach arms experiencing V/C’s of less 85% in both peak hours.

7.7 M5 Junction 14 area

7.7.1 Overview

Although M5 Junction 14 is located outside of Stroud District, the Local Plan is of relevance to the junction and the local highway network within the northern parts of South Gloucestershire. Traffic generated by the allocation sites at Sharpness, Cam and Dursley and the employment site at Renishaw New Mills (9 hectares) are all likely to use Junction 14 to access the Strategic Road Network.

The forecast changes in traffic flows in this area as a result of the Local Plan development allocations are identified in Figure 7.12 and Figure 7.13 for the AM and PM peak hours respectively.

Figure 7.12: M5 J14 – Local Plan Traffic Flow Impacts – AM Peak

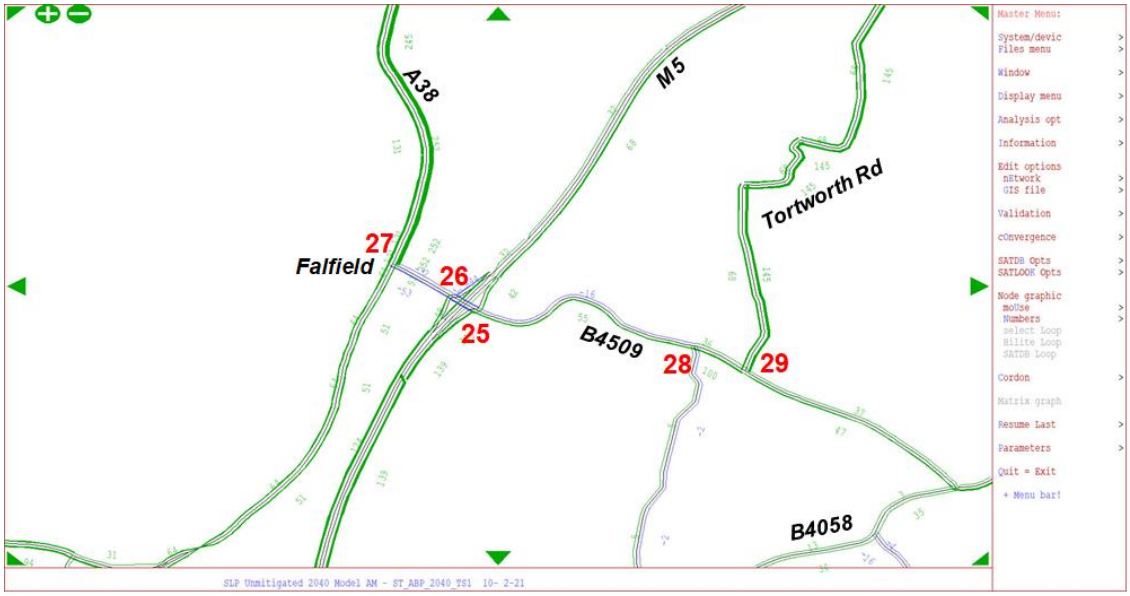
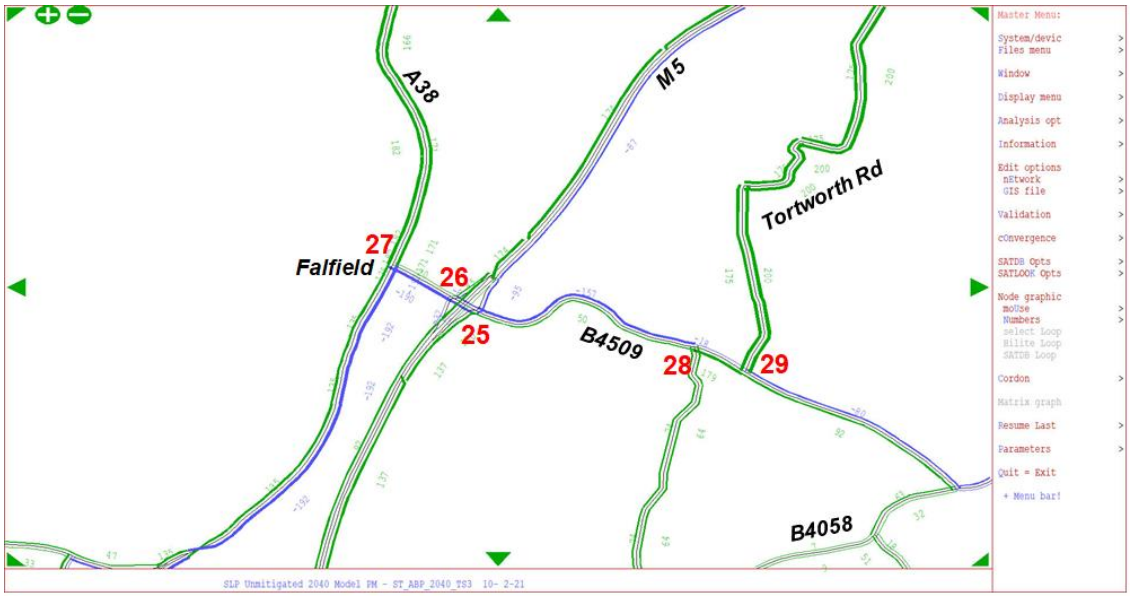


