MAY 2020

NORTH STAFFORDSHIRE LOCAL AIR QUALITY PLAN

UNAPPROVED OUTLINE BUSINESS CASE
APPENDIX 27 - T4 Local Plan Traffic Forecasting Report

Staffordshire County Council

NEWCASTLE UNDER LYME BOROUGH COUNCIL

City of Stoke-on-Trent

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Executive Summary

The North Staffordshire Multi-Modal (NSMM) transport model has been updated and refined to provide an appropriate analytical tool that will aid Newcastle-under-Lyme Borough Council (NuLBC), Stoke-on-Trent City Council (SoTCC) and Staffordshire County Council (SCC) in the development and implementation of an Air Quality Local Plan. The need to develop a Local Plan comes as a direct result from a High Court ruling, where ministers were required to set out any additional steps that could be taken by the councils to speed up compliance with the NO_2 limits, which have been exceeded since 2010.

The NSMM transport model has been validated against extensive observed traffic data as described in the T2 - Local Plan Transport Model Validation Report with the methodology used to develop the transport model appropriately described in the T3 - Local Plan Transport Modelling Methodology Report.

This T4 - Local Plan Traffic Forecasting Report describes the application of the NSMM transport model to derive appropriate Reference Case forecast traffic information which will be used to inform the development of an air quality model, identify appropriate air quality initiatives and the subsequent appraisal of the Local Plan. These traffic forecasts will also be used to inform the benchmarking of the Local Plan against a charging Clean Air Zone (CAZ) type D. The development and application of the NSMM transport model has been carried out in accordance with the Department for Transport (DfT) TAG guidance and additional guidance issued by the Joint Air Quality Unit (JAQU).

The NSMM transport model has been used to derive traffic forecasts for a future year of 2022, the year by which compliance with air quality targets is expected to be achieved. The traffic forecasts take account of all committed transport schemes and land-uses developments which are expected to be implemented by 2022. The results of the traffic forecasting work carried out as part of the option and scenario testing work to develop and identify the preferred Air Quality Local Plan are detailed in this report.

Traffic forecasts for a second future year of 2025 have also been produced, this will be used to inform the economic assessment and wider appraisal of the Local Plan and a charging CAZ. The assumptions made in the derivation of the forecast 2025 traffic data are detailed in this report.

In summary, it has been demonstrated that the NSMM transport model is a robust tool for the purpose of deriving forecast traffic data to develop and assess the impact of an Air Quality Local Plan and comparison against a charging CAZ.

1 Introduction

1.1 Purpose of the Traffic Forecasting Report

The purpose of the Traffic Forecasting Report (TFR) is to detail the methodologies and assumptions used to produce traffic forecasts to inform the air quality modelling work and subsequent identification, development and appraisal of an appropriate Air Quality Local Plan.

It also demonstrates that the forecasts have been produced in accordance with guidance given by the DfT in TAG and additional guidance provided by the JACU.

This report forms part of a series of modelling documentation that includes:

- T1 - Tracker Table - a live document that demonstrates all the transport modelling requirements have been met.
- T2 - Local Plan Transport Model Validation Report – which demonstrates that the NSMM transport model accurately represents existing traffic conditions.
- T3 - Local Plan Transport Modelling Methodology Report – which outlines the methodology of the transport modelling work undertaken.

1.2 Scheme background

The need to develop options to improve NO_2 levels within Stoke-on-Trent and Newcastle-under-Lyme, comes as a result of the UK's Plan for Tackling Roadside Nitrogen Dioxide Concentrations. In October 2018, Stoke-on-Trent and Newcastle-under-Lyme were identified by Government as two areas in which NO_2 levels exceed EU regulations. These two authorities, alongside SCC (the County being the Highway Authority for the highway network in Newcastle-under-Lyme), are to produce an Air Quality Local Plan which will address these NO_2 exceedances in the shortest timeframe possible. The Government will work with the Authorities through its JAQU to support and develop their plans to reduce NO_2 emissions.

2 Overview of the NSMM transport model

2.1 Purpose of the NSMM transport model

The NSMM transport model has been created in order to allow the impact of proposed land-use and infrastructure improvements to be forecast. The transport model has been developed in accordance with appropriate TAG guidance and is an appropriate tool to be used to inform the development, appraisal and implementation of an Air Quality Local Plan.

2.2 Extent of the NSMM transport model

The NSMM transport model has been developed entirely in CUBE Voyager and covers the whole of the urban areas of Stoke-on-Trent and Newcastle-Under-Lyme with both road and rail links modelled.

The transport model consists of the following three main modules:

- Highway Assignment Model
- Public Transport Assignment Model
- Variable Demand Model

The modelled time periods are as follows:

- AM Peak-Hour (08:00 - 09:00hrs)
- Inter-Peak Hour (14:00 - 15:00hrs)
- PM Peak-Hour (17:00 - 18:00hrs)

Figure 2-1 and Figure 2-2 show the extents of the modelled road and rail networks.

The transport model has 288 zones which are split as follows:

- Internal zones 1 – 207 and 275 – 288
- Peripheral zones 208 – 233
- Regional zones 234 – 255
- National zones 256 – 274

The Internal zones and modelled transport network represent the greatest level of detail in order to capture local routeing and travel demand responses. The Peripheral zones form a ring of buffer zones just outside the detailed modelled area, with a dimension a little larger than the internal zones in order to provide realistic travel demand to and from these areas.

The Regional and National zones are far coarser, for example Scotland is represented by a single zone, and this permits the representation of destination choice and travel opportunities between external zones and between internal and external zones. Capturing external to external demand is important in the NSMM transport model area, as it includes roads carrying significant through traffic such as the M6, A50 and A500 Trunk Roads.

Further details on the scope, specification and development of the NSMM transport model are detailed in the T2 - Local Plan Transport Model Validation Report and T3 - Local Plan Transport Modelling Methodology Report.

Figure 2-1 : Extents of modelled road and rail networks

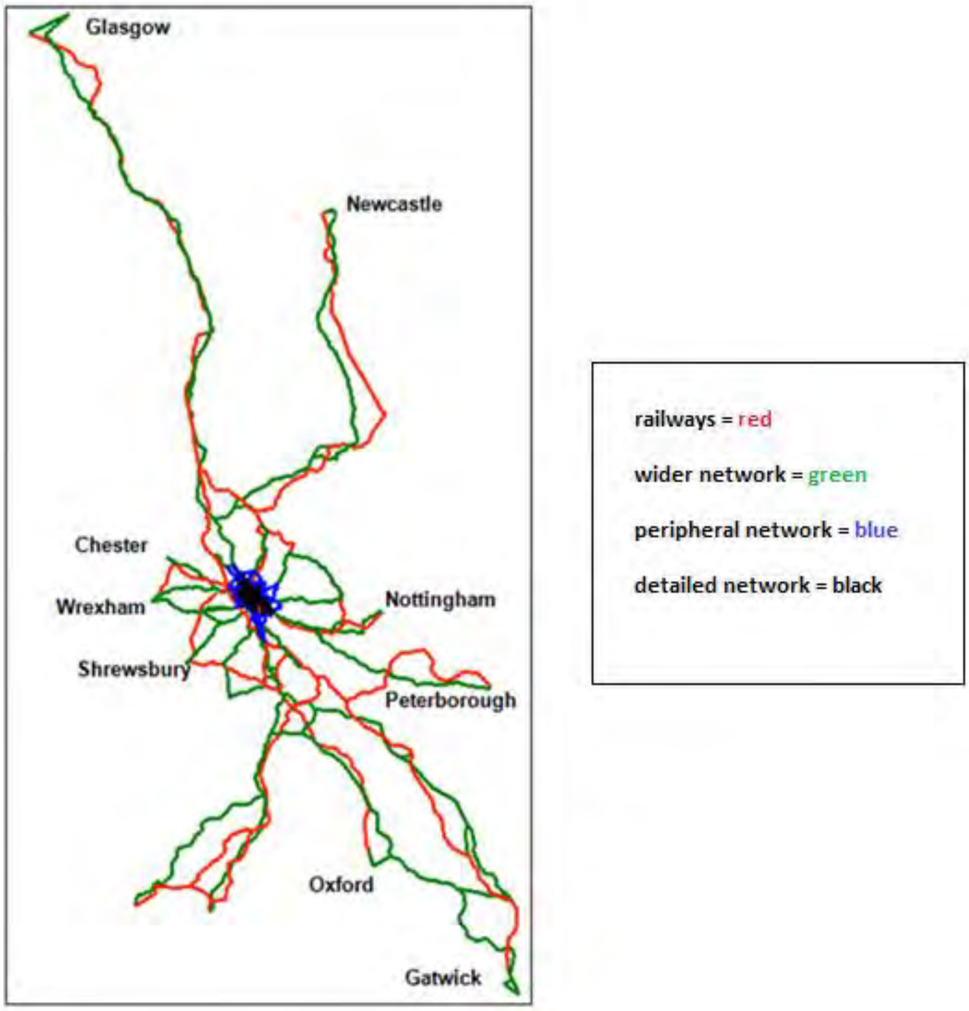
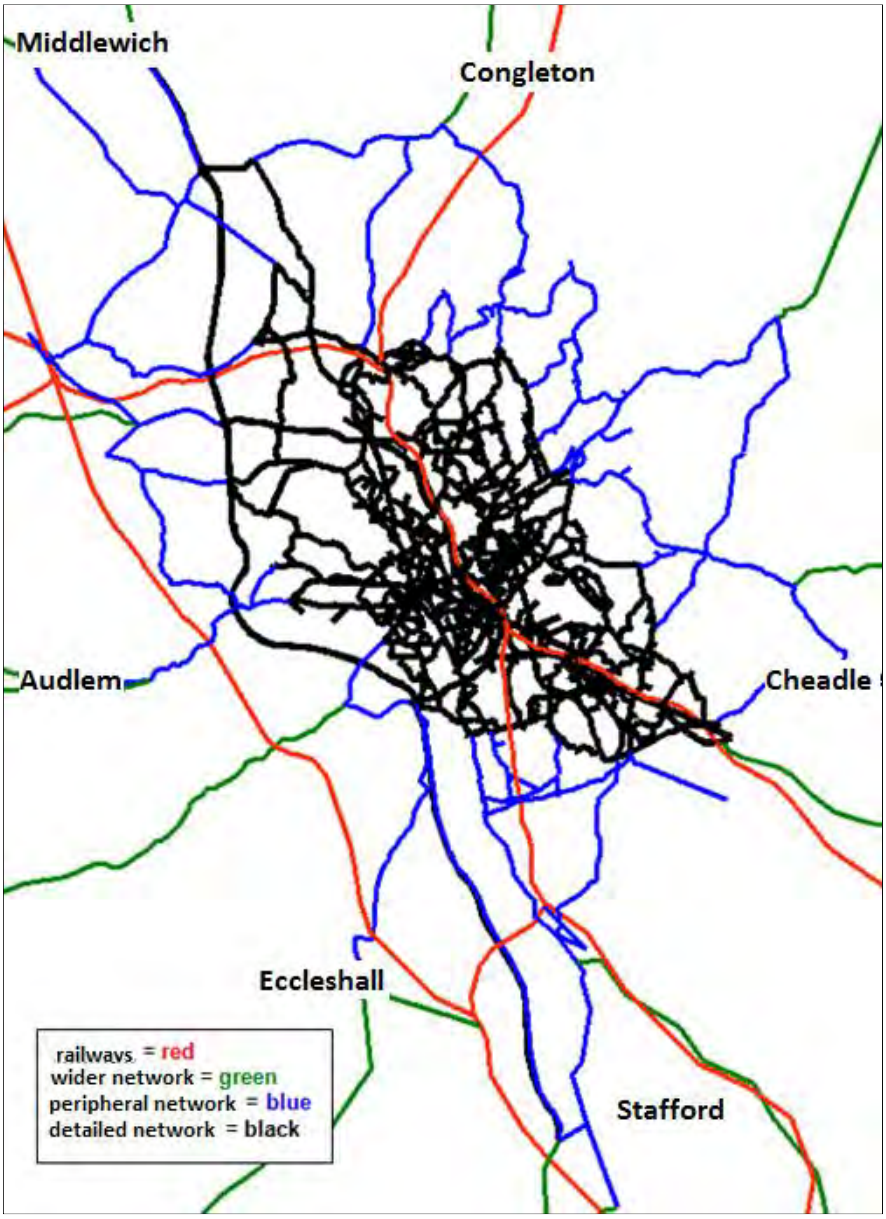


Figure 2-2: Extents of modelled peripheral and internal road and rail networks



2.3 Updated 2015 Base-Year model

The NSMM transport model has been updated from a 2009 base-year to a new base-year of 2015. The vehicle types represented by the transport model have also been disaggregated by compliant and non-compliant vehicles. The transport model has been validated against traffic counts at both a link and screenline level, observed journey time data and Automatic Number Plate Recognition (ANPR) data.

The results of the validation work are documented in the T2 - Local Plan Transport Model Validation Report. The updated and refined 2015 base-year NSMM transport model has been shown to be fit for purpose and ready to be taken forward for traffic forecasting and the development and appraisal of the required Air Quality Local Plan.

3 Forecasting approach

3.1 Overview of approach

Traffic forecasts using the NSMM transport model have been produced for the AM Peak-Hour, Inter-Peak Hour and PM Peak-Hour modelled time periods for the following forecast years:

- 2022 – The year by which compliance should be achieved.
- 2025 – Required for the extrapolation of benefits for the economic and environmental appraisal of the Air Quality Local Plan.

In accordance with Government guidance, the forecasting approach used involves three basic steps:

- Development of future year transport networks
- Derivation of future year travel demand
- Assignment of the future year travel demand to the future transport networks

3.2 Traffic forecasting guidance

The following TAG Units have been adhered to in the development of the required traffic forecasts:

- TAG Unit M2 – Variable Demand Modelling
- TAG Unit M4 – Forecasting and Uncertainty
- TAG Data Book (May 2019)

3.3 Uncertainty Log

The purpose of an uncertainty log is to identify all the local and external uncertainties and factors which could affect the traffic/patronage, revenues and delivery of scheme benefits. Typically, these factors include proposed land-use developments and transport infrastructure improvements.

An uncertainty log for the future year land-use developments and transport infrastructure improvements has been prepared using the uncertainty levels defined in Table 3-1. The modelled forecast Reference Case will include those developments and transport schemes which fall under the Near Certain and More Than Likely uncertainty levels, i.e. they are considered committed schemes in terms of having planning permission and available funding, which is consistent with the core scenario defined in TAG Unit M4 – Forecasting and Uncertainty.

All the proposed highway and public transport schemes which have been identified in the uncertainty log are described further in Chapter 4. Details of the future year land-use developments contained in the uncertainty log and how they have been converted into trips for inclusion in the forecast trip matrices are detailed in Chapter 5.

Table 3-1: Uncertainty level definition and categorisation for proposed land-use developments and proposed transport infrastructure improvements

Uncertainty Level	Probability	Status	Reference Case
Completed	Happened	Built/open.	✓
Near Certain	The outcome will happen or there is a high probability that it will happen	Intent announced by proponent to regulatory agencies. Approved development proposals. Projects under construction.	✓
More Than Likely	The outcome is likely to happen but there is some uncertainty	Submission of planning or consent application imminent. Development application within the consent process.	✓
Reasonably Foreseeable	The outcome may happen but there is significant uncertainty	Identified within a development plan. Not directly associated with the transport strategy/scheme but may occur if the strategy/scheme is implemented. Development conditional upon a transport 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 on currently available information. Discussed on a conceptual basis. One of a number of possible inputs in an initial consultation process. Or, a policy aspiration.	

3.4 Sensitivity tests

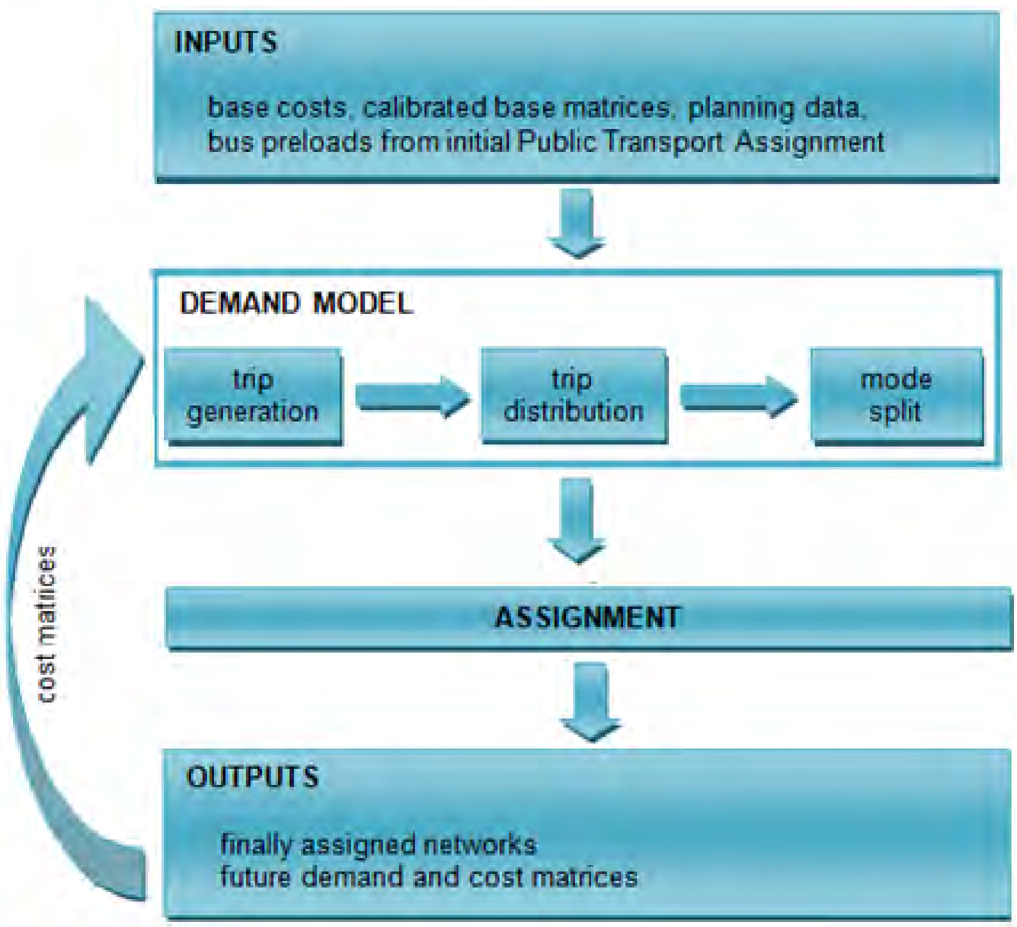
Appropriate sensitivity tests will be carried out on key assumptions made in the application of the Reference Case transport model to test any uncertainties in predicted outcomes. For example, with regards to the modelling of a charging CAZ, sensitivity tests will be undertaken on different charging levels and assumptions regarding the responses of vehicle upgrades.

3.5 NSMM demand model

Variable Demand Modelling (VDM) captures the principle that travel demand will be affected by proposed transport schemes. Demand model runs have therefore been undertaken for each scenario, forecast year and modelled time period to produce future year synthetic demand trip matrices.

The basic structure of the NSMM demand model is shown diagrammatically in Figure 3-1 and covers trip generation, trip distribution and modal split responses.

Figure 3-1: Demand model structure



Home based car and public transport trips are segmented as follows in the demand model:

- Six socio-economic groupings (HH1 to HH6)
- Three car ownership categories (0, 1, 2 or more)
- Four trip purposes:
    - home based work (HBW)
    - home based education (HBE)
    - home based shopping (HBS)
    - home based other (HBO)

This gives a total of 72 home based demand segments.

Non-home-based car and public transport trips are divided into two segments:

- Non-home based (employer’s business) (NHBEB)
- Non-home based (other) (NHBO)

Goods vehicle trips are divided into two segments:

- Non-home based LGV trips
- Non-home-based HGV trips

The NSMM transport model is an incremental demand model using an additive approach, therefore the difference between the 2015 base-year and future year synthetic car trip matrices are applied to the 2015 validated car trip matrices to produce forecast car trip matrices. The resultant car trip matrices are subsequently constrained to NTEM traffic forecasts and assigned to the corresponding future year highway network.

Similarly, the future year synthetic LGV and HGV trip matrices derived from the demand model will be constrained to NTM growth. The difference between the 2015 base-year and constrained future year synthetic goods vehicle trip matrices are then applied to the validated 2015 goods vehicle trip matrices to create future year trip matrices and assigned to the corresponding future year highway network.

Further information on the scope, specification and calibration of the NSMM demand model can be found in the T2 - Local Plan Transport Model Validation Report and T3 - Local Plan Transport Modelling Methodology Report.

4 Forecast network development

4.1 Overview of approach

For the testing, appraisal and development of an Air Quality Local Plan and its subsequent economic and environmental appraisal, appropriate comparisons will be made between the traffic forecasts without and with the proposed mitigation measures. Thus, a Do-Minimum and Do-Something transport network will be prepared for each modelled scenario and forecast year.

The Do-Minimum (or Reference Case) transport network is based on the validated base-year network and includes those proposed transport schemes that are expected to be implemented by the forecast year.

The Do-Something transport networks are based on the Do-Minimum network. However, they will include the proposed mitigation measures to be tested and appraised to inform the development of the Air Quality Local Plan. These mitigations measures, modelled scenarios and resultant traffic forecasts will be reported in an updated version of this report.

4.2 Reference Case transport schemes

The proposed transport schemes identified for inclusion in the 2022 and 2025 Reference Cases have been allocated an uncertainty level as defined in Chapter 4 and are detailed in Table 4-1:

For the 2022 Reference Case, buses on routes 3, 3A, 4, 4A, 21 and 23 which use the A53 Etruria Road corridor will be retrofitted to make them compliant to Euro 6 standards. Furthermore, buses on other routes will be expected to achieve 49% compliance in accordance with the EFT. Therefore, the proportions of buses on other routes in the NSMM transport model have been appropriately adjusted to meet this compliance rate.

Table 4-1: 2022 and 2025 Reference Case transport schemes

Scheme No.	Scheme Name	Uncertainty Level
1	M6 J16 Improvements	Completed
2	A520 Weston Road/Weston Coyney Road Junction Improvement	Completed
3	Knutton Lane Road Safety Scheme	Completed
4	A5007 City Road/Glebedale Road Junction Improvement	Completed
5	A50 Safety Schemes	Completed
6	A5006 Broad Street/A5010 Marsh Street Junction Improvement	Completed
7	A5010 Marsh Street/Trinity Street Improvements	Completed
8	A53 Etruria Road/Festival Way Roundabout Improvement - Removal of Bus Lane	Completed
9	Chatterley Valley Sustainable Transport Package	Near Certain
10	Unity Walk/City Centre Network Changes	Near Certain
11	A500 Widening (Porthill to Wolstanton)	Near Certain
12	A34 London Road – Removal of On-Street Parking and Reduction in Speed Limit	Near Certain
13	Newcastle-under Lyme Ring Road – Reduction in Speed Limit	Near Certain
14	A50 Kidsgrove Traffic Management Scheme	Near Certain
15	A50 Waterloo Road/A53 Cobridge Road (Cobridge Traffic Lights) Junction Improvement	Near Certain
16	A5007 Uttoxeter Road/Meir Hay Road Junction Improvement	Near Certain
17	A500/A52 City Road Junction Improvement	Near Certain
18	A52 Leek Road/Station Road Junction Improvement	Near Certain
19	A50 Waterloo Road – Removal of Bus Lane	Near Certain
20	Sutherland Road/Weston Coyney Road Junction Improvement	Near Certain
21	A53 Etruria Road Corridor Euro 6 Bus Retrofit	Near Certain
22	Etruria Valley Link Road Project	Near Certain
23	A50 Victoria Road/A52 Leek Road (Joiners Square) Junction Improvement	More Than Likely
24	A5008 Bucknall New Road Widening	More Than Likely

4.3 Forecast network calibration

The modelling of the proposed transport schemes has been based on appropriate scheme drawings and designs. The modelling of new highway links has been defined by the coding of appropriate link lengths, speed/flow curves (as specified by the attribution of appropriate link types), numbers of lanes and speed limits. The modelling of new junction layouts has been based on measured junction geometry in order to derive appropriate saturation flows. In particular, the modelling of new or improved signalised junctions has been validated to ensure that sensible phasing's, cycle times and inter-green times are achieved and result in appropriate delays.

The modelling of all new transport schemes has been appropriately reviewed and tested to ensure that the resultant changes in traffic flows and routeing of traffic are logical and robust.

5 Forecast trip matrix development

5.1 Overview of approach

Future year trip matrices will be produced for the Do-Minimum and Do-Something scenarios for each forecast year and modelled time period. The NSMM demand model will take account of the appropriate predicted changes in planning data and transport schemes.

As the NSMM transport model is incremental, the change in the predicted travel demand between the 2015 base-year synthetic trip matrices and the future year synthetic trip matrices will be constrained to the appropriate NTEM and NTM forecasts and additively applied to the 2015 validated assignment trip matrices to produce the required forecast trip matrices.

The scope and specification of the NSMM demand model is detailed further in T2 - Local Plan Transport Model Validation Report and T3 - Local Plan Transport Modelling Methodology Report. The development of the forecast trip matrices is discussed further below.

5.2 Future year planning data

To derive the forecast trip matrices, proposed changes in the following planning data (since the 2015 base-year of the NSMM transport model) have been collated for the Internal and Peripheral zones of the transport model:

- Numbers of households
- Numbers of jobs (derived from Gross Floor Area (GFA) for proposed employment developments)
- Retail floor space by GFA and the following retail types:
    - Food Store
    - Local Shops
    - Non-Food Retail
    - Shopping Mall
- Education places for primary, secondary and tertiary levels

For the purpose of deriving changes in numbers of jobs from the GFA, the employment density factors for each employment land-use shown in Table 5-1: were used.

Table 5-1: Employment densities (employment densities guide, 2nd edition, Drivers Jonas Deloitte, 2010)

Use Class	Use Type	Area per Full Time Equivalent (m^2)
B1(a)	General Office	12
B1(a)	Call Centres	8
B1(a)	IT/Data Centres	47
B1(a)	Business Park	10
B1(a)	Serviced Office	10
B1(c)	Light Industrial (Business Park)	47
B2	General Industrial	36
B8	General Warehouse	70
B8	Large Scale and High Bay Warehouse	80

Table 5-2 summarises the uncertainty log for the changes in planning data between the 2015 base-year and the 2022 Reference Case and between the 2015 Base-Year and the 2025 Reference Case. The changes in planning data since the 2015 base-year has been mapped to the NSMM transport model zones using GIS software. Figure 5-1 to Figure 5-8 show the change in jobs, households and retail development between 2015 and the future modelled years.

Table 5-2: Uncertainty log for planning data

Land-Use by Local Authority Area	Completed by 2022		Completed by 2025	
	More Than Likely	Near Certain	More Than Likely	Near Certain
Employment (Numbers of Jobs)				
Newcastle-under-Lyme	-642	613	-596	2,883
Stoke-on-Trent	517	13,409	965	15,048
Residential (Numbers of Households)				
Newcastle-under-Lyme	515	2,467	650	3,271
Stoke-on-Trent	708	3,846	2,004	4,361
Retail (GFA m^2)				
Newcastle-under-Lyme	-107	-790	9,818	3,030
Stoke-on-Trent	-1,785	44,364	-175	49,123
Education (Numbers of Student Places)				
Newcastle-under-Lyme	210	0	210	0
Stoke-on-Trent	0	1,350	0	1,350

Figure 5-1: Change in jobs between 2015 and 2022

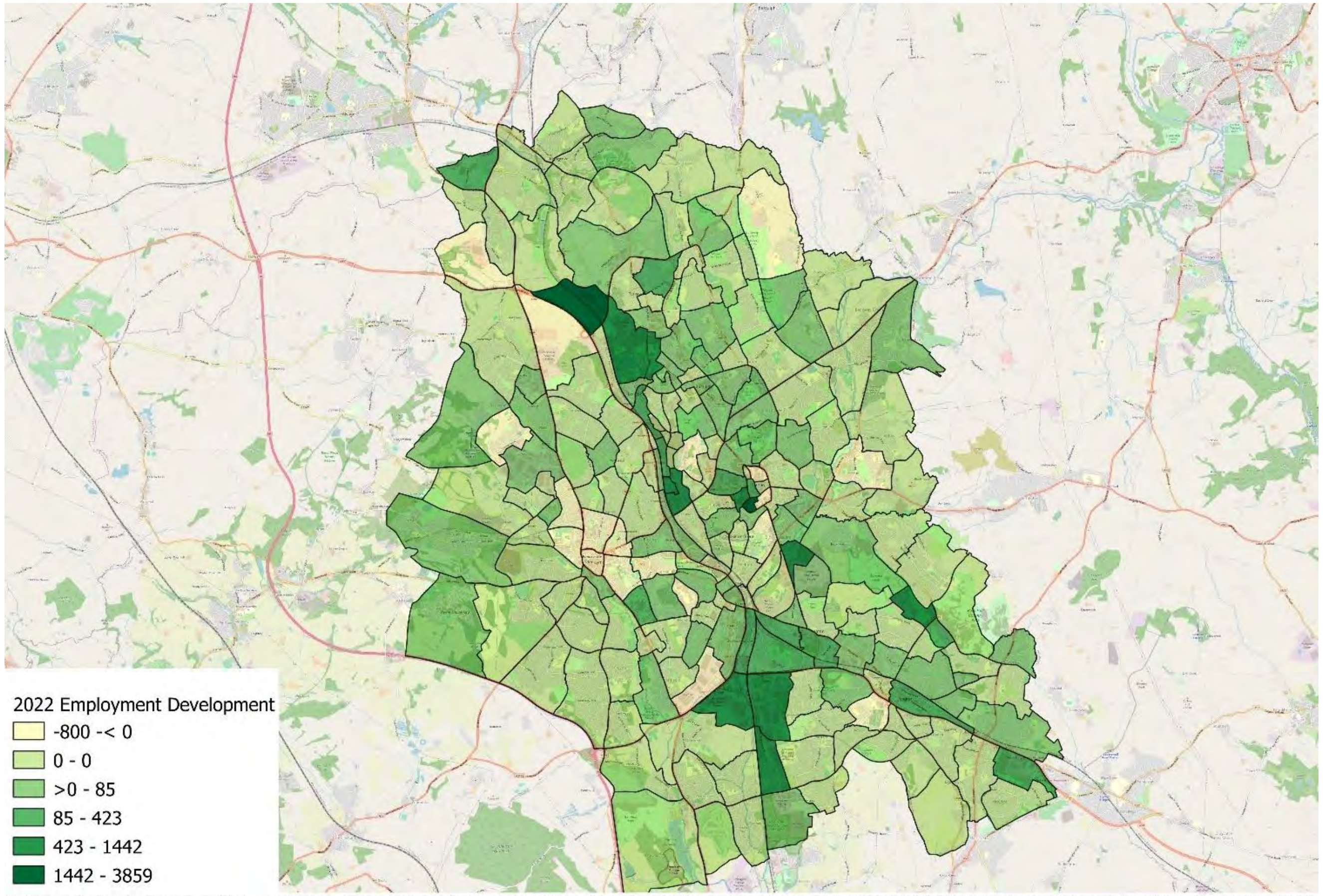


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Figure 5-2: Change in jobs between 2015 and 2025

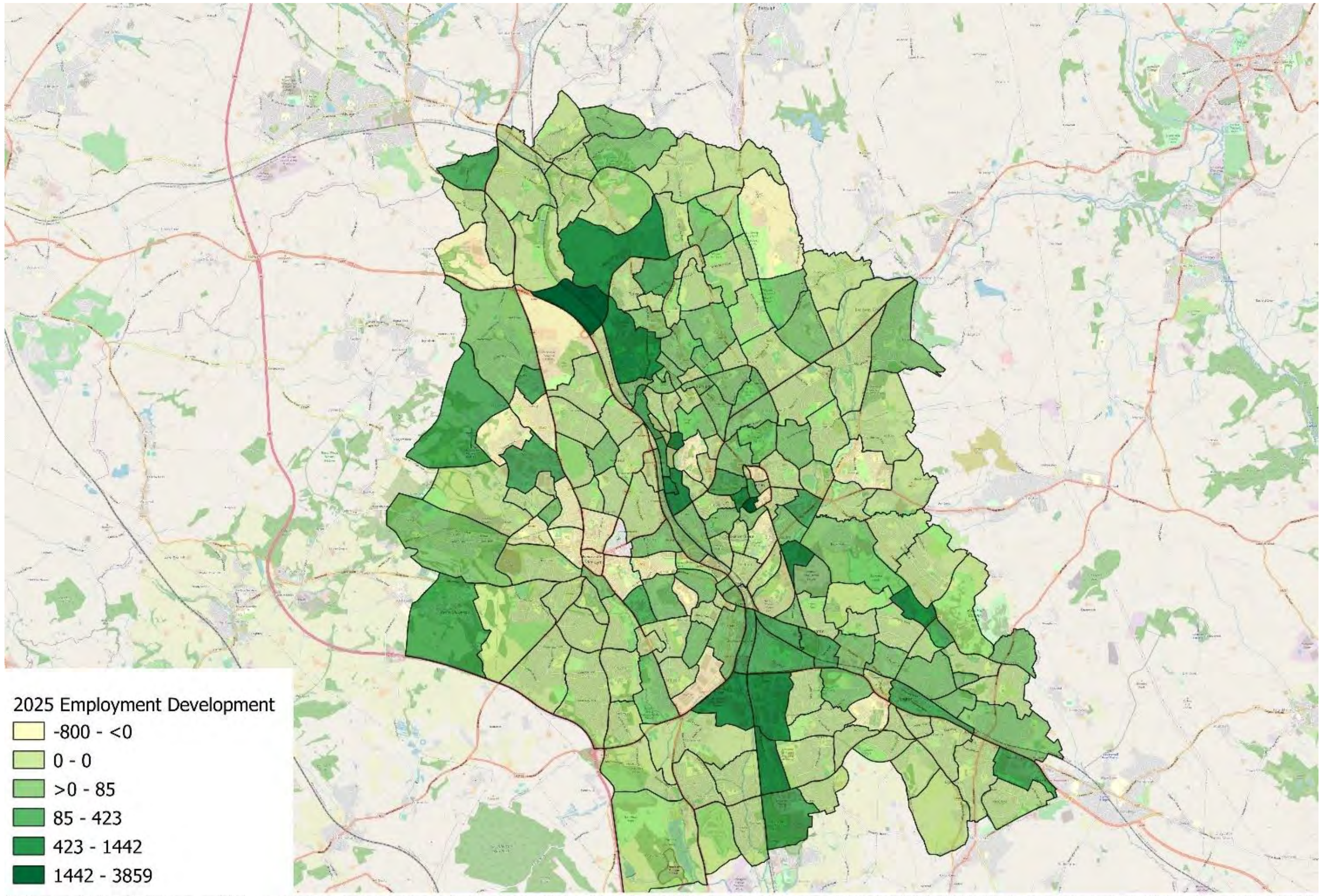

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Figure 5-3: Change in households between 2015 and 2022

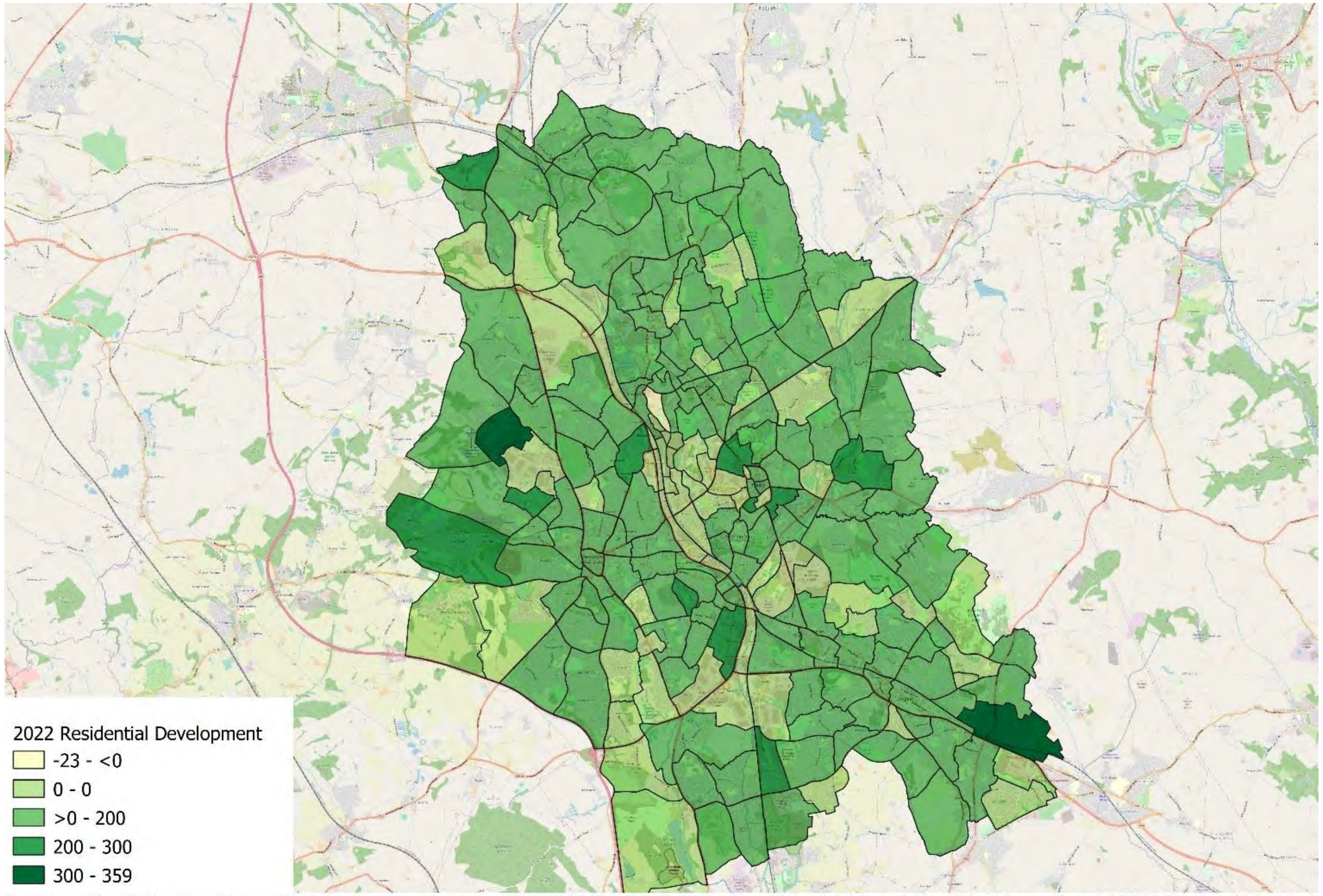

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Figure 5-4: Change in households between 2015 and 2025

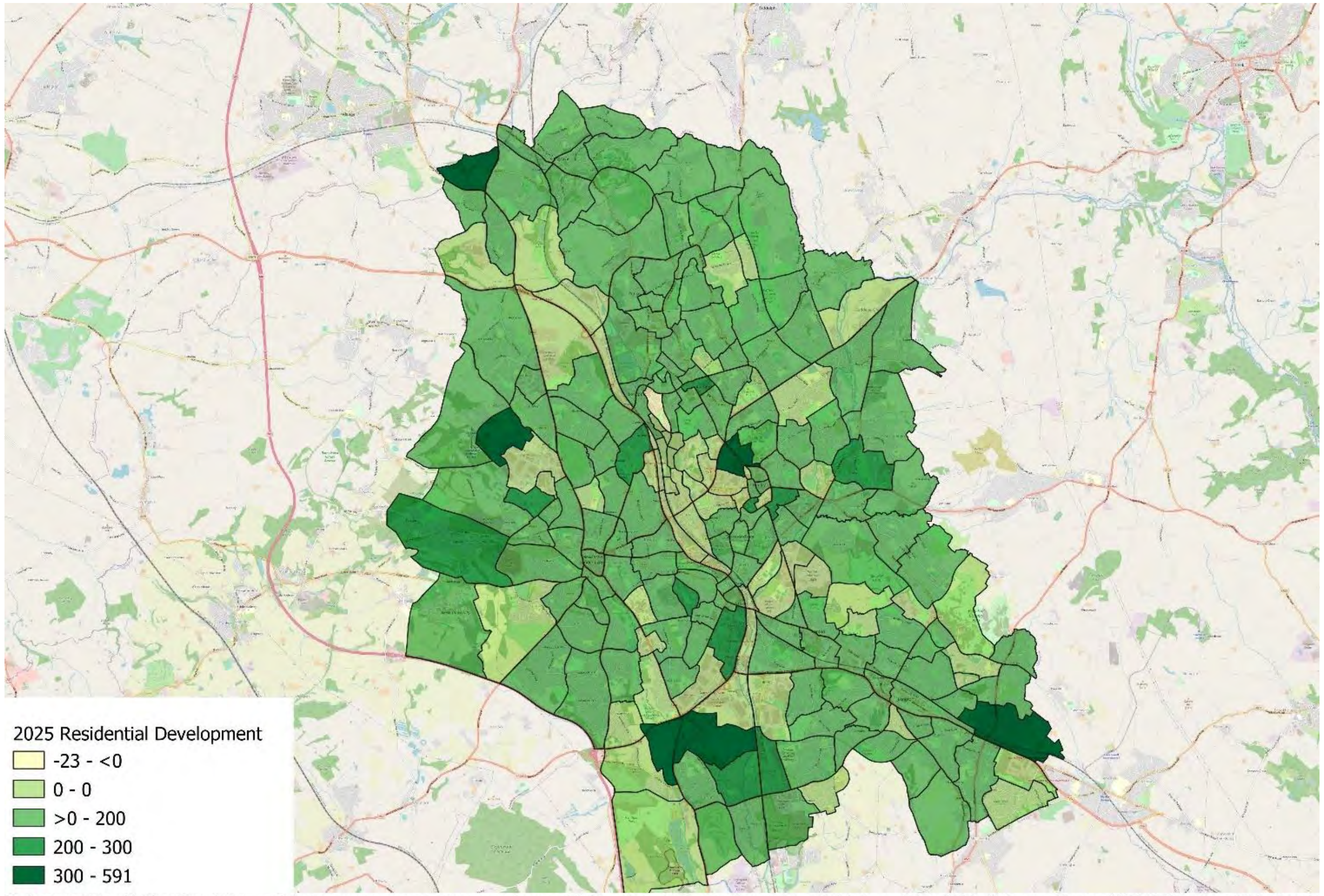

Figure 5-5: Change in retail developments between 2015 and 2022 (GFA m2)

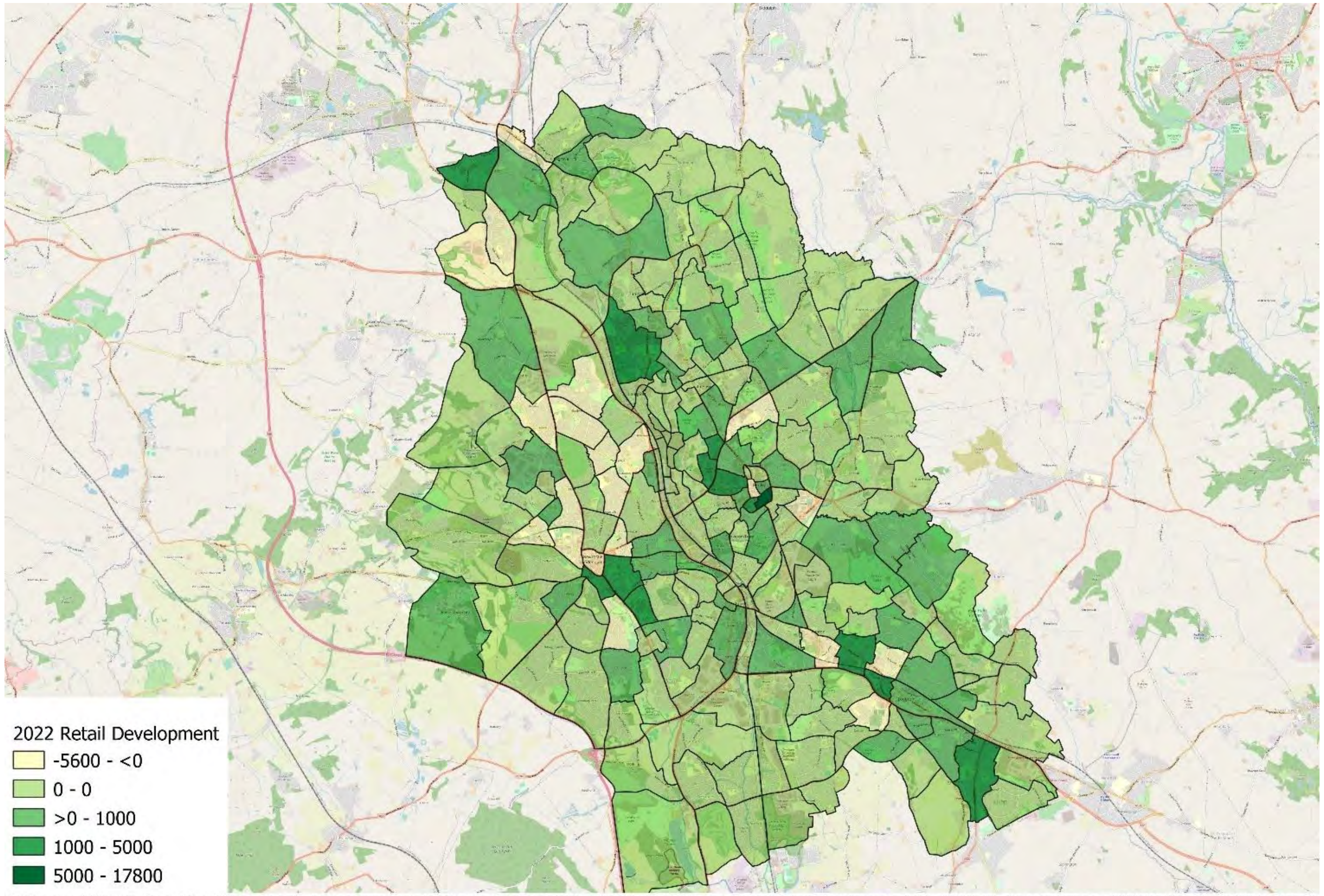

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Figure 5-7: Change in retail developments between 2015 and 2025 (GFA m2)

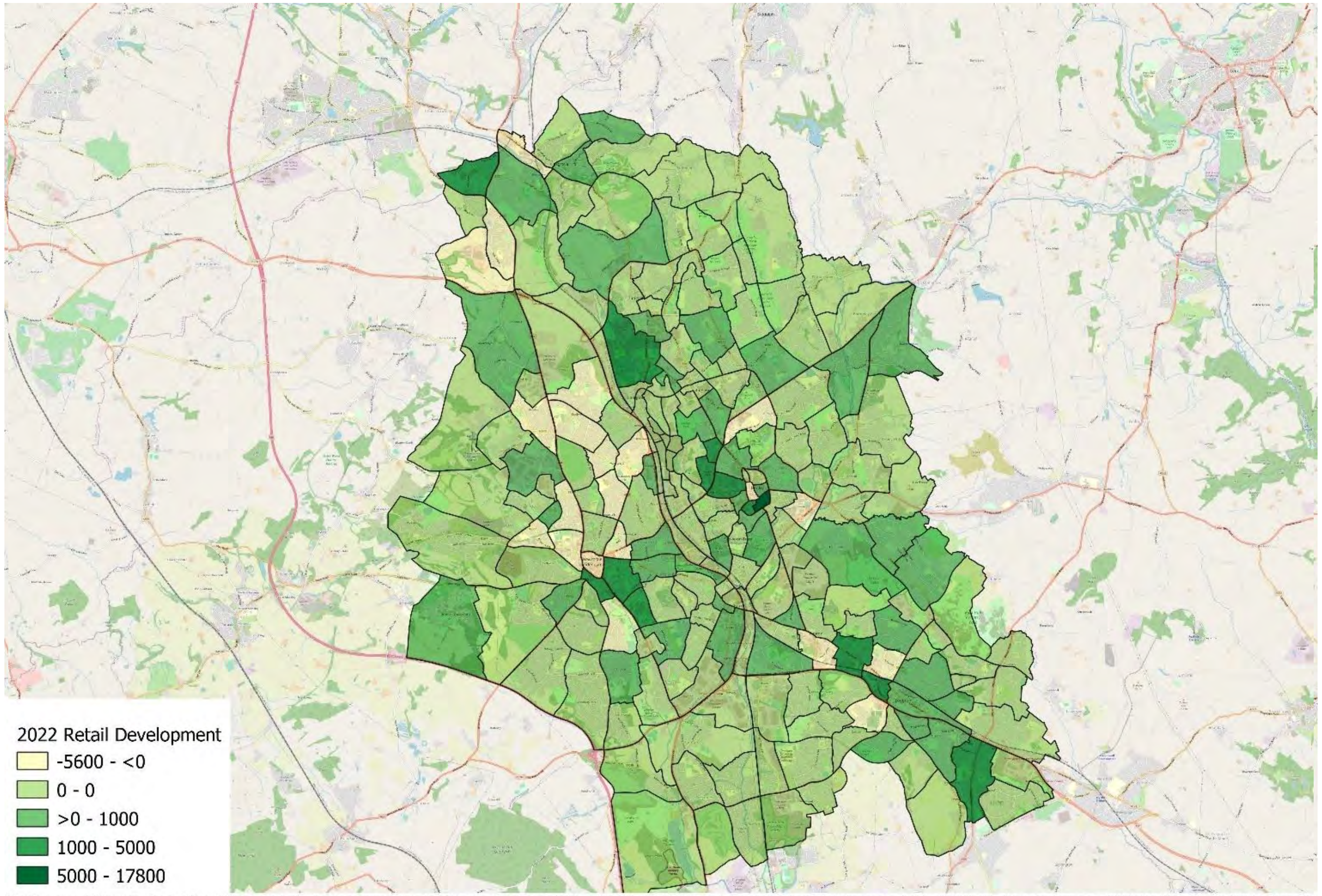

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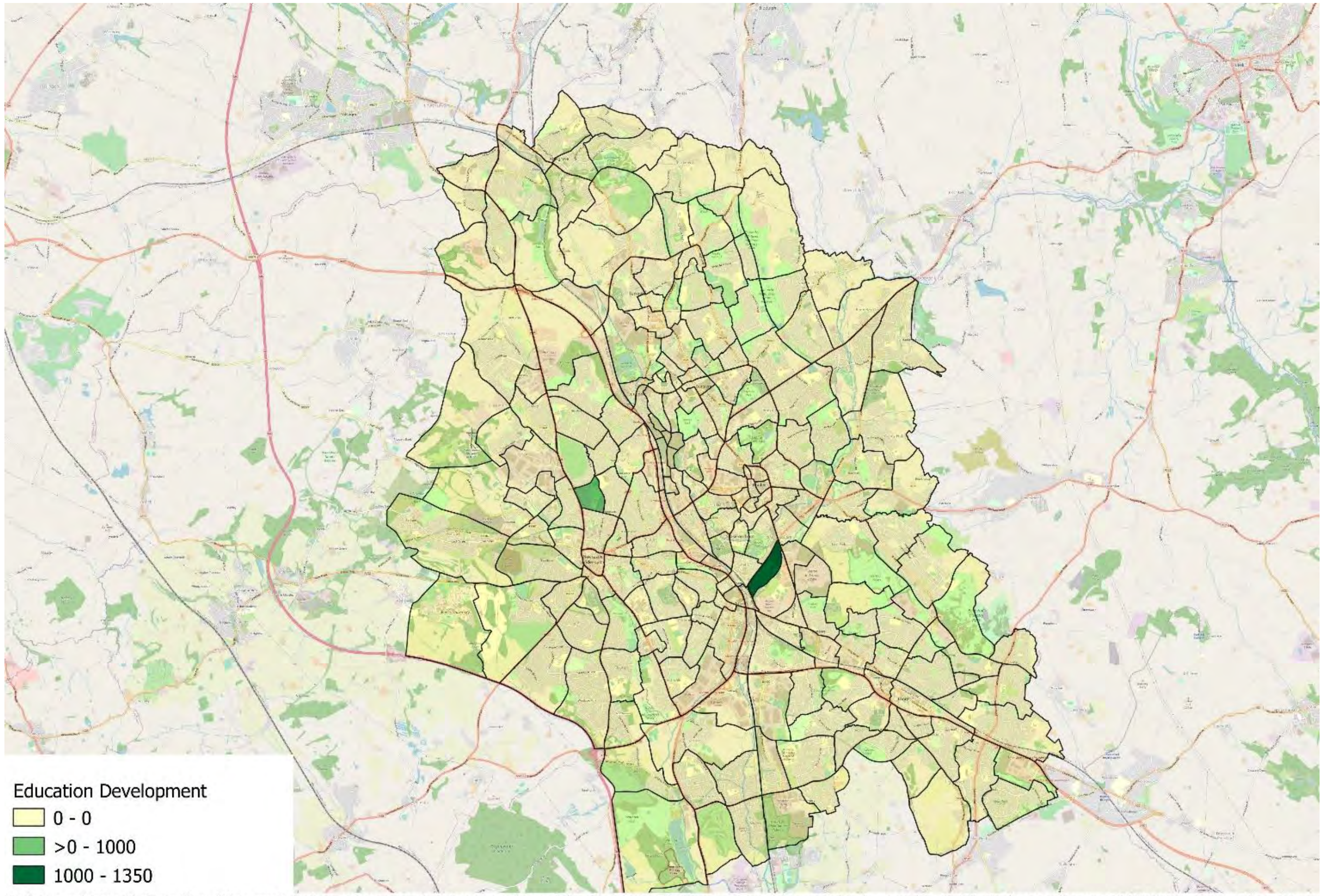
Figure 5-8: Change in educational developments between 2015 and 2022/2025 (number of student places)



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5.3 Matrix constraint

TAG Unit M4 – Forecasting and Uncertainty states that the forecast trip end growth should be consistent with NTEM growth at the study area level to ensure consistency between different geographical locations when assessing transport proposals. To accord with this, the growth in the forecast year car assignment trip matrices have been constrained to Version 7.2 of the NTEM traffic forecasts. The NTEