Chapter 4 – Traffic Modelling

A38 Bromsgrove Route Enhancement Programme

March 2023

Table of Contents

List of Appendices

Appendix TM.1 – Appraisal Specification Report (ASR).

Appendix TM.2 - Traffic Data Collection Report. *This remains as per the version submitted at SOC stage.*

Appendix TM.3 – Local Model Validation Report (LMVR). *This remains as per the version submitted at OBC stage.*

Appendix TM.4 – Demand Model Report (DMR). *This remains as per the version submitted at OBC stage.*

Appendix TM.5 – Traffic Forecasting Report (TFR).

Appendix TM.6 - DfT Comments on OBC and Responses

List of figures

List of tables

4. Traffic Modelling

4.1 Background

The A38 in Bromsgrove is an important corridor on the Major Road Network (MRN). It acts as a key strategic link, providing access to the Strategic Road Network (SRN), as well as offering an important local function as an eastern bypass to Bromsgrove town centre and providing access to housing, services and employment frontages.

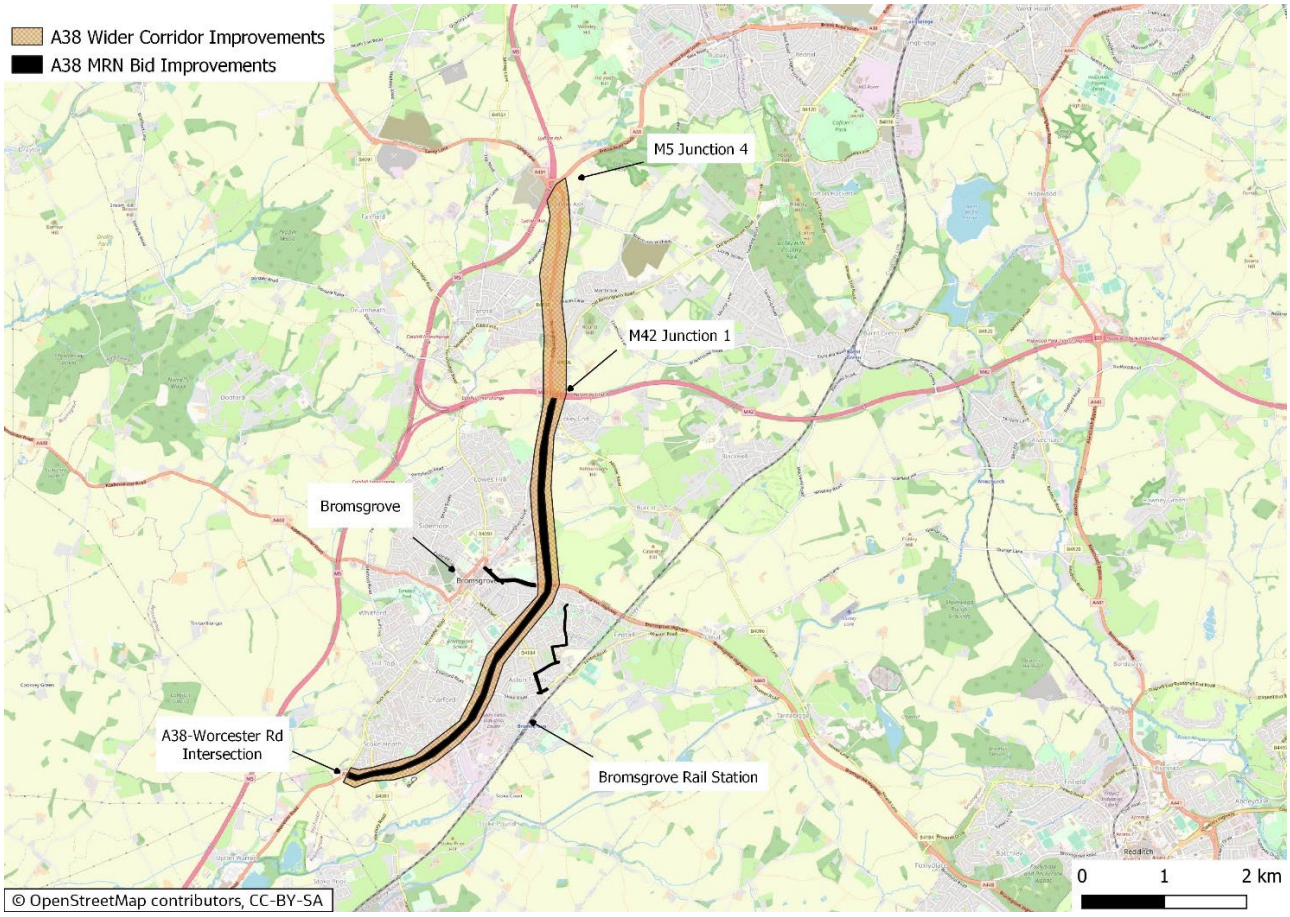
Worcestershire County Council (WCC) is delivering a major upgrade of the A38 corridor between M5 Junction 4 to the north and the junction of A38 with B4094 Worcester Road to the south, which is approximately 7.5 miles (12 km) long. This Full Business Case (FBC) seeks funding to deliver Phase 3 of the major upgrade of the A38 corridor between M42 Junction 1 to the north and the junction of A38 with B4094 Worcester Road to the south, which is approximately 3.8 miles (6.1 km) long. This corridor forms part of the strategic north south spine through Worcestershire, connecting Worcester, Droitwich, Bromsgrove to Birmingham to the North and Gloucester and Bristol to the south as an alternative to the M5 route. The study area is shown in Figure 4.1.

The A38 corridor is a multi-functional route serving a range of users which contributes to the problems and issues. The key characteristics are:

- The route performs a range of different functions, including as a link to the SRN, a corridor to bypass Bromsgrove town centre, a distributor road for journeys that have an origin and/or destination in Bromsgrove and a local access route for residents and businesses that have direct frontages on to the corridor.
- The corridor comprises sections with differing speed limits, levels of frontage and access points in addition to varying levels of pedestrian and cyclist provision. In addition, the driving experience along the route varies due to the differing land uses along sections of the A38 from residential, open field to employment and retail.
- The two features of the A38 corridor outlined above, combined with high levels of car dependency across Bromsgrove, result in substantial congestion.

The A38 BREP comprises a package of schemes delivering targeted improvements to junctions and significant enhancement of facilities for active modes.

Figure 4.1: Scheme location



This situation is projected to worsen in the future as new housing and employment planned for the local area are delivered. The planned growth in housing will increase the demand for travel. The following points summarise the planned developments in the area:

- The Bromsgrove District Plan (adopted in 2017) includes major residential development sites around the edge of Bromsgrove, with Perryfields Road and Whitford Road being particularly relevant to the A38. Smaller residential allocations are also found in surrounding areas. In total the Local Plan identifies a need for 7,000 dwellings and 28 Hectares of employment land in the period 2011-2030. However, the adopted Local Plan only allocated land for 4,700 dwellings to 2023, noting that allocating land for the remaining 2,300 homes would be subject to a Green Belt review as part of a Local Plan Review. Subject to the ongoing Local Plan review, the scheme may further support delivery of additional homes and employment land.
- The Local Plan Review will also identify development allocations for growth beyond 2030 and in its Issues and Options consultation put forward various scenarios. The consultation documents published in September 2019 proposed that the new Plan will have a likely start date of 2023 and an end date of 2040. Over this period the Plan will be required to provide for at least 6,443 dwellings and up to 90 Hectares of employment land.
- Within close proximity of the A38 corridor area there are significant cross-boundary allocations within the adopted Local Plan for Redditch. This includes an additional 3,400 dwellings (and 5.5 hectares of employment land) on the border with Redditch but located within Bromsgrove District, to meet Redditch's housing need, as identified in their own Local Plan. The allocation at Foxlydiate is particularly relevant to the A38.
- In addition, there are further allocations within the Redditch Local Plan (and sited within Redditch itself). Around 3,000 dwellings and 27.5 hectares of employment land are to be accommodated within Redditch Borough.

Table 3.34 of the Strategic Dimension shows key development sites in the vicinity of the A38 identified within the adopted Local Plans. The quantum of proposed development (housing and employment) within the adopted Local Plans requires enhancements to transport infrastructure, including the A38. Whilst no individual development site currently has planning conditions that restrict development in advance of delivery of the A38 schemes, there are planning linkages between the A38 BREP and the delivery of allocations identified in adopted Local Plans, and this is reflected in the requirement for S106 contributions to the BREP scheme. The A38 in its current form is a key constraint to additional future development allocations through the Local Plan review process. Therefore, in summary, the A38 BREP supports the delivery of 5310 homes and 13.45 Hectares of employment land based on the current plan. Subject to the ongoing Local Plan review, the scheme may further support delivery of additional homes.

To effectively support the future development of Bromsgrove and to deliver economic growth, significant improvements are required to the corridor itself, supported by targeted improvements for other modes.

The scheme for which funding is sought through this MRN bid is an important part of the overall approach to transport in Bromsgrove. It will support ongoing work that is aiming to enhance both the major and local road network, as well as encouraging walking, cycling and the use of public transport.

4.2 Introduction

The wider A38 BREP corridor enhancement is being delivered in four phases, these phases are presented in Figure *4.2* and described below:

- Phase 1 (funded by Worcestershire Local Enterprise Partnership (WLEP), Greater Birmingham and Solihull Local Enterprise Partnership (GBSLEP) and National Highways' Growth and Housing Fund (GHF)), provided for capacity upgrades at M5 Junction 4, M42 Junction 1 (completed in 2020/21) and the Barley Mow Lane junction with the A38 (completed in 2019). The works are included in the Do Minimum scenario for the A38 BREP Phase 3, as these have now been completed on site.
- Phase 2 comprised of the early delivery elements (also referred to as Schemes 2a, 2b and 4) of the BREP package presented at both the Strategic Outline Case (SOC) and Outline Business Case (OBC) stages. The early delivery schemes have been delivered early using WLEP local contribution funding to take advantage of the local funding availability. These works are an important part of the overall BREP scheme, contributing to the improvement of active mode facilities on the corridor.

    - Scheme 2a: An active travel corridor on the A38 between Charford Road and Harvington Road that includes a 3m wide cycleway and 2m wide segregated pedestrian / cycle facility provision of connection to Harvington Road.

    - Scheme 2b: An active travel corridor providing connection between the A38 and Scheme 2A to South Bromsgrove High School, it includes the provision of a 3m wide shared cycle path and footpath.

    - Scheme 4 is a signal toucan crossing of A448 to east of Fordhouse Road, to provide connectivity between Blackwood Road (Heart of Worcestershire College) and Regents Park Road and Fordhouse Road, and tie into Scheme E, Scheme 3 and Scheme 9.

    Phase 2 schemes have been developed as part of the overall strategic active mode upgrade as part of the A38 BREP package. The FBC will continue adopting the same approach presented in the OBC submission in relation to these schemes: they form part of Phase 3 Do Minimum scenario, and their economic and financial impacts are reported as a sensitivity test in the Economic Dimension. It should be noted that the Phase 2 package offered a High Value for Money to taxpayers.

- Phase 3 includes three active mode, two local public transport and six hybrid highway capacity and active travel improvement schemes which were included in the OBC submission:

  - Three active mode improvement schemes, namely Schemes 3, 6 and 9.

  - Two local public transport improvement schemes which have not changed compared to the OBC stage. Local public transport improvements, notated as Scheme 7 (provision of upgrades to 9 bus stops including provision of physical infrastructure/shelters and wind turbines/solar panels powered Real Time Information (RTI) screens; and Scheme 8 which includes the provision of select vehicle detection at New Road and Charford Road junctions to support buses in crossing the A38 corridor, on the primary routes between the Town Centre and (Scheme 8 will be delivered at the same time as Schemes C and D).

  - Six hybrid schemes containing highways capacity and active travel improvements which were included in the OBC submission. These are Schemes: C to F and parts of Schemes A and B (only limited elements of the latter two schemes have been moved to Phase 4).

- Phase 4 includes schemes that were originally included in the OBC stage but have now been moved to Phase 4. This was due to increased inflation experienced in 2022, resulting in increased scheme costs. Phase 4 includes the following schemes:

  - Three highways improvement schemes: Scheme G and the complementary remaining parts of Schemes A and B that have been removed from OBC stage.

  - Two active mode improvement schemes, namely Schemes 1 and 5.

  Phase 4 schemes (see Figure 4.2) have been removed from all aspects of this bid, and will be progressed once alternative funding sources are secured hence will be subject to a separate business case.

Figure 4.2 presents the phasing of the A38 corridor improvements, while Figure 4.3 provides an overview of the highway, active mode and public transport elements of the A38 BREP scheme, and Figure 4.3 presents the locations of the new Shelters and RTI interventions included in Scheme 7.

Figure 4.2: A38 corridor improvement phasing

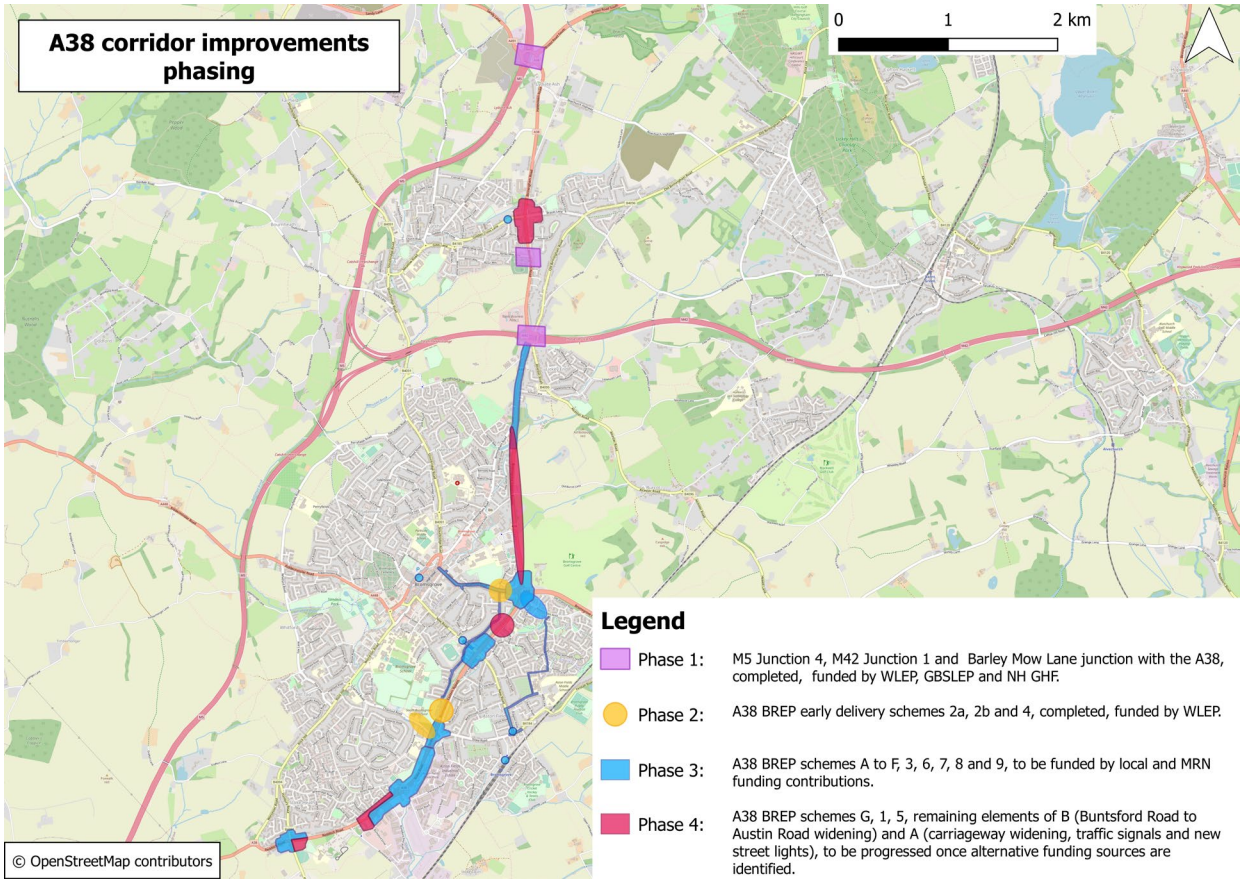
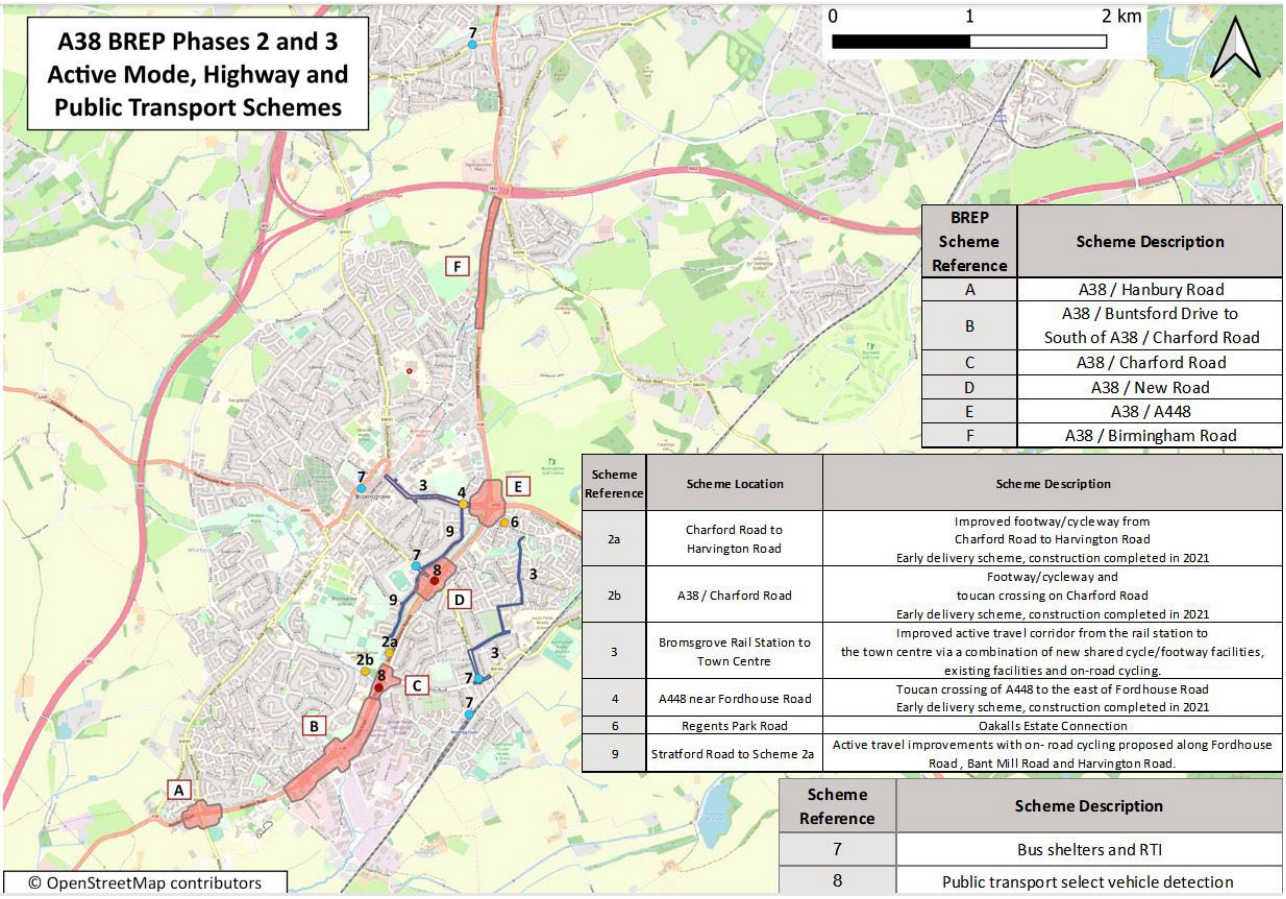


Figure 4.3: Highway, active mode and public transport schemes included in the FBC stage (Phases 2 and 3)

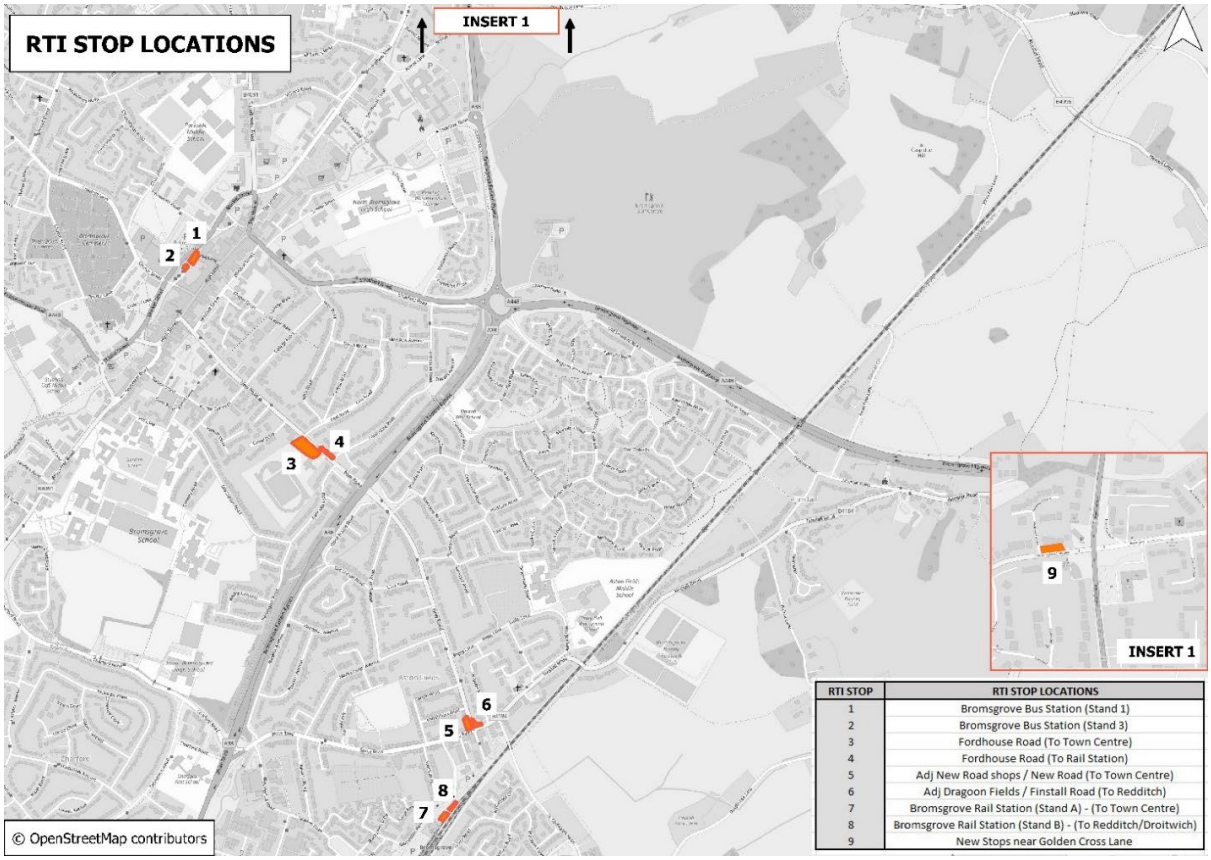


BREP Scheme Reference	Scheme Description
A	A38 / Hanbury Road
B	A38 / Buntsford Drive to South of A38 / Charford Road
C	A38 / Charford Road
D	A38 / New Road
E	A38 / A448
F	A38 / Birmingham Road

Scheme Reference	Scheme Location	Scheme Description
2a	Charford Road to Harvington Road	Improved footway/cycleway from Charford Road to Harvington Road Early delivery scheme, construction completed in 2021
2b	A38 / Charford Road	Footway/cycleway and toucan crossing on Charford Road Early delivery scheme, construction completed in 2021
3	Bromsgrove Rail Station to Town Centre	Improved active travel corridor from the rail station to the town centre via a combination of new shared cycle/footway facilities, existing facilities and on-road cycling.
4	A448 near Fordhouse Road	Toucan crossing of A448 to the east of Fordhouse Road Early delivery scheme, construction completed in 2021
6	Regents Park Road	Oakalls Estate Connection
9	Stratford Road to Scheme 2a	Active travel improvements with on- road cycling proposed along Fordhouse Road , Bant Mill Road and Harvington Road.

Scheme Reference	Scheme Description
7	Bus shelters and RTI
8	Public transport select vehicle detection

Figure 4.4: Scheme 7/ Shelters and RTI stop locations



RTI STOP	RTI STOP LOCATIONS
1	Bromsgrove Bus Station (Stand 1)
2	Bromsgrove Bus Station (Stand 3)
3	Fordhouse Road (To Town Centre)
4	Fordhouse Road (To Rail Station)
5	Adj New Road shops / New Road (To Town Centre)
6	Adj Dragoon Fields / Finstall Road (To Redditch)
7	Bromsgrove Rail Station (Stand A) - (To Town Centre)
8	Bromsgrove Rail Station (Stand B) - (To Redditch/Droitwich)
9	New Stops near Golden Cross Lane

4.3 Traffic Modelling

The A38 BREP FBC stage model consists of:

- A Highway Assignment Model (HAM).
- A Variable Demand Model (VDM).

Traffic modelling was undertaken using VISUM version 21.0, which is a strategic macroscopic assignment modelling software. These models were purpose built for the assessment of this scheme and based upon traffic data collected in June 2017.

VISUM allows junctions to be modelled in detail including signals, priorities and roundabouts; enabling an estimation of delays experienced along the A38 and other junctions in the Area of Detailed Modelling (AoDM). Additionally, this package allows for wide area re-routing impacts to be considered as part of the economic assessment.

The SOC stage used a Variable Demand VISUM model based on an Origin – Destination (OD) method. However, following feedback from DfT, the SOC stage model has been converted to a Production – Attraction (PA) method for use at OBC and FBC stages. The methodology for the conversion of the OD matrices to PA matrices was documented in the Appraisal Specification Report (ASR) which was shared with DfT in summer 2020 and then discussed at subsequent meetings as part of the OBC model development. The ASR for the FBC is provided in Appendix TM.1 detailing the approach to the modelling process.

For each modelled year, three time periods have been considered. These are:

- Morning peak hour (AM): 08:00 – 09:00.
- Interpeak period (IP): Average hour from 09:00 – 15:00.
- Afternoon peak hour (PM):17:00 – 18:00.

This Chapter provides an overview of the traffic model used for both the OBC and FBC stages appraisal.

4.4 Base Scenario

The base year for the transport model is 2017 (defined by the data collection). Traffic data used to calibrate and validate the model was from 2017, and included the following data:

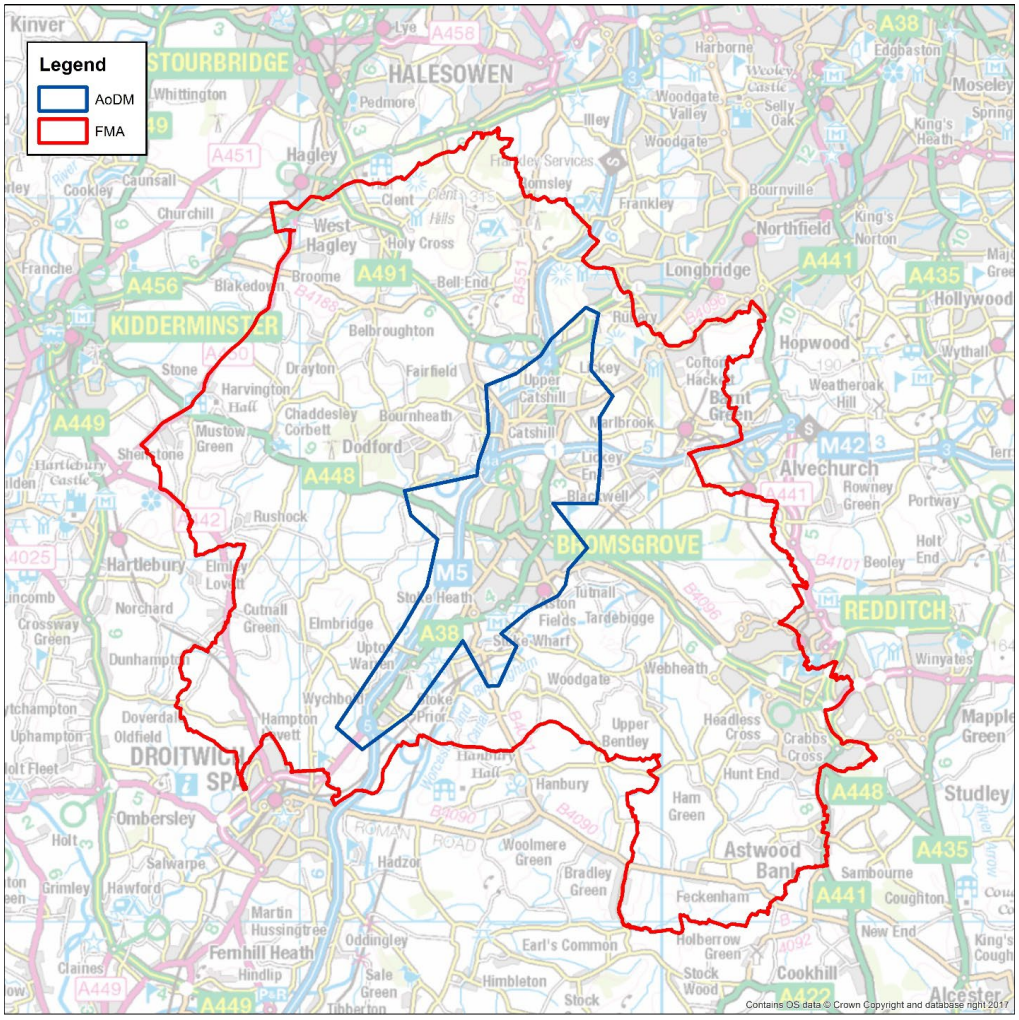
- Junction Turning Counts (JTC)
- Automatic Traffic Counts (ATC).
- Road Side Interviews (RSI).
- Journey Time surveys.
- Queue length surveys.
- Car park surveys.

Full details of data collection can be found in the Traffic Data Collection Report (TDCR, Appendix TM.2). This remains as per the version submitted at SOC and OBC stage. Comments received from the DfT on the TDCR and responses provided are included in Appendix TM.6.

The study area of the model was defined for the purpose of testing the impacts of improvements schemes on the A38 in Bromsgrove. The AoDM includes the detailed network, such as the smaller residential roads within Bromsgrove. The AoDM covers the urban area of Bromsgrove, Catshill and the north Marlbrook neighbourhood area, and includes the key junctions linking the A38 to the M5. The wider Fully Modelled Area (FMA) includes key routing options from Birmingham,

Redditch, Droitwich and Kidderminster. These boundaries are illustrated in Figure 4.5. There has been no change to the extent of the modelled area since the SOC stage.

Figure 4.5: Extent of Fully Modelled Area (FMA)



4.5 Highway Assignment Model

Model demand was predominantly based upon the National Trip End Model (NTEM) trip ends and smoothened with observed RSI data. The demand was developed in a PA form representing a 12-hr period consistent with the temporal coverage of the RSI and car park surveys.

The demand matrices were segmented into Home-Based Work (HBW), Home-Based Employers Business (HBEB), Home-Based Others (HBO), Non-Home-based Employers Business (NHBEB) and Non-Home based Other (NHBO) purpose trips. Matrices for LGV and HGV from the SOC model were retained for the model peak hours as they are fixed demand segments not subjected to VDM.

The NTEM 12-hour trip end data at Mid-Level Super Output Area (MSOA) and aggregate spatial boundaries was converted to the A38 model zones using zonal population and employment data obtained from Office of National Statistics (ONS), Business Register Employment Survey (BRES) data and Postcode point data.

The distance skims from the SOC model were used to develop a gravity model for each demand segment. The peak hour cost skims are used to inform the HBW and HBEB segments, whilst the

IP cost skims are used to inform the HBO, NHBEB and NHBO demand segments. This process resulted in deriving 12-hour synthetic PA matrices for each demand segment.

The validity of the synthetic prior matrices was verified by comparing the goodness of fit of the modelled TLD against the target TLD. The 12-hour synthetic matrices for Home-based and Non-home-based purposes were allocated to model time period and converted to OD matrices for assignment based on time of day factors derived from RSI data and TAG car occupancy factors.

The out-turn matrices (Prior matrices) were assigned to the HAM networks and model flows compared with observed flows along cordons and screenlines. Further refinements were undertaken of the prior matrices including trip rate adjustment and smoothening with observed data to arrive at the final set of prior matrices. Generalised cost parameters were taken from TAG databook 'v1.15 May 2021 Forthcoming change'.

Matrix estimation was undertaken on the prior matrix so that assigned demand matches observed link counts. Matrix estimation was undertaken for three model hours (AM, IP and PM). The base scenario was validated against the Journey Time data along nine routes.

The model results achieved various TAG criteria for changes to matrices brought about by matrix estimation, flow calibration and validation along the A38 and its approaches, as well as across the full model area; and journey time validation. It can be concluded that the model robustly reflects observed flows and delays along key routes in the modelled area.

Across all model time periods, 13 out of 14 screenlines/cordons passed the TAG criteria. A summary of the flow calibration and validation is given in Table 4.1 that shows the model passes the flow criteria across all time periods.

Table 4.1: Summary of model performance – link flow calibration

Time period /Vehicle Type Description	Direction	No of sites	Flow Criteria	GEH<5	Overall	% Overall Pass
AM/Light Vehicles Non-Screenline	All	119	101	102	107	90%
AM/Light Vehicles All Calibration	All	139	120	121	127	91%
AM/Total Vehicles Non-Screenline	All	119	101	102	107	90%
AM/Total Vehicles All Calibration	All	139	120	121	127	91%
IP/Light Vehicles Non-Screenline	All	111	104	100	106	95%
IP/Light Vehicles All Calibration	All	131	122	118	125	95%
IP/Total Vehicles Non-Screenline	All	111	102	100	106	95%
IP/Total Vehicles All Calibration	All	131	119	118	125	95%
PM/Light Vehicles Non-Screenline	All	119	104	98	105	88%
PM/Light Vehicles All Calibration	All	139	122	114	124	89%
PM/Total Vehicles Non-Screenline	All	119	102	101	105	88%
PM/Total Vehicles All Calibration	All	139	119	118	123	88%

A summary of the flow calibration on A38 mainline and approaches to junctions on A38 is given in Table 4.2 shows the model passes the flow criteria across all time periods.

Table 4.2: Calibration summary of count data on A38 and approaches to junctions on A38

Time period	Direction	No of sites	Flow Criteria	GEH<5	Overall Pass	% Overall Pass
AM	All	62	57	54	58	94%
IP	All	62	58	58	60	97%
PM	All	62	55	55	56	90%

Similarly, the link flow validation across all time periods pass the TAG criteria as shown in Table 4.3.

Table 4.3: Summary of model performance – link flow validation

Time period	Vehicle Type	Direction	No of sites	Flow Criteria	GEH<5	Overall Pass	% Overall Pass
AM	Light Vehicles	All	33	28	27	29	88%
AM	Total Vehicles	All	33	28	26	28	85%
IP	Light Vehicles	All	33	32	30	32	97%
IP	Total Vehicles	All	33	32	30	32	97%
PM	Light Vehicles	All	33	29	24	30	91%
PM	Total Vehicles	All	33	30	26	31	94%

Of the 18 journey time routes by direction (9 routes), 15 routes (83%) pass the TAG criteria across all three model periods.

Full details of the highway assignment model build process can be found in the Local Model Validation Report (LMVR, see Appendix TM.3). This remains as per the version submitted at OBC stage. Comments received from the DfT on the LMVR and responses provided are included in Appendix TM.6.

4.6 Variable Demand Model

The VDM was built using Visum 21, consistent with the version used for the HAM. The VDM developed was for a 12-hour period with demand in a PA format. The person trip demand was segmented into HBW, HBEB, HBO, NHBEB and NHBO purpose trips, consistent with the segments used in the HAM. The VDM was developed only for car-available trips. No income segmentation was used within the VDM. LGV and HGV were excluded from demand response changes. In forecast years, growth for goods vehicles (LGV, HGV) were based on DfT's Road Traffic Forecasts (RTF, Sep 2018). No public transport model was validated. However, to better reflect the mode choice response within the demand model, a representation of the detailed PT supply network was incorporated within the HAM to produce the required PT skims for each demand alternatives.

The A38 BREP VDM incorporates Model choice, followed by Destination choice. It does not include time of day choice but incorporates a Trip frequency component. The model adopts an incremental approach to absolute estimates.

The parameters used in the VDM were defined from values in TAG databook 1.15 May 2021 Forthcoming release. Starting values for the VDM parameters lambda (λ) and scaling factors (θ) for each demand response were taken as the median value from Table 5.1 and Table 5.2 of TAG unit M2.1, then adjusted during model calibration. Cost damping was required as part of the VDM calibration process.

Realism tests were undertaken to test model response to changes in travel costs for the following elasticity tests:

- Car fuel cost increase by 10%.
- Car journey time increase by 10%.

The results of the realism tests on the model elasticities are shown in Table 4.4 and Table 4.5. They show that the model elasticities are in line with the TAG specified values for both the fuel cost changes and journey time changes.

Table 4.4: Fuel cost elasticities- Fuel cost - 10% increase – 20km Cost Damping - Matrix

Elasticity Values	AM	IP	PM	Annual
Matrix Based elasticities				
Commute	-0.31	-0.20	-0.29	**-0.28**
Employer Business	-0.13	-0.10	-0.09	**-0.10**
Other	-0.40	-0.38	-0.36	**-0.38**
All Purpose	-0.29	-0.28	-0.27	**-0.28**
Network Based elasticities				
Commute	-0.34	-0.23	-0.33	**-0.32**
Employer Business	-0.09	-0.08	-0.09	**-0.08**
Other	-0.34	-0.35	-0.34	**-0.34**
All Purpose	-0.30	-0.27	-0.30	**-0.29**

Table 4.5: Journey time elasticities - Journey time - 10% increase – 20km Cost Damping

Elasticity Values	AM	IP	PM	Annual
Commute	-0.29	-0.13	-0.40	**-0.30**
Employer Business	-0.06	-0.12	-0.02	**-0.08**
Other	-0.23	-0.36	-0.47	**-0.36**
All Purpose	-0.24	-0.30	-0.40	**-0.31**

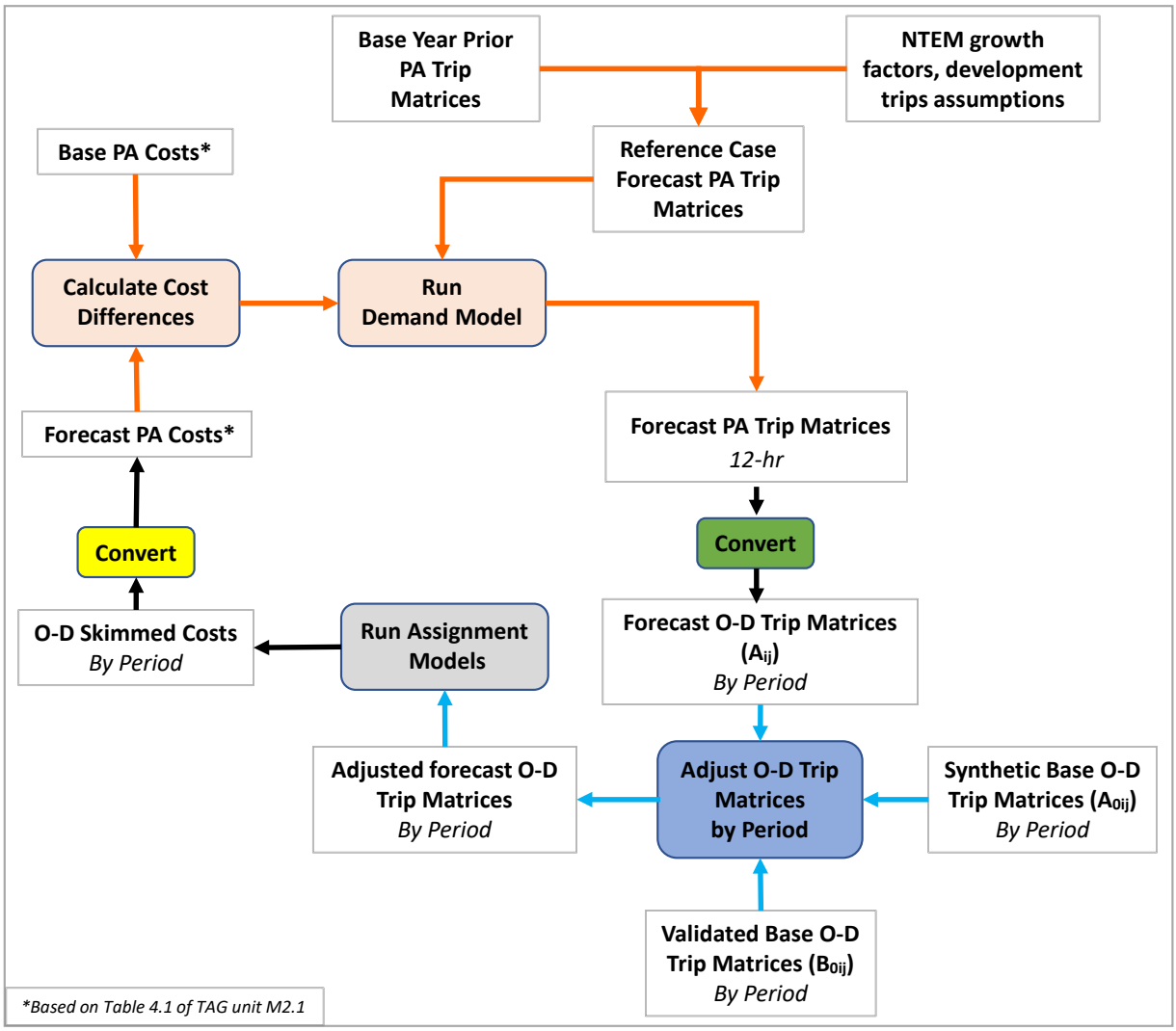
Additional information on the VDM can be found in the Demand Model Report (DMR, Appendix TM.4). This remains as per the version submitted at OBC stage. Comments received from the DfT on the DMR and responses provided are included in Appendix TM.6.

4.7 Traffic Forecasting

The A38 BREP Phase 3 scheme follows principles set out in the TAG Unit M4 Forecasting and Uncertainty (May 2019) as summarised in Figure 4.6 below. A new version of Unit M4 was released in December 2022. Aligning the forecasting process to the December 2022 version is considered disproportionate. Therefore, any reference to TAG unit M4 in this report, its appendices and other documents supporting the FBC relate to the version released in May 2019.

The forecast models developed for the OBC were updated to reflect the change in the proposed A38 BREP Phase 3 scheme taken forward to the FBC as described in section 4.2. The approach to forecasting and assumptions made for the rest in the FBC are consistent with the method adopted for the OBC.

Figure 4.6: Basic approach to forecasting using a transport model (Source: TAG)



The modelling framework has been developed to represent a 2017 Base Year to which the model has been calibrated and validated. Forecasts for two future years have been produced:

- Opening year – 2025.
- Design year - 2040.

These years have been chosen to ensure consistency with the scheme opening and design years as well as providing for a phased assessment of the development quantum. The developments are programmed to be completed by 2040.

The forecast scenarios which have been modelled are the Without scheme (WoS) and With scheme (WS) scenarios for 2025 and 2040. The Without scheme scenario consists of the base network with committed infrastructure schemes and demand growth from base to future year. The demand growth is based on proposed development allocations in the local plan and their uncertainty classification with the overall growth constrained to TEMPro v7.2 at a suitable spatial level. Since then, a new version of TEMPro (version 8) has been released by the DfT. However, for this FBC submission, it was agreed with the DfT to retain the use of TEMPro 7.2 for forecasting purposes. The With scheme network includes all elements of the Without scheme network and the proposed A38 BREP Phase 3 schemes being appraised. The input demand to the Without scheme and With scheme VDM models are the same.

In addition, the DfT have requested a forecast as far into the future as possible. Therefore, a third future year model has been developed for 2050, the last year available (at the time of undertaking

forecasts) within DfT's Road Traffic Forecasts for growth in LGVs and HGVs. A new version of National Road Traffic Projections has since been released with forecasts available until 2060. Adopting the 2022 National Road Traffic Projections is considered disproportionate to use for this submission due to progress in analytical work undertaken and in maintaining consistency with the use of TEMPro v7.2.

For the purposes of appraisal, only the opening and design year model outputs have been used in line with section 1.2.1 TAG unit M4 that states "*For most schemes, forecasts of economic benefits will be calculated for the scheme opening year and at least one other forecast year*".

Development and scheme assumptions have been identified for the forecast years of 2025 and 2040. In line with TAG guidance (unit M4 Forecasting and Uncertainty), the assumptions have been categorised to identify sites and schemes which are near certain, more than likely, reasonably foreseeable and hypothetical. Only those schemes and developments that are 'Near Certain' or 'More than likely' are considered for the core scenario. The planned HS2 stations in Birmingham central and Birmingham international have not been modelled as part of the Public Transport (PT) forecast supply network following discussions with WCC on the assumption that the impact the scheme would have on them will be negligible.

Based on the uncertainty log, the most unbiased and realistic set of assumptions that form the WoS and WS core scenario forecast include only those developments that have been completed since the model base year/are under construction/'near certain'/'more than likely'. The major committed developments proposed in Bromsgrove and Redditch are shown in Table 4.6. It should be noted that the uncertainty log for the FBC remains the same as the OBC stage.

Table 4.6: Major development sites in Bromsgrove and Redditch

Land Use Type	Expected Construction Period	Location (Figure 4.1 of TFR)	Quantum
Employment	2020 – 2036	(1) Perryfields Road, Bromsgrove	19,500 sqm
Employment	2022 – 2036	(2) Eastern Gateway (Phases 1-3), Redditch	189,000 sqm
Employment	2020 – 2021	(3) Nash Road, Old Forge Drive Redditch	30,745 sqm
Residential	2021 – 2036	(1) Perryfields Road, Bromsgrove	1,300 dwellings
Residential	2017 – 2021	(4) Birmingham Road (Norton Farm), Bromsgrove	318 dwellings
Residential	2020 – 2040	(5) Foxlydiate (Redditch expansion site in Bromsgrove District)	2,800 dwellings
Residential	2017 – 2028	(6) Brockhill East (A441 Birmingham Road, off Weights Lane, Redditch expansion site in Bromsgrove district)	828 dwellings
Residential	2017 – 2036	(7) Webheath Strategic Site	600 dwellings
Residential	2021 – 2036	(8) Whitford Road (BROM3)	490 dwellings

As part of defining the core scenario for forecast models, TAG unit M4 specifies that local sources of uncertainty that depend on the transport schemes should adopt the guidance on induced investments of which dependent developments is one type.

A meeting to discuss the approach to dependent development assessment was held with DfT in February 2019. At this meeting the potential approach to the assessment of the following three key site was discussed:

- Foxlydiate.
- Perryfields Road.

- Whitford Road.

For each site, the status in the planning system, at that time, was discussed. Upon consideration of this information, DfT confirmed (as minuted) that "There is dependency of the developments on the A38 scheme as it is driven by planning requirement and a dependency assessment is required to define the core scenario. The dependency assessment should inform the quantum of development that can be accommodated without the scheme (not dependent on the scheme). The transport user benefits assessment has to be based on the development quantum that is not dependent on the scheme.

On this basis a dependency assessment was undertaken in accordance with TAG unit A2.2. This work was undertaken after the submission of the SOC, in preparation for OBC stage. A draft technical note on Dependent Development tests was submitted to the DfT in November 2019. Subsequently DfT provided a number of comments and responses to these have been documented.

As the planning status of the three sites progressed, DfT were informed of their status in Spring 2021 when two of the sites (Foxydiate and Whitford Road site) had obtained planning consent while the Perryfield Road site had progressed to an appeal. The Perryfield site has since won their appeal and consent granted in summer 2021. As a result, these developments are not considered to be dependent on the A38 BREP Phase 3 schemes and therefore form part of the core scenario. There are no further developments that are considered dependent on the scheme.

Trip rates for the development sites was used to determine site specific vehicle trip rates and vehicle trips generated (all-purpose trips by direction) over a 12-hr period. Where development trips rates were not available, they have been determined using publicly available transport assessments or TRICS database. The final trip rates for all developments are reported in the forecasting report.

The development trips derived from the trip rates were disaggregated to home-based and non-home-based purposes based on either existing zone/surrounding zones/sectors as in the synthetic base model and car occupancy factors applied to derive the total car users as person-trips (driver and passengers). The development trips (in PA form) were thereafter added to the base year trip ends (by purpose) to derive the forecast trip ends for internal zones. TEMPro (v7.2) growth factors were applied to base year trip ends (PA) for external zones to derive their forecast trip ends. The forecast demand was constrained to TEMPro forecasts at the district level.

The LGV and HGV traffic growth forecasts were based on the DfT's Road Traffic Forecasts (RTF) Sep 2018 – Scenario 1.

The validated base year model networks were adjusted to create the forecast networks. The WoS forecast represents a scenario of network impacts in the absence of the scheme proposals. It corresponds to maintaining existing transport facilities and implementing the 'near certain' and 'more than likely' aspects of regional and local transport strategies details of which are provided in Table 4.7.

Table 4.7: Without scheme network improvements

ID	Network Improvement	Geographical Location	Uncertainty	Scheme details
1	Junction Improvements	Perryfields Road/A448 Kidderminster Road	Near Certain	Section 278 scheme comprising new roundabout, ghost island junction, and signal junction along Kidderminster Road, and closure of Perryfields Road at approach to A448 junction.
2	Junction Improvements	Perryfields Road/B4091 Stourbridge Road	Near Certain	Section 278 scheme comprising new signal junction on Stourbridge Road (north of existing Perryfields Road/Stourbridge Road junction).
3	New Spine Road	Perryfields development site	Near Certain	Development spine road linking A448 Kidderminster Road and B4091 Stourbridge Road.
4	Junction Improvements	Fox Lane (Whitford Road) & Rock Hill	Near Certain	Altered junctions at Whitford Road / Kidderminster Road and B4091 Rock Hill/Fox Lane/Albert Road (Greyhound PH).
5	Reduced Speed limit	Charford Road	Completed	A new reduced speed limit of 20mph on Charford Road.
6	Junction Improvements	A448 Kidderminster Road/ St John Street	More than likely	Currently 3 arm roundabout; a new scheme to create three arm signalised junction incorporating pedestrian movements, single lane on each approach. Phasing not defined assumed that Kidderminster Road and Hanover Street would run as main movement with opposed right turn movement, with St John Street being unopposed movements.
7	PT Improvements	West Midlands	Operational	New cross city train services between Bromsgrove and Birmingham New Street resulting in 3 trains per hour during weekdays.
8	Phase 1 Junction Improvements	A38 Bromsgrove	Completed	A38 Bromsgrove Major Scheme - Phase 1 schemes.
9	Phase 2 WLEP funded active mode schemes	A38 Bromsgrove	Completed	Phase 2 Early delivery schemes 2a, 2b and 4
10	Junction improvements	Foxlydiate development site	Near certain	S278 scheme comprising new signalised junction

The WS scenario includes a series of A38 BREP Phase 3 mainline and junction improvements described in Section 4.2. The proposed A38 BREP Phase 3 schemes include various packages that improve signalised junctions as well as introducing new signals at existing junction. Signal timings for the scheme junctions were based on outputs from stand-alone junction models developed in LinSig and refined through an iterative process between the strategic model and operational models.

Values of Time (VoT) are based on and are assumed to increase in line with guidance in TAG unit A1 – Cost-benefit analysis. Vehicle Operating Costs (VOC) were taken from TAG unit A1 and adjusted for the forecast years modelled to take into account changes in fuel cost and vehicle fuel efficiency. Generalised cost parameters for the future years were derived using values from 'TAG data book-, May 2021 Forthcoming change'.

4.8 Model Results

The following sections illustrate the model results and compares the key metrics of the WS scenario against the WoS scenario. The results compared are:

- Matrix changes.
- Network summary statistics.
- Link Flow changes.
- Select link analysis.
- Junction delays and queues.
- Journey time along the A38.

Detailed outputs are reported in Appendix TM. 5 Traffic Forecasting Report.

4.9 Forecast Matrices

The forecast models were run through the VDM to convergence using reference case demand input in 12-hr PA form. The outputs of the VDM were converted time period and peak hour OD matrices for assignment. The post-VDM matrices for movements that interact with the Fully Modelled Area under the WoS and WS scenarios are given in Table 4.8 and Table 4.9.

These tables show that the change in demand in 2025 between the WS and WoS are minimal with the AM and PM demand slightly increasing for the HBW and HEB purposes whilst the 'other' purpose trips show a slight drop in demand. During the IP, all car user classes show a decrease or marginal change in demand.

In 2040, all car user classes show an increase in demand due to the scheme except for HBW during the Inter peak that shows a marginal decrease in demand. The increase in demand is marginal across all time periods indicating the scheme does not induce much additional demand overall.

Table 4.8: Matrices comparisons – 2025

User Class	2025 WoS AM Peak	2025 WoS Inter Peak	2025 WoS PM Peak	2025 WS AM Peak	2025 WS Inter Peak	2025 WS PM Peak	%Diff AM Peak	%Diff Inter Peak	%Diff PM Peak
HBW	13249	2973	13306	13327	2961	13350	0.6%	-0.4%	0.3%
HBEB	1369	782	1261	1374	783	1265	0.3%	0.2%	0.3%
HBO	8463	12462	10778	8457	12464	10772	-0.1%	0.0%	-0.1%
NHBEB	1024	1052	1179	1024	1052	1179	0.0%	0.0%	0.0%
NHBO	1668	2592	2476	1668	2593	2473	0.0%	0.0%	-0.1%
LGV	4016	3835	3944	4016	3835	3944	0.0%	0.0%	0.0%
HGV	824	1259	568	824	1259	568	0.0%	0.0%	0.0%
Total	**30614**	**24956**	**33513**	**30691**	**24947**	**33552**	**0.3%**	**0.0%**	**0.1%**

Table 4.9: Matrices comparisons – 2040

User Class	2040 WoS AM Peak	2040 WoS Inter Peak	2040 WoS PM Peak	2040 WS AM Peak	2040 WS Inter Peak	2040 WS PM Peak	%Diff AM Peak	%Diff Inter Peak	%Diff PM Peak
HBW	13654	3070	13989	13751	3058	14023	0.7%	-0.4%	0.2%
HBEB	1446	825	1300	1451	827	1306	0.4%	0.3%	0.5%
HBO	9088	13525	11795	9094	13548	11818	0.1%	0.2%	0.2%
NHBEB	1104	1157	1257	1104	1158	1257	0.0%	0.1%	0.1%
NHBO	1858	2967	2953	1859	2970	2957	0.1%	0.1%	0.1%
LGV	4842	4624	4755	4842	4624	4755	0.0%	0.0%	0.0%
HGV	857	1308	591	857	1308	591	0.0%	0.0%	0.0%
Total	**32848**	**27475**	**36639**	**32958**	**27492**	**36707**	**0.3%**	**0.1%**	**0.2%**

4.10 Network Summary Statistics

The network performance summary statistics of the WoS and WS scenarios across the fully modelled area and comparison between them are given in Table 4.10 to Table 4.15 for 2025 and 2040.

Table 4.10 shows that vehicle-hours reduce for all vehicle classes in 2025 AM Peak under WS compared to WoS whilst vehicle-kms increase for all vehicle classes. Average speeds increase across all vehicle classes by 0.19% to 0.62% in 2025. This pattern in the network performance is logical as the scheme provides additional capacity at junctions along the A38 corridor.

Table 4.11 shows marginal change in vehicle-hours for all vehicle classes during the 2025 Inter Peak. Vehicle-kms also change marginally in WS for all vehicle classes due to a slight reduction of the average speeds. The reason for the slight reduction of the average speed could be attributed to the introduction of signals at the A38/A448 roundabout (scheme E) which increases the travel cost during the inter-peak in 2025.

Table 4.12 shows that vehicle-hours reduce for all vehicle classes in 2025 PM Peak under WS compared to WoS. Vehicle-kms increase slightly in WS for all vehicle classes. Average speed increases across all vehicle classes by 0.12% to 0.74% in 2025 PM Peak. This is similar to the pattern in the AM Peak.

Table 4.10: Without Scheme and With Scheme - 2025 AM Peak Highway network statistics

User Class	WoS Veh-km	WoS Veh-hrs	WoS Aver Speed (kph)	WS Veh-km	WS Veh-hrs	WS Aver Speed (kph)	%Diff Veh-km	%Diff Veh-hrs	%Diff Aver Speed (kph)
Car	550871	10654	51.70	552501	10620	52.02	0.30%	-0.32%	0.62%
LGV	100863	1863	54.13	100929	1856	54.39	0.07%	-0.42%	0.49%
HGV	71218	1175	60.63	71230	1172	60.75	0.02%	-0.18%	0.19%
Total	**722951**	**13692**	**52.80**	**724661**	**13648**	**53.10**	**0.24%**	**-0.32%**	**0.56%**

Table 4.11: Without Scheme and With Scheme - 2025 Inter Peak Highway network statistics

User Class	WoS Veh-km	WoS Veh-hrs	WoS Aver Speed (kph)	WS Veh-km	WS Veh-hrs	WS Aver Speed (kph)	%Diff Veh-km	%Diff Veh-hrs	%Diff Aver Speed (kph)
Car	397867	7361	54.05	397915	7369	54.00	0.01%	0.11%	-0.10%
LGV	111250	1917	58.04	111258	1918	58.02	0.01%	0.04%	-0.03%
HGV	100303	1615	62.11	100300	1615	62.11	0.00%	-0.01%	0.00%
Total	**609420**	**10893**	**55.95**	**609473**	**10902**	**55.91**	**0.01%**	**0.08%**	**-0.07%**

Table 4.12: Without Scheme and With Scheme - 2025 PM Peak Highway network statistics

User Class	WoS Veh-km	WoS Veh-hrs	WoS Aver Speed (kph)	WS Veh-km	WS Veh-hrs	WS Aver Speed (kph)	%Diff Veh-km	%Diff Veh-hrs	%Diff Aver Speed (kph)
Car	687354	13456	51.08	689232	13394	51.46	0.27%	-0.46%	0.74%
LGV	106148	1986	53.45	106181	1978	53.69	0.03%	-0.42%	0.45%
HGV	52864	875	60.40	52868	874	60.48	0.01%	-0.11%	0.12%
Total	**846367**	**16317**	**51.87**	**848281**	**16245**	**52.22**	**0.23%**	**-0.44%**	**0.67%**

Table 4.13 shows vehicle-hours reduce for all vehicle classes in 2040 AM Peak under WS compared to WoS whilst vehicle-kms increase in WS for all vehicle classes, similar to the pattern predicted in 2025. Average speed increases across all vehicle classes by 0.30% to 0.71% in 2040 AM Peak. Table 4.14 shows marginal change in vehicle-hours for all vehicle classes and vehicle-kms in WS for all vehicle classes during the Inter peak. Cars show a slight increase in vehicle-kms with an insignificant increase in vehicle hours. All vehicle classes show a marginal increase in average speeds in 2040 Inter Peak.

Table 4.15 shows vehicle-hours reduce for all cars and HGVs in 2040 PM Peak under WS compared to WoS whilst vehicle-kms increase slightly in WS for cars and LGVs. Average speed increases across all user classes by 0.25% to 0.68% in 2040 PM Peak.

Table 4.13: Without Scheme and With Scheme – 2040 AM Peak Highway network statistics

User Class	WoS Veh-km	WoS Veh-hrs	WoS Aver Speed (kph)	WS Veh-km	WS Veh-hrs	WS Aver Speed (kph)	%Diff Veh-km	%Diff Veh-hrs	%Diff Aver Speed (kph)
Car	628570	12262	51.26	630434	12212	51.62	0.30%	-0.41%	0.71%
LGV	122348	2296	53.28	122376	2285	53.55	0.02%	-0.48%	0.50%
HGV	74383	1228	60.58	74419	1225	60.76	0.05%	-0.25%	0.30%
Total	**825301**	**15786**	**52.28**	**827229**	**15722**	**52.62**	**0.23%**	**-0.41%**	**0.64%**

Table 4.14: Without Scheme and With Scheme – 2040 Inter Peak Highway network statistics

User Class	WoS Veh-km	WoS Veh-hrs	WoS Aver Speed (kph)	WS Veh-km	WS Veh-hrs	WS Aver Speed (kph)	%Diff Veh-km	%Diff Veh-hrs	%Diff Aver Speed (kph)
Car	466249	8667	53.80	466907	8665	53.89	0.14%	-0.02%	0.16%
LGV	134808	2355	57.25	134828	2352	57.33	0.01%	-0.13%	0.14%
HGV	104716	1684	62.18	104696	1683	62.21	-0.02%	-0.07%	0.05%
Total	**705773**	**12705**	**55.55**	**706430**	**12699**	**55.63**	**0.09%**	**-0.05%**	**0.14%**

Table 4.15: Without Scheme and With Scheme – 2040 PM Peak Highway network statistics

User Class	WoS Veh-km	WoS Veh-hrs	WoS Aver Speed (kph)	WS Veh-km	WS Veh-hrs	WS Aver Speed (kph)	%Diff Veh-km	%Diff Veh-hrs	%Diff Aver Speed (kph)
Car	785583	15653	50.19	786435	15563	50.53	0.11%	-0.57%	0.68%
LGV	128754	2456	52.43	128751	2441	52.74	0.00%	-0.58%	0.58%
HGV	55156	915	60.31	55204	913	60.46	0.09%	-0.16%	0.25%
Total	**785583**	**15653**	**50.19**	**786435**	**15563**	**50.53**	**0.11%**	**-0.57%**	**0.68%**

4.11 Link Flow Changes

Figure 4.7 to Figure 4.12 illustrate the link flow differences between WoS and WS scenarios for the 2025 and 2040 forecast years. The link bar/text in red indicates an increase in traffic flow under WS scenario whilst the green bar/text indicates a reduction in traffic under WS scenario compared to the WoS scenario.

These figures illustrate an increase in traffic on A38 (north-south) in both peak hours and in model forecast years. The A38 mainline will experience an increase of up to 473veh/hr in the AM peak and up to 530veh/hr in the PM Peak) in the northbound direction. In the southbound direction, the A38 will experience an increase of up to 440veh/hr in the AM peak and up to 476veh/hr in the PM Peak.

There are appreciable increases in 2040 AM peak flow of up to 757veh/hr in the AM peak and up to 789veh/hr in the PM Peak along the A448 between the A38 and Redditch due to the scheme improvements. These increases are due primarily to traffic re-routeing from alternative routes (B4096, B4184) that experience a reduction in flows and using the A448 to access the A38.

During the Inter peak, the scheme does not attract much traffic from alternative routes and along some sections, traffic moves away from the scheme due to better alternatives. This is more so in 2025 than in 2040 Inter peak.

There are also reductions in flows west of A38 in Bromsgrove town, but these are relatively low compared to the increases along the A38.

Figure 4.7: 2025 AM Peak (WS minus WoS)

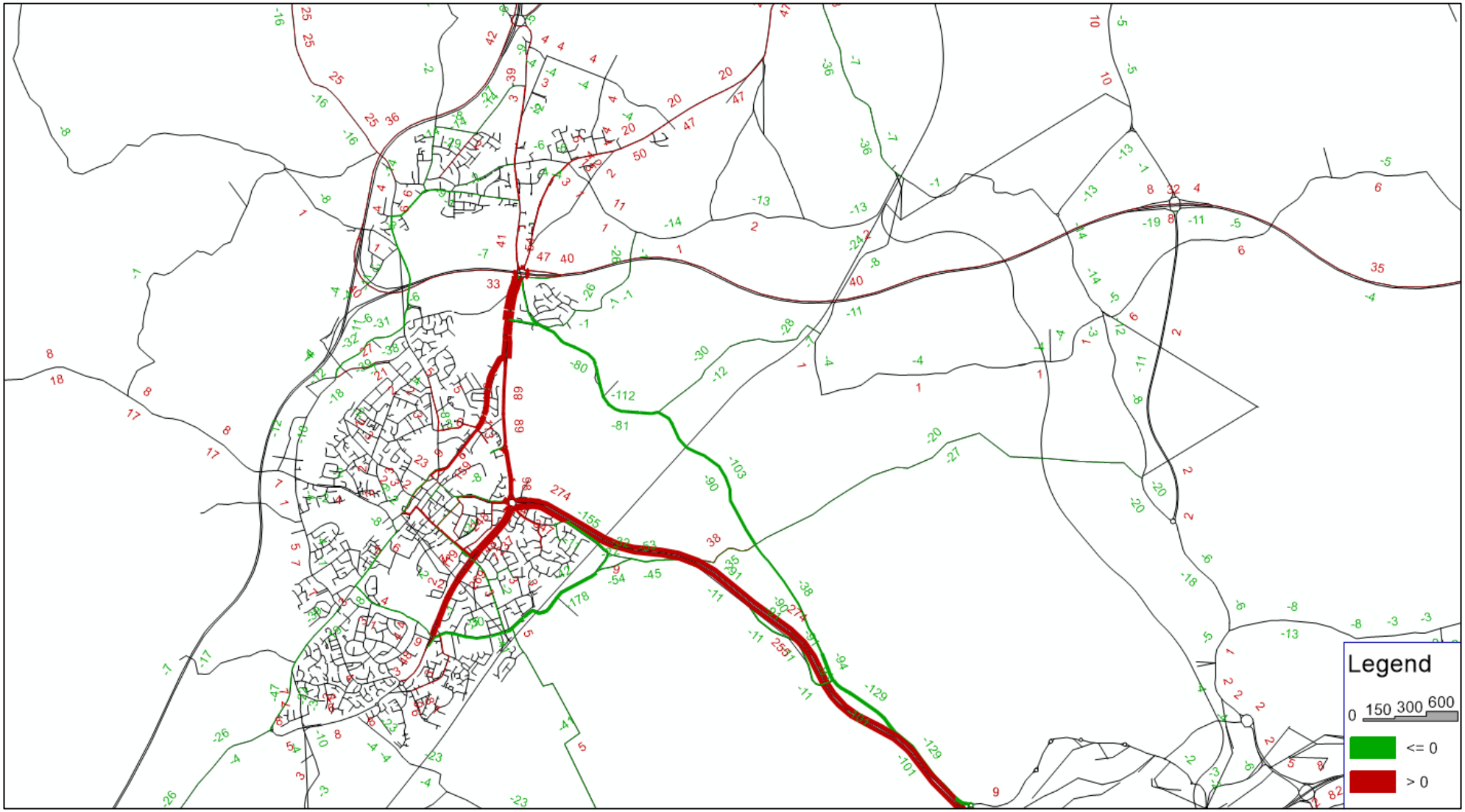


Figure 4.8: 2025 Inter Peak (WS minus WoS)

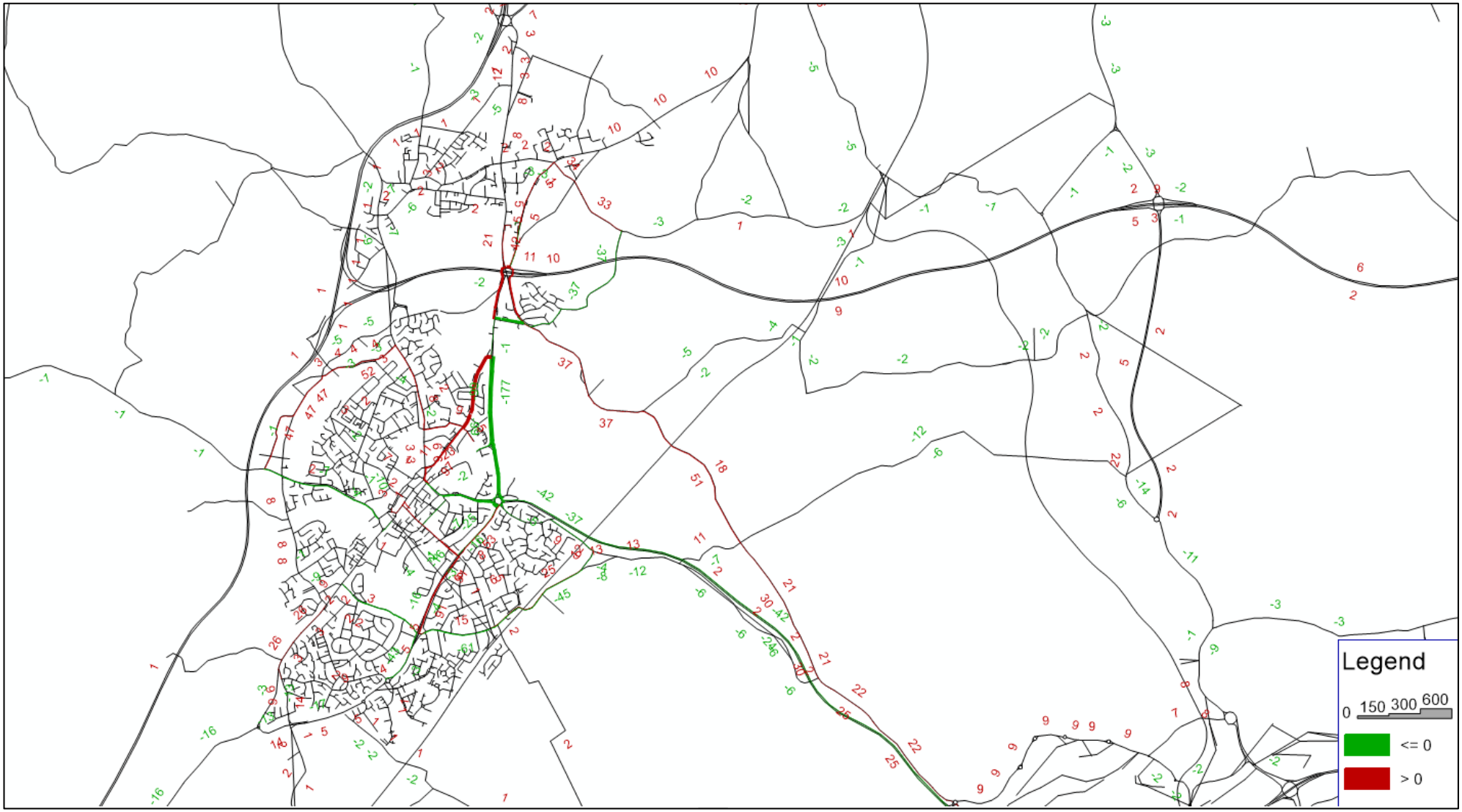


Figure 4.9: 2025 PM Peak (WS minus WoS)

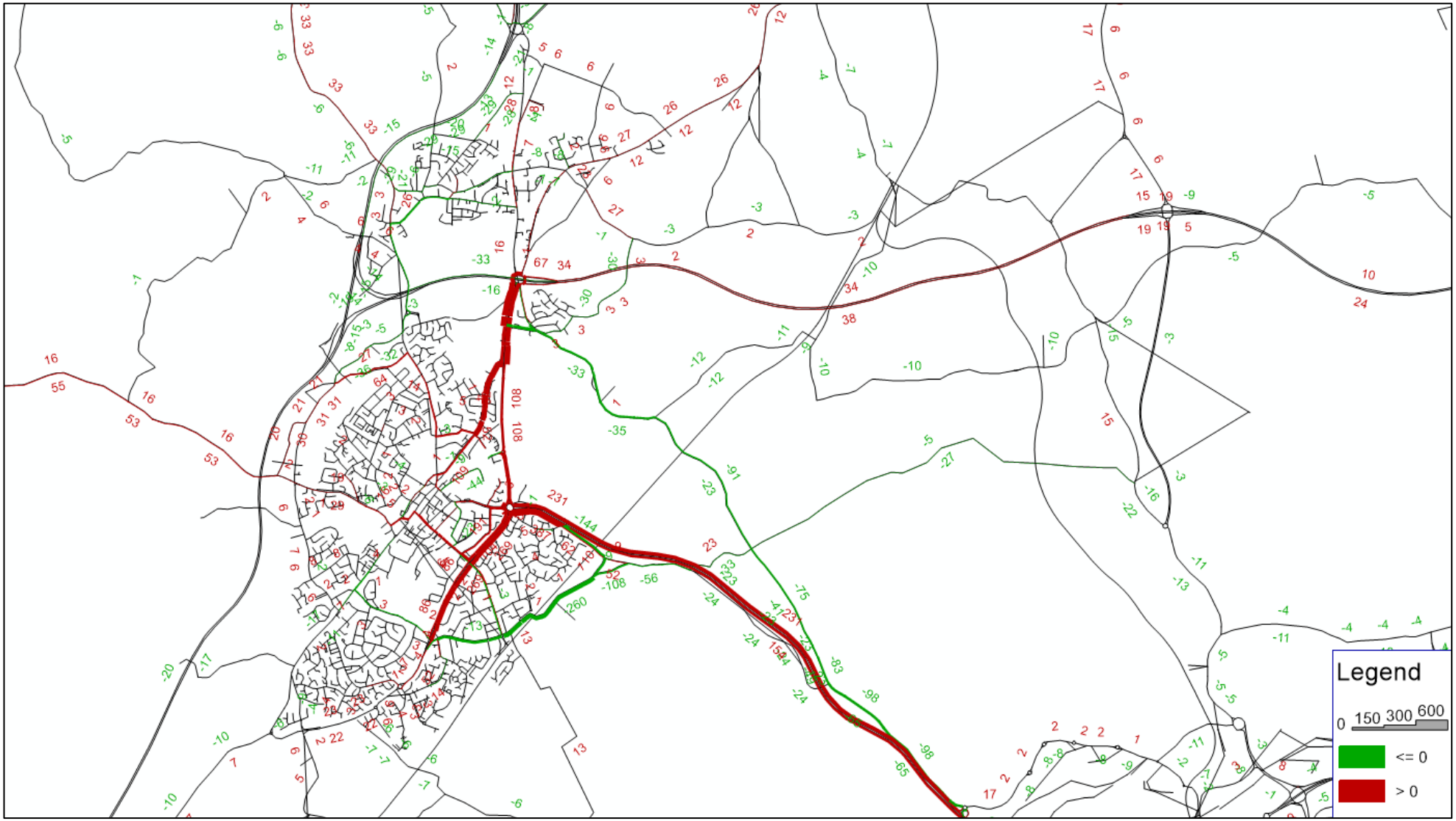


Figure 4.10: 2040 AM Peak (WS minus WoS)

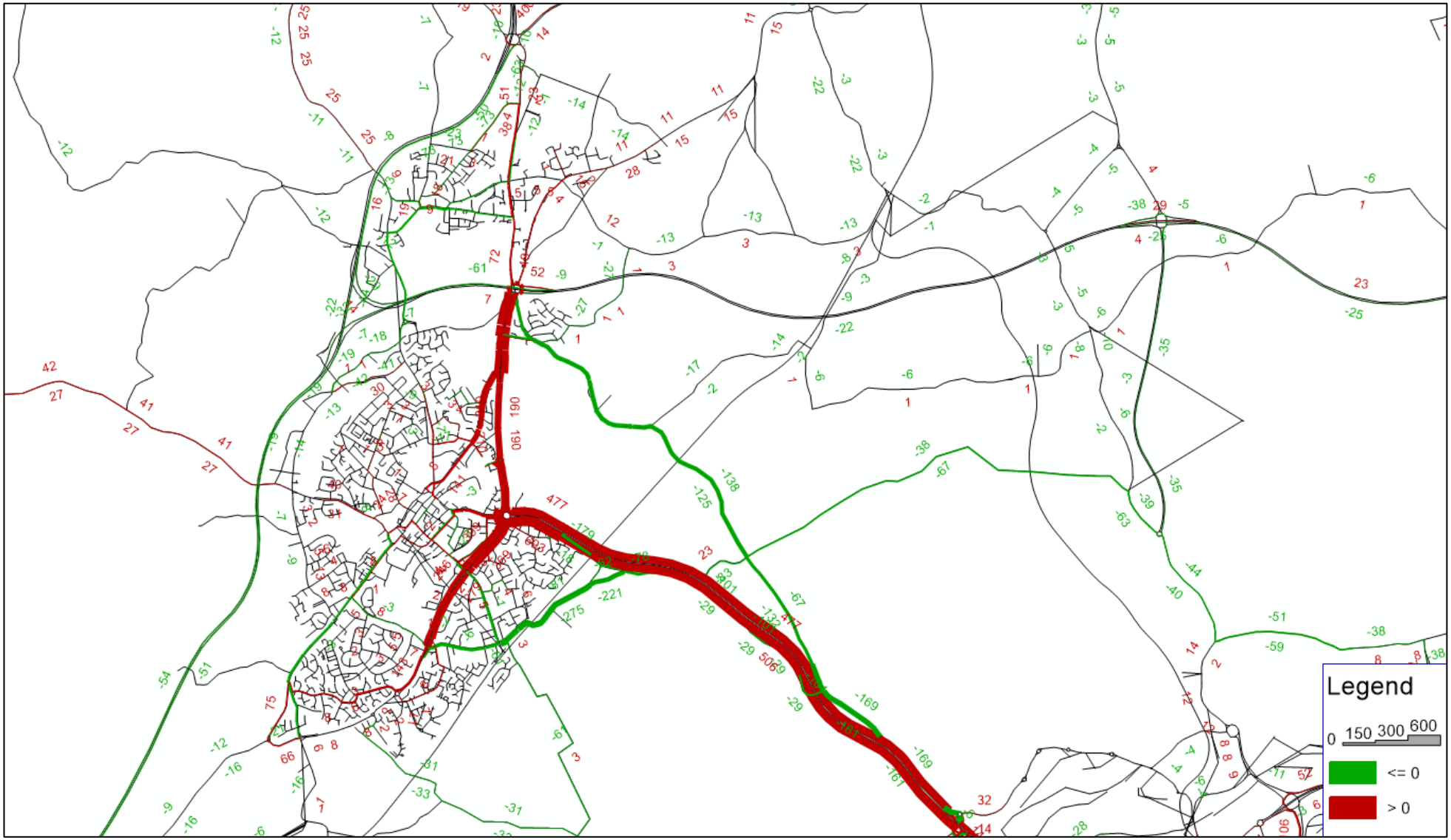


Figure 4.11: 2040 Inter Peak (WS minus WoS)

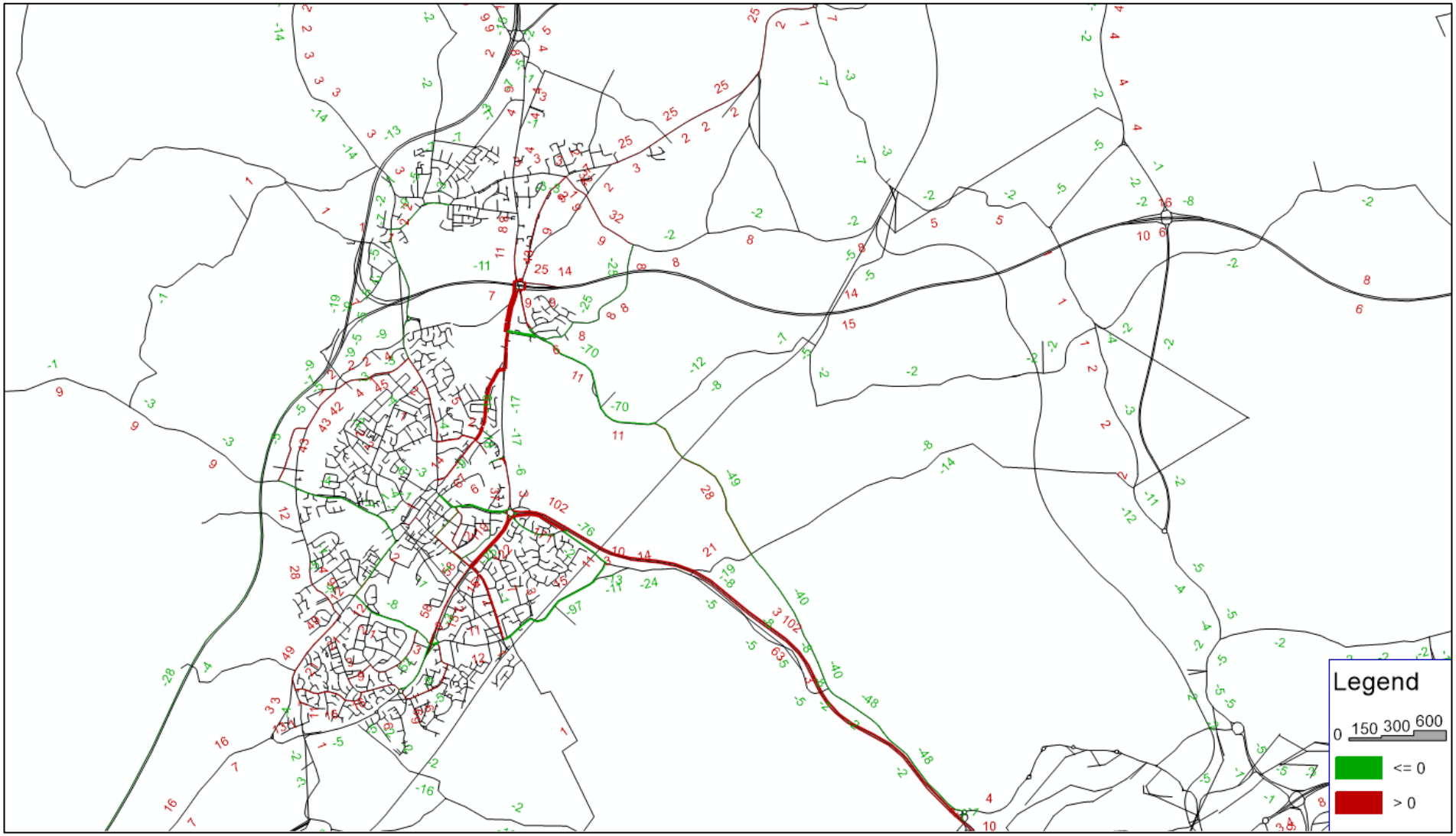
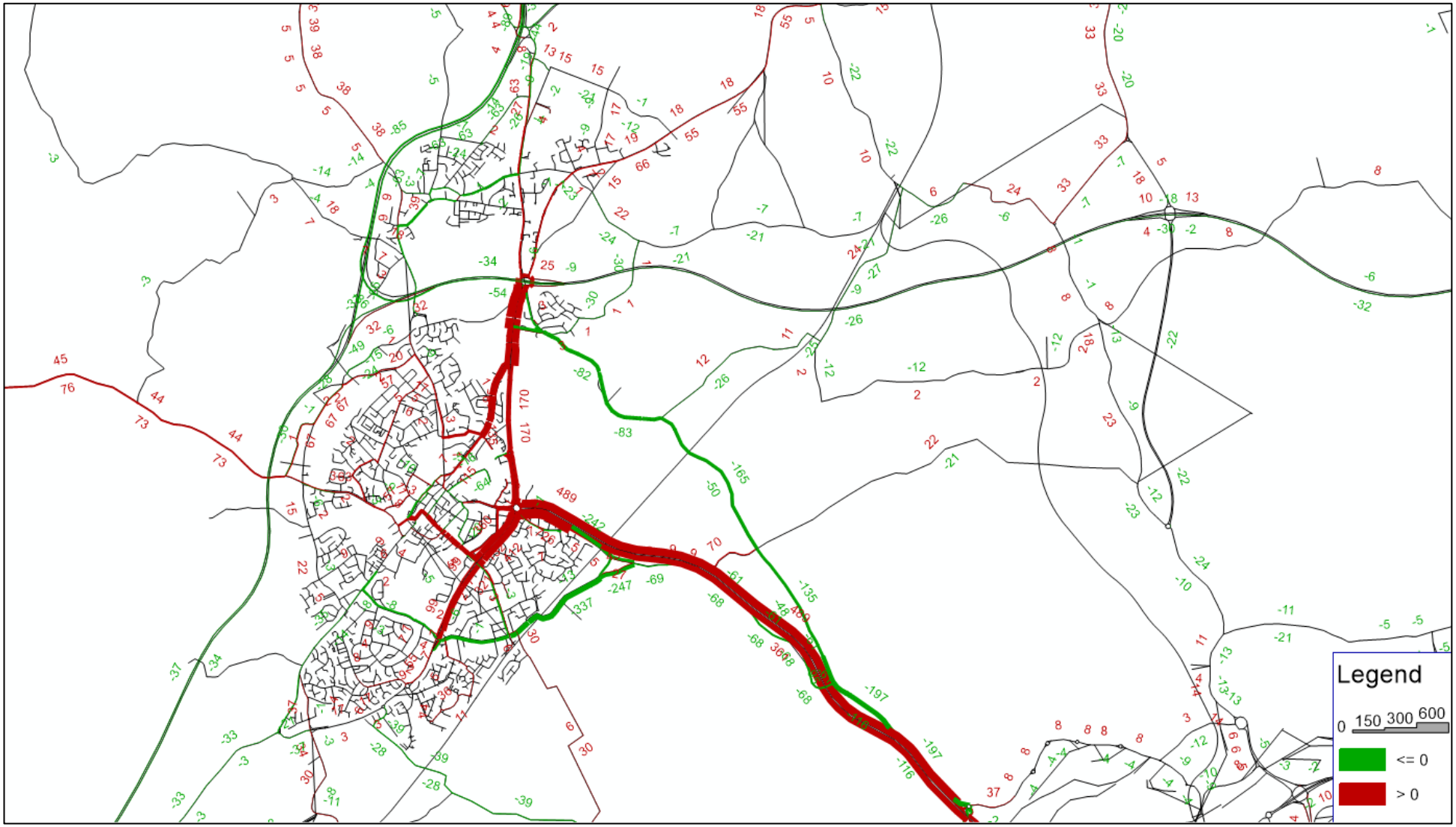


Figure 4.12: 2040 PM Peak (WS minus WoS)



4.12 Select Link Analysis

Select link analysis of flows travelling along any of the A38 BREP Phase 3 schemes sections during 2040 AM and PM peak are shown in Figure 4.13 to Figure 4.16 for the WoS and WS. The patterns of movement using the A38 sections are very similar in both the WoS and WS scenarios, but the quantum of flows are greater in WS due to the attractiveness of the scheme. The plots demonstrate the A38 corridor, with the proposed A38 BREP Phase 3 schemes, acts as a primary distributor for trips to access the SRN and other radial routes into Redditch to the East and Wyre Forest to the west.

Figure 4.13: Select Link Analysis on A38 - 2040 AM WoS

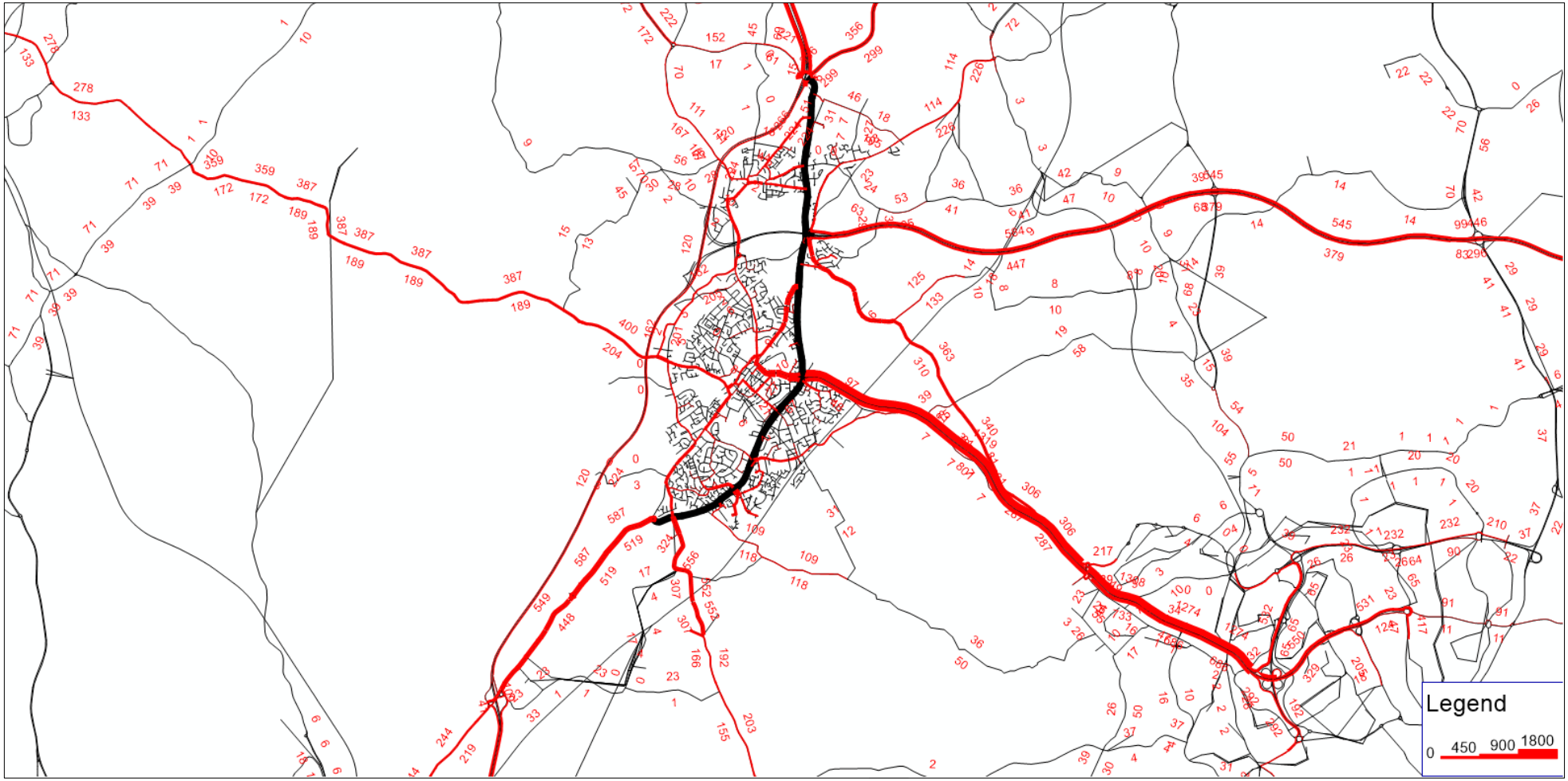


Figure 4.14: Select Link Analysis on A38 - 2040 AM WS

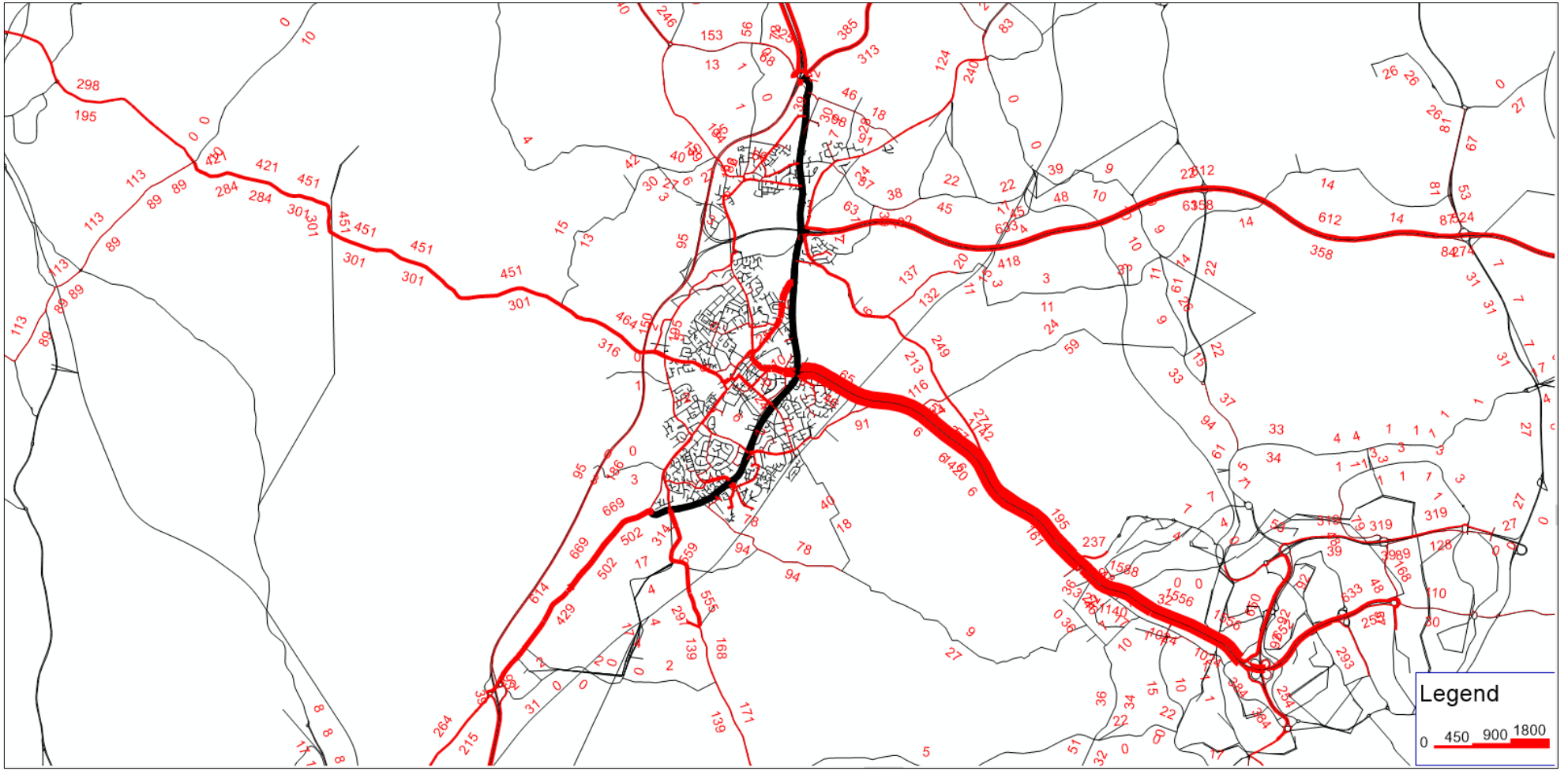


Figure 4.15: Select Link Analysis on A38 - 2040 PM WoS

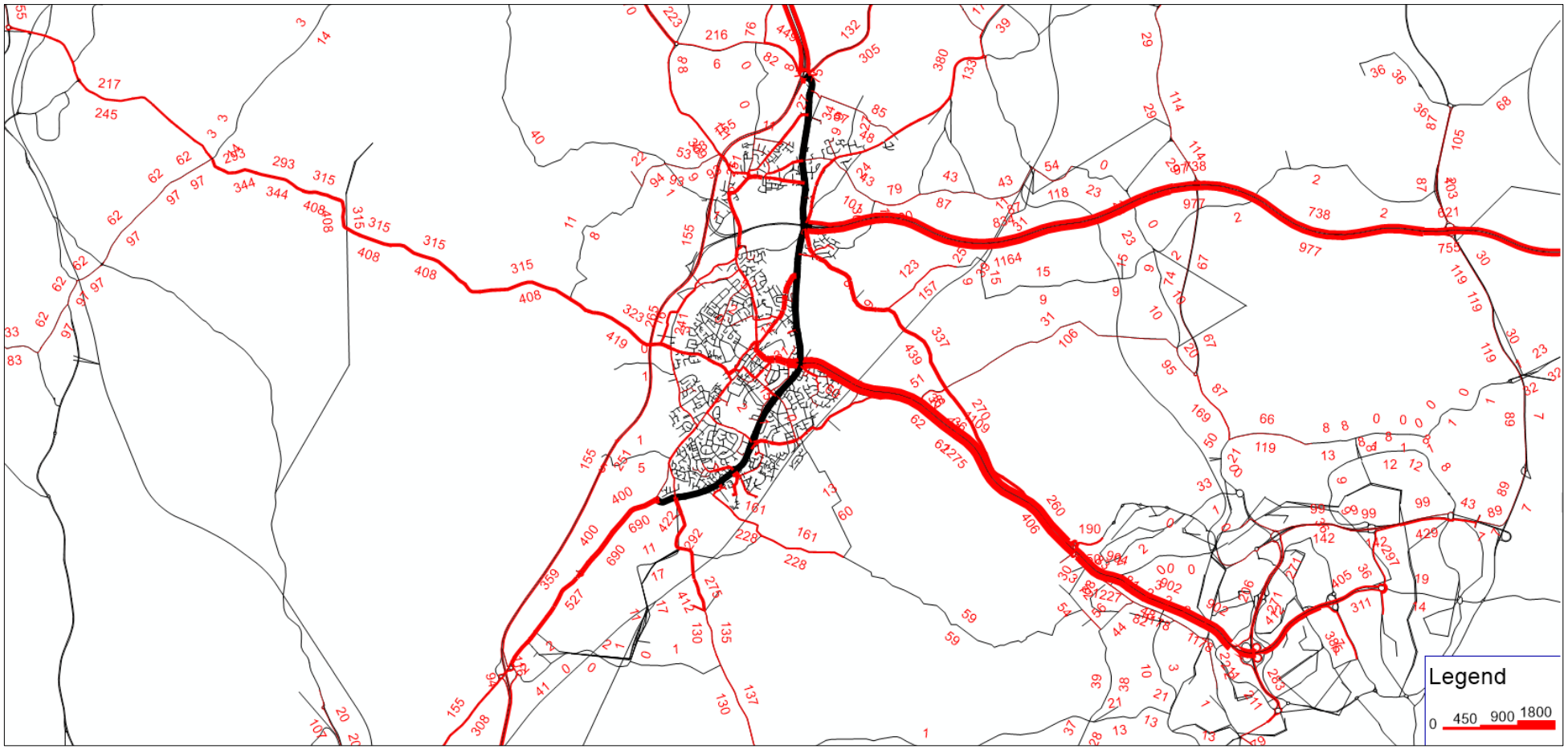


Figure 4.16: Select Link Analysis on A38 - 2040 PM WS

4.13 Junction Delays and Queues

Figure 4.17 to Figure 4.20 show the mean junction delay (>10s) and relative queue lengths (proportion of link queued up) for the 2040 peak hours under both WoS and WS scenarios. The plots show the delays are predominantly experienced at the same junctions in both WoS and WS but the magnitude of delay is mostly lower under the WS scenario. In addition, the relative queue lengths on links significantly reduces in the WS scenario compared to the WoS scenario along the A38 corridor.

Figure 4.17: Junction delay and link queue lengths – 2040 AM WoS

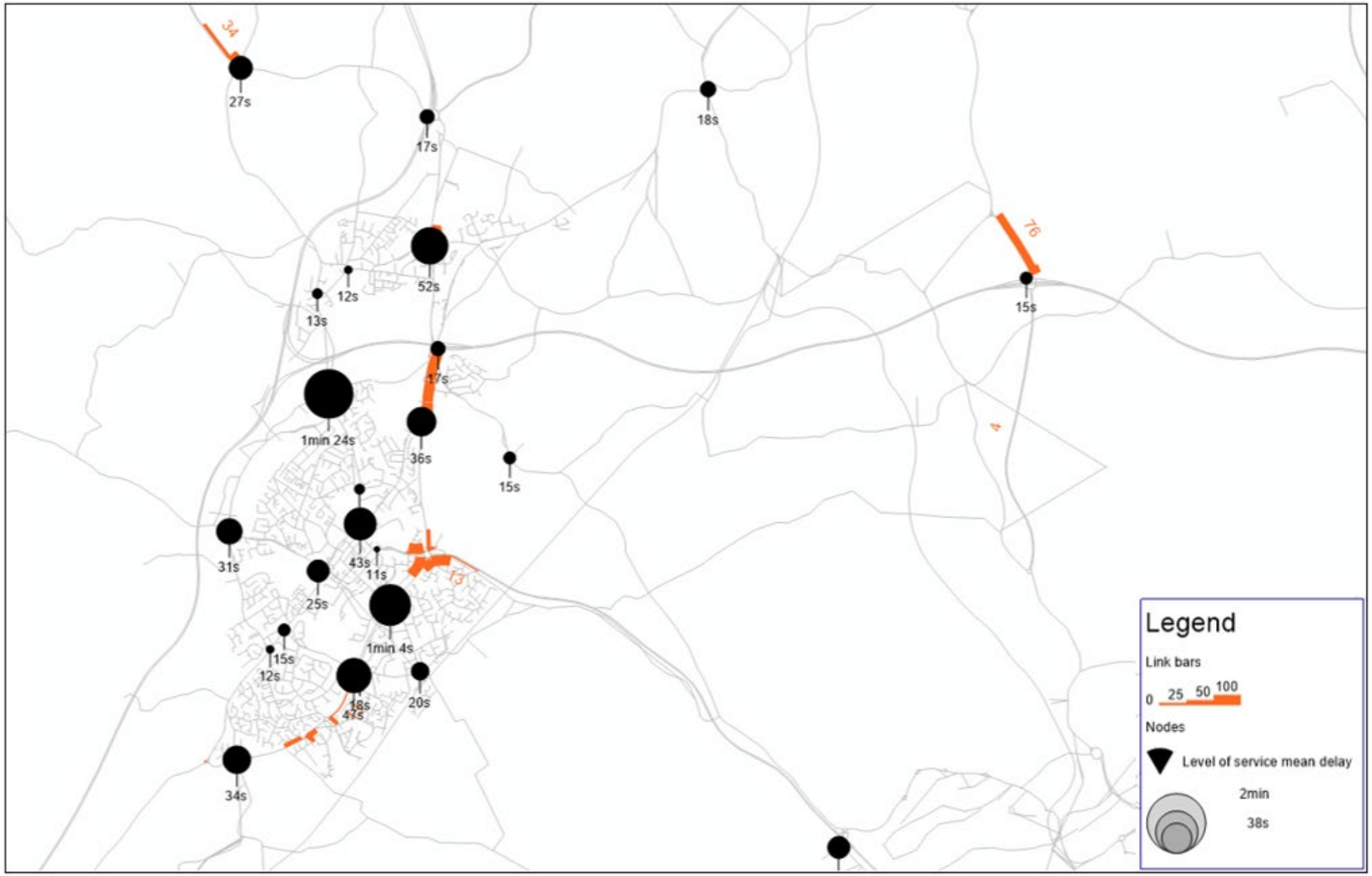


Figure 4.18: Junction delay and link queue lengths – 2040 AM WS

Figure 4.19: Junction delay and link queue lengths – 2040 PM WoS

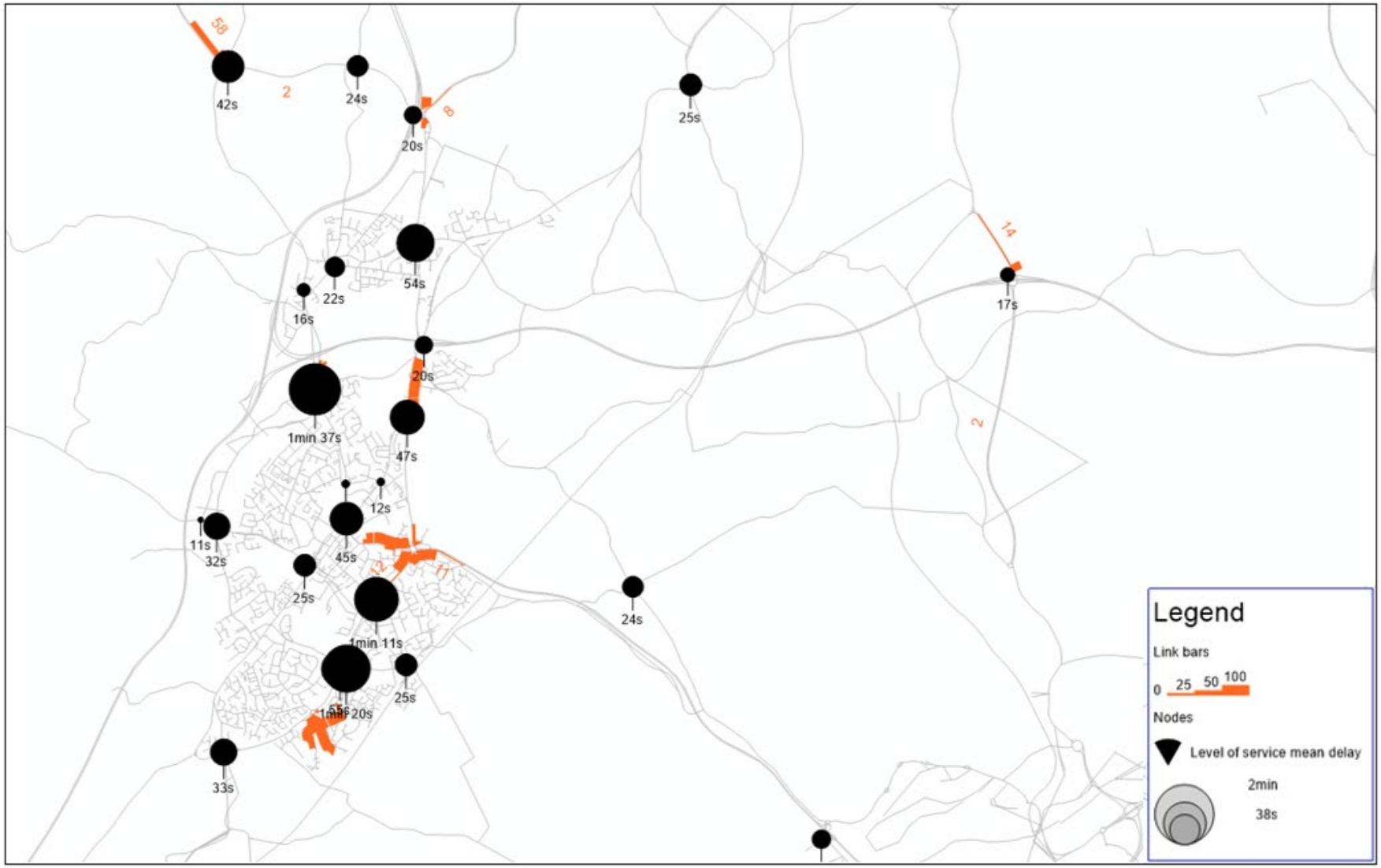
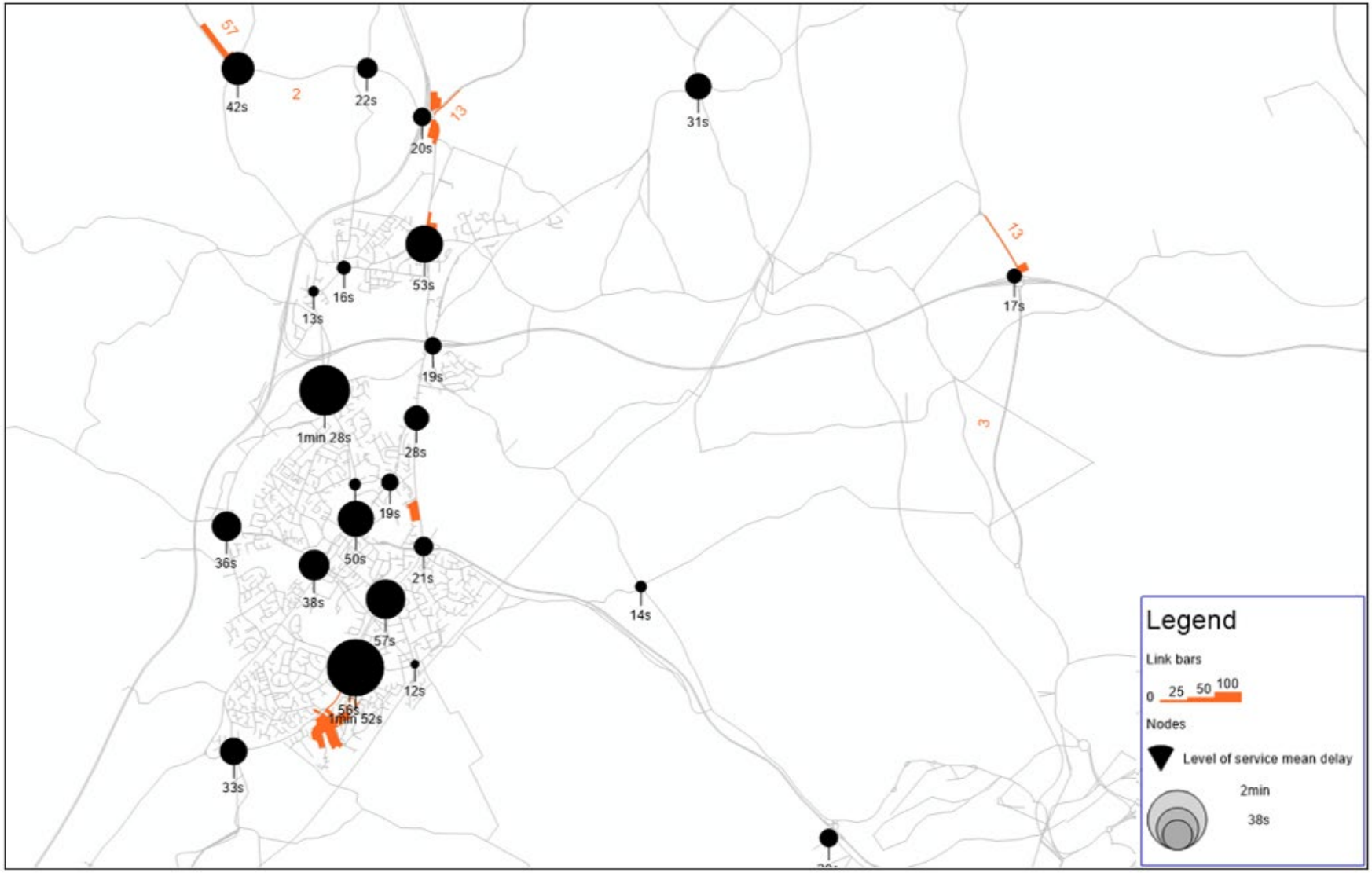


Figure 4.20: Junction delay and link queue lengths – 2040 PM WS



4.14 Analysis of Journey Times

In order to understand the impact of the scheme to the vehicles using the A38 corridor with the proposed Phase 3 improvements, modelled journey times have been extracted. Table 4.16 shows the journey time for WoS and WS for the 2025 and 2040 and all modelled hours while Table 4.17 shows the differences between them.

The time taken to travel along the A38 route in Bromsgrove between its junction with M5 J4 in the north and M5 J5 via M42 J1 and A38/A448 roundabout under the WoS and WS scenarios in both 2025 and 2040 for all modelled hours are shown. Table 4.16 show the WS scenario provides journey time savings primarily in the southbound direction in both 2025 and 2040 and across the AM and PM peak hours. The scheme results in savings of up to 2.1 minutes in the peak hour with the AM peak hour showing greater savings than the PM peak (up to 1.0 minute).

The journey times in the Inter Peak hour however slightly increase by 0.2 minutes in the WS scenario compared to the WoS. This is primarily due to proposed signals at the A38/A448 roundabout at Scheme E and the reduction in speed limits at Scheme F in the WS scenario compared to the WoS scenario.

In the Northbound direction, the journey times in the WS scenario are lower than the WoS scenario in 2025 across all modelled hours with savings of up to 0.5 minutes. However, in 2040, only the AM and IP hours show journey time savings of up to 0.9 minutes whilst the PM hour shows a marginal increase in journey times in the WS scenario compared to the WoS scenario.

Table 4.16: 2025 and 2040 Model Forecast Journey times (minutes)

Route	WoS 2025 AM	WoS 2025 IP	WoS 2025 PM	WoS 2040 AM	WoS 2040 IP	WoS 2040 PM	WS 2025 AM	WS 2025 IP	WS 2025 PM	WS 2040 AM	WS 2040 IP	WS 2040 PM
A38 NB	22.6	20.4	23.0	24.0	21.0	24.6	22.1	20.1	22.6	23.0	20.6	25.0
A38 SB	25.5	20.5	24.1	27.2	22.0	24.9	23.4	20.8	23.1	26.3	22.2	24.3

Table 4.17: 2025 and 2040 Forecast Journey time changes

Route	2025 AM - WS vs WoS	2025 IP - WS vs WoS	2025 PM - WS vs WoS	2040 AM - WS vs WoS	2040 IP - WS vs WoS	2040 PM - WS vs WoS
	Absolute Difference	Absolute Difference	Absolute Difference	Absolute Difference	Absolute Difference	Absolute Difference
A38 NB	-0.5	-0.3	-0.4	-0.9	-0.4	0.5
A38 SB	-2.1	0.2	-1.1	-0.9	0.2	-0.6
	% Difference	% Difference	% Difference	% Difference	% Difference	% Difference
A38 NB	-2.1%	-1.6%	-1.9%	-4.0%	-1.8%	1.9%
A38 SB	-8.3%	1.1%	-4.4%	-3.5%	1.1%	-2.3%

4.15 Sensitivity Tests

Sensitivity tests around the core scenario 'central forecasts' were undertaken in line with TAG guidance. To provide an indication of the uncertainty around these forecasts, high and low growth scenarios have been produced based on the guidance detailed in Section 4 of TAG Unit M4.

The adjustments of the matrices were made by taking the appropriate proportion of the 2017 base year matrix and adding or subtracting it from the incremental adjustment as recommended in Box1 of TAG Unit M4. In order to provide the required future year sensitivity tests the adjusted matrices

were used to iterate the demand and supply models to convergence. The TAG high / low growth sensitivity tests have been run from 2025 and 2040 and compared to the Core scenario.

The forecast demand totals after VDM for WoS and WS for 2025 in the low growth scenario varies between -6.3% and -7.1% compared to the core scenario. The high growth demand similarly varies between 6.3% and 7.2% for 2025 WoS and WS scenario.

The forecast demand totals after VDM for WoS and WS for 2040 in the low growth scenario varies between -8.8% and -12.0% compared to the core scenario. The high growth demand similarly varies between 8.8% and 12.0% for 2040 WoS and WS scenario.

The change in demand in both 2025 and 2040 scenarios show similar pattern of demand changes in the high / low growth scenarios.

The network performance summary statistics of the WoS and WS scenarios across the study area and comparison with the Core scenario are given in Table 4.18 to Table 4.21 for vehicle-kms. These tables show that there is a good correspondence between the expected difference in vehicle-kms and the difference in demand forecasts between the high / low growth scenario and the Core forecasts for highway demand.

Table 4.18: Vehicle-km comparisons between 2025 WoS Low, Core and High Growth

User Class	Low Growth	Low Growth	Low Growth	Core Growth	Core Growth	Core Growth	High Growth	High Growth	High Growth	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (High – Core)	%Diff (High – Core)	%Diff (High – Core)
	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak
HBW	251190	60492	297176	268150	64736	317320	285518	69160	338610	-6.3%	-6.6%	-6.3%	6.5%	6.8%	6.7%
HBEB	56839	39908	54795	61245	42913	58798	65546	45853	62767	-7.2%	-7.0%	-6.8%	7.0%	6.9%	6.8%
HBO	117184	176324	175102	126045	189957	189538	133642	200757	199637	-7.0%	-7.2%	-7.6%	6.0%	5.7%	5.3%
NHBEB	57800	46998	61468	62354	50573	66433	66512	53917	70773	-7.3%	-7.1%	-7.5%	6.7%	6.6%	6.5%
NHBO	30749	46272	51322	33077	49689	55266	35228	52925	58772	-7.0%	-6.9%	-7.1%	6.5%	6.5%	6.3%
LGV	94453	104268	99688	100863	111250	106148	107300	118233	112773	-6.4%	-6.3%	-6.1%	6.4%	6.3%	6.2%
HGV	66182	93178	49115	71218	100303	52864	76296	107444	56613	-7.1%	-7.1%	-7.1%	7.1%	7.1%	7.1%
Total	**674397**	**567440**	**788666**	**722951**	**609420**	**846367**	**770041**	**648289**	**899945**	**-6.7%**	**-6.9%**	**-6.8%**	**6.5%**	**6.4%**	**6.3%**

Table 4.19: Vehicle-km comparisons between 2025 WS Low, Core and High Growth

User Class	Low Growth	Low Growth	Low Growth	Core Growth	Core Growth	Core Growth	High Growth	High Growth	High Growth	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (High – Core)	%Diff (High – Core)	%Diff (High – Core)
	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak
HBW	252086	60484	298397	269955	64830	319198	287746	69250	340240	-6.6%	-6.7%	-6.5%	6.6%	6.8%	6.6%
HBEB	56837	39875	54791	61182	42852	58865	65485	45804	62840	-7.1%	-6.9%	-6.9%	7.0%	6.9%	6.8%
HBO	117002	176179	174889	125922	189927	189516	133589	200555	199439	-7.1%	-7.2%	-7.7%	6.1%	5.6%	5.2%
NHBEB	57820	46984	61439	62366	50574	66442	66517	53906	70768	-7.3%	-7.1%	-7.5%	6.7%	6.6%	6.5%
NHBO	30716	46255	51215	33076	49732	55211	35226	52897	58675	-7.1%	-7.0%	-7.2%	6.5%	6.4%	6.3%
LGV	94514	104274	99711	100929	111258	106181	107318	118239	112797	-6.4%	-6.3%	-6.1%	6.3%	6.3%	6.2%
HGV	66164	93175	49115	71230	100300	52868	76288	107444	56625	-7.1%	-7.1%	-7.1%	7.1%	7.1%	7.1%
Total	**675141**	**567226**	**789558**	**724661**	**609473**	**848281**	**772168**	**648096**	**901384**	**-6.8%**	**-6.9%**	**-6.9%**	**6.6%**	**6.3%**	**6.3%**

Table 4.20: Vehicle-km comparisons between 2040 WoS Low, Core and High Growth

User Class	Low Growth	Low Growth	Low Growth	Core Growth	Core Growth	Core Growth	High Growth	High Growth	High Growth	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (High – Core)	%Diff (High – Core)	%Diff (High – Core)
	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak
HBW	258409	62302	310179	290419	70183	349372	320559	77830	385321	-11.0%	-11.2%	-11.2%	10.4%	10.9%	10.3%
HBEB	63751	43581	57338	72561	49404	64836	81449	55242	72368	-12.1%	-11.8%	-11.6%	12.2%	11.8%	11.6%
HBO	135116	200782	200423	152517	226203	226738	167755	247125	247480	-11.4%	-11.2%	-11.6%	10.0%	9.2%	9.1%
NHBEB	63916	51779	66047	72729	59035	75454	81201	65654	84077	-12.1%	-12.3%	-12.5%	11.6%	11.2%	11.4%
NHBO	35831	54815	61784	40345	61424	69182	44408	67495	75965	-11.2%	-10.8%	-10.7%	10.1%	9.9%	9.8%
LGV	111396	123083	115952	122348	134808	128754	133199	146434	139915	-9.0%	-8.7%	-9.9%	8.9%	8.6%	8.7%
HGV	65770	92585	49232	74383	104716	55156	82998	116812	61527	-11.6%	-11.6%	-10.7%	11.6%	11.6%	11.6%
Total	**734189**	**628927**	**860957**	**825301**	**705773**	**969492**	**911569**	**776592**	**1066653**	**-11.0%**	**-10.9%**	**-11.2%**	**10.5%**	**10.0%**	**10.0%**

Table 4.21: Vehicle-km comparisons between 2040 WS Low, Core and High Growth

User Class	Low Growth	Low Growth	Low Growth	Core Growth	Core Growth	Core Growth	High Growth	High Growth	High Growth	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (High – Core)	%Diff (High – Core)	%Diff (High – Core)
	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak
HBW	259660	62234	310526	292340	70481	349887	323268	78026	387280	-11.2%	-11.7%	-11.2%	10.6%	10.7%	10.7%
HBEB	63675	43484	57407	72439	49299	64912	81186	55102	72405	-12.1%	-11.8%	-11.6%	12.1%	11.8%	11.5%
HBO	135190	201298	200701	152547	226647	227105	168060	248119	247912	-11.4%	-11.2%	-11.6%	10.2%	9.5%	9.2%
NHBEB	63912	52055	66079	72761	59028	75396	81110	65584	84022	-12.2%	-11.8%	-12.4%	11.5%	11.1%	11.4%
NHBO	35818	54848	61743	40348	61451	69135	44428	67597	75939	-11.2%	-10.7%	-10.7%	10.1%	10.0%	9.8%
LGV	111413	123089	116069	122376	134828	128751	133256	146757	137956	-9.0%	-8.7%	-9.9%	8.9%	8.8%	7.1%
HGV	65781	92586	49243	74419	104696	55204	83022	116817	62124	-11.6%	-11.6%	-10.8%	11.6%	11.6%	12.5%
Total	**735448**	**629594**	**861768**	**827229**	**706430**	**970390**	**914330**	**778004**	**1067637**	**-11.1%**	**-10.9%**	**-11.2%**	**10.5%**	**10.1%**	**10.0%**

4.16 Summary

The analysis of the modelled outputs discussed shows the A38 BREP Phase 3 schemes help in relieving congestion along the corridor compared to the WoS scenario while also drawing in traffic from other routes and thereby reducing congestion in other parts of the Bromsgrove town network. Additional information on VISUM forecast model can be found in the Traffic Forecasting report (Appendix TM.5).

4.17 Outputs for Appraisal

The forecast model outputs in terms of skims (demand, time, distance) for all user classes modelled were extracted and fed into the economic appraisal for the calculation of transport user benefits using the DfT Transport User Benefits Appraisal (TUBA) software. Link flow, congested speeds, travel times, and junction performance data were used to inform COst and Benefit to Accidents – Light Touch (COBALT), wider impacts and operational traffic, noise and air quality modelling.
Model outputs in terms of journey times/total travel times (in vehicle-hours) in the Fully Modelled Area were extracted to undertake a reliability assessment in accordance with section 6.3 of TAG unit A1.3. This analysis is reported in the Economic Dimension.