Figure 7.13: M5 J14 – Local Plan Traffic Flow Impacts – PM Peak



Increases in traffic flows along the A38 and Tortworth Road are forecast to arise as a result of the Local Plan allocations, as development traffic uses these routes to travel to and from the south and the M5 at Junction 14. However, the increase in traffic using Junction 14 is forecast to lead to significant increases in delays at the motorway junction in both peak hours – this results in an element of traffic reassignment along the B4509 as other traffic takes alternative routes to avoid major congestion at the motorway junction.

The route provided by Tortworth Road largely consists narrow country lanes and would be unsuitable to accommodate significant volumes of traffic. However, capacity constraints along the A38 route toward the M5 J14 are forecast to encourage traffic to use Tortworth Road as an alternative.

The following key “problem locations” were identified based on a review of model outputs and following liaison with GCC:

- ID25 – M5 J14 (eastern);
- ID26 – M5 J14 (western);
- ID27 – A38 / B4509;
- ID28 – B4509 / Tortworth Road (south); and
- ID29 – B4509 / Tortworth Road (north).

These locations are subject to further discussion below.

7.7.2 ID25 & ID26 – M5 Junction 14

This motorway junction is a low-capacity ‘diamond’-style interchange, consisting of a single overbridge, with staggered crossroad junctions with the B4509 at the top of each slip-road. Each crossroad junction operates under part-time traffic signal control.

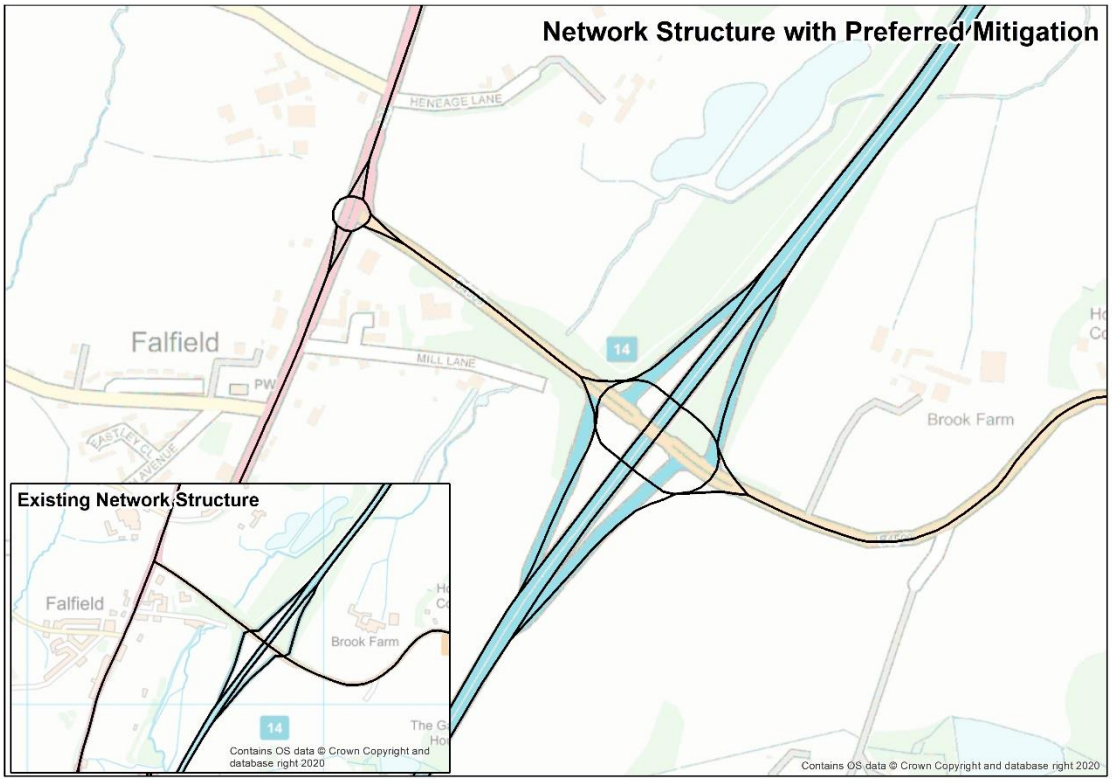
It is understood that the junction currently experiences significant congestion issues in the peak periods – the existing overbridge can only accommodate a maximum of three lanes, and right-turning traffic is prone to impeding other movements along the B4509.

By 2040, even without the inclusion of Local Plan demand, the junction is forecast to become significantly over-capacity, particularly in the AM peak when the eastbound overbridge link has a V/C of over 110%. The addition of Local Plan traffic further exacerbates the issue by increasing delays at both the eastern and western sides of the junction.

Based on an initial review of the junction layout, and following liaison with GCC and Highways England, it was apparent that only a substantial junction upgrade would be capable of providing sufficient capacity for future year demand, either with or without the Stroud Local Plan allocation.

As such, a significant improvement scheme, consisting of a new all-movements grade-separate junction and incorporating two overbridges, has been assessed. Following a review of initial assignments, traffic signal control was also included on each approach at the junction. Figure 7.14 identifies the assumed indicative arrangement for the enhanced mitigation scheme at this location.

Figure 7.14: Indicative Mitigation Scheme at M5 J14



The forecast modelling results from the mitigated scenarios indicate that a new interchange at this location can accommodate future year demand including the Local Plan, with all approaches operating below 90% in both peak hours.

Furthermore, it is noted that traffic growth associated with South Gloucestershire, both from incremental growth through expected planning applications and from the future South Gloucestershire Local Plan, is also expected to be particularly relevant at this location. A M5 Junction 14 working group containing prospective developers, South Gloucestershire Council, Gloucestershire County Council, Stroud District Council, and Highways England has been established to examine highway mitigation options and how these could be jointly funded.

7.7.3 ID27 – A38 / B4509

In the Local Plan unmitigated scenario, this existing signal-controlled junction is forecast to exceed its capacity by a large degree with the B4509 approach reaching V/Cs of around 110% in both peak hours. This approach is forecast to experience delays of five or six minutes in the unmitigated scenario. Whilst there are some capacity issues forecast in the Baseline scenario, these are significantly worsened by the inclusion of Local Plan traffic.

An indicative highway improvement scheme at this location involved widening of the A38 approaches and the provision of a longer flare on the B4509 approach. However, initial SATURN assignments with this scheme included indicated that more significant enhancements would be required to accommodate the forecast future year traffic volumes associated with the

Local Plan. These assignments also illustrated that the link capacity on the B4509 between the A38 and the M5 could become a constraint in the future.

The proposed mitigation at this location was therefore modified to involve the creation of a new large roundabout, and also an upgrade of the B4509 to two-lanes in each direction between the A38 and the M5. The model forecasts demonstrate that this package of mitigation is capable of accommodating future year demand, with the maximum link V/C remaining below 90% in both peak hours.

7.7.4 ID28 & ID29 – B4509 / Tortworth Road (ID28 south & ID29 north)

In the Local Plan unmitigated scenario, the minor arms (Tortworth Road) at these two junctions are forecast to begin reaching, or exceeding, their absolute capacity. This is partly associated with the large volume of traffic switching to use Tortworth Road as it attempts to avoid significant delays along the A38/B4509 route to the M5 J14.

It became apparent that improving these junctions would only serve to further encourage traffic to use this inappropriate route, which predominantly consists of a narrow country lane. As such, it was agreed with GCC to not allow for mitigation at these locations but to monitor their performance as mitigation along the preferable A38/B4509 route is implemented.

With relevant mitigation, including capacity improvements at M5 J14 and the A38/B4509 junction, the minor arms at these two junctions are forecast to operate within capacity, with link V/Cs of less than 85%. This improvement in performance results from a reduction in traffic using the inappropriate Tortworth Road route.

7.8 Other Impacts

At this stage, modelling has focused on developing a high-level mitigation strategy that is forecast to maintain a satisfactory level of operational performance on the highway network. It is acknowledged that further assessment would be required to understand the wider impacts of the Local Plan proposals against policies set out within the National Planning Policy Framework. For example, consideration would need to be given to environmental impacts, such as greenhouse gas emissions, noise and air quality.

8 Summary and Conclusions

8.1 Overview

This report has detailed the development of traffic forecasting undertaken in relation to the emerging Stroud Local Plan, which identifies the development requirements for Stroud District for the next 20 years and sets out the Council's preferred development strategy for this period.

The overall purpose of the traffic modelling work presented in this report is to assess the cumulative impact of the emerging Local Plan site allocations on both the local and strategic road networks, and to articulate a long-term transport investment strategy within the county and adjoining areas.

In this respect, traffic forecasts have been produced for a future year of 2040, which aligns with the end of the plan period for the proposed Local Plan. The forecasts have been developed through liaison and agreement within the Stroud Local Plan Review Transport Group (SLPRTG).

A 2040 Baseline scenario has been developed to understand the performance of the highway network in and around Stroud District in the absence of the Local Plan proposals. This Baseline scenario allows for the delivery of existing proposed transport schemes and developments, as well as general growth in traffic levels.

Traffic impacts of the Local Plan proposals have been assessed through the development of a forecast scenario that includes travel demand associated with the proposed site allocations included in the November 2019 Draft Local Plan. Levels of traffic demand associated with the Local Plan sites have been forecast using trip rates and trip distribution assumptions developed and agreed collaboratively by the SLPRTG.

The forecast impacts on the highway network have been reviewed and have informed the development of a package of mitigation measures, including both sustainable interventions and highway capacity improvements. These mitigation measures have been assessed using the forecast traffic models to understand the potential scale of interventions required to enable the local and strategic highway networks to accommodate the Local Plan proposals without significant detrimental impacts.

8.2 Conclusions

The traffic forecasts indicate that the various locations across the highway network will begin to experience significant capacity issues and delays in the 2040 Baseline (i.e. without Local Plan) scenario – most notable locations include M5 J12, M5 J14, St Barnabas and Cross Keys roundabouts in Gloucester, the A419 corridor in Stonehouse and junctions in Stroud town centre. The inclusion of travel demand associated with the Local Plan allocation sites is forecast to further exacerbate problems at these locations and more generally across the local and strategic highway networks.

To mitigate the impact of the Local Plan sites, a package of sustainable transport interventions and indicative highway capacity improvements at key 'pinch-points' has been developed and assessed using traffic model forecasts. Although some residual capacity issues remain within the network, overall, these forecasts demonstrate that the impacts of the proposed Local Plan sites can be largely mitigated, and that the highway network can operate at similar levels of performance to the 2040 Baseline situation. Notwithstanding the above, individual

developments will still need to be assessed on their own merits as they progress through the planning system.

It has, however, been identified that certain key locations in the network would necessitate improvements requiring significant expense. Major infrastructure identified to both deliver background growth and facilitate Local Plan proposals includes the provision of expanded motorway interchanges at M5 J12 and J14. Further consideration would need to be given as to potential funding sources for such schemes.

8.3 Preferred Mitigation

As noted above, the traffic modelling and STS work undertaken to date has culminated in the identification of a preferred set of mitigation measures throughout the study area.

At this stage, the preferred package of mitigation, consisting of both highway capacity improvements and sustainable transport measures, is intended to represent a strategic approach to mitigating the impact of the proposed Local Plan development sites. The strategy identifies the main locations and broad scale of likely interventions required and provides a starting point for the development of detailed schemes related to particular developments as they come forward through the planning process.

It is acknowledged that the proposed package is not necessarily an exhaustive list of every location forecast to require mitigation as a result of the Local Plan sites. Conversely, some of the locations for which highway improvements are proposed are forecast to experience congestion even without the proposed Local Plan allocations, though the inclusion of additional traffic demand will clearly further exacerbate operational problems. Examples of this include the M5 J12 and J14 and St Barnabas Roundabout, where the cumulative impact of Local Plan traffic on top of existing demand would necessitate significantly greater interventions than might otherwise be required.

A series of indicative highway improvement schemes have been identified for various key locations, are grouped into broad estimated cost bands and summarised below. Given the early stage of option development at each location, and in the absence of detailed designs, survey information (e.g. surveys of statutory undertakers' equipment, topographical surveys, ground condition surveys etc) and a full understanding of other potential constraints, the estimated costs are subject to a large degree of uncertainty.

Notwithstanding the above, and based on the modelling and assessments undertaken to date, the following mitigation measures are considered necessary to suitably alleviate the traffic impacts of the proposed Local Plan.

Preferred Highway Mitigation Strategy

Very High cost schemes (>£10m)

- **M5 Junction 12** – replacement of existing single overbridge dumbbell arrangement with a new grade-separated signalised roundabout;
- **M5 Junction 14** – replacement of existing single overbridge diamond interchange with new grade-separated signalised roundabout.

High cost schemes (£2.5m-£10m)

- **A38 Cross Keys Roundabout** – widening and signalisation of both A38 approach arms;
- **St Barnabas Roundabout** – approach widening on three arms and associated circulatory capacity improvements;
- **A38 / A430 / B4008 Cole Avenue** – widening of southbound A430 to three lanes, with nearside flare extension and widening on B4008 and westbound A38 approaches;
- **A419 / Oldends Roundabout** – dualling of A419 between Oldends and Chipman's Platt roundabouts;
- **A38 / B4509** – replacement of existing signal-controlled junction with large at-grade roundabout.

Medium cost schemes (£250k-£2.5m)

- **A38 / Epney Road** – widening of both A38 approaches to two ahead lanes, plus right-turn lanes;
- **A38 / B4071 Perry Way** – conversion of existing give-way junction to signal control, with associated widening on minor arm approach;
- **A38 at Claypits** – widening of both A38 approaches to two ahead lanes at existing signalised junction;
- **M5 Junction 13** – inclusion of traffic signals on all approaches to existing roundabout junction;
- **A46 / Dudbridge Hill** – Dudbridge Hill eastbound approach widening to three lanes on entry to junction;
- **A38 / B4066** – conversion to signal control with flare extension on B4066 approach;
- **A38 / B4066 Berkeley Road** – addition of traffic signals, with flaring provided on A38 southbound approach;
- **A38 / Alkington Lane** – signalisation of existing three-arm give-way junction, with widening on Alkington Lane approach;
- **B4066 / Alkington Lane** – introduction of traffic signal control.

Low and very low cost schemes

- **B4008 / Stonehouse** – simple signalisation scheme, with limited/no widening or kerb realignment;
- **B4008 / A38 northbound off-slip** – signal re-optimisation;
- **A419 Boakes Drive roundabout** – minor widening on A419 approach arms;
- **B4066 / Station Road roundabout** – limited widening on B4066 eastbound approach to existing roundabout;
- **A38 / A4135** – removal of existing hatch marking and potentially minor carriageway widening on northbound A38 approach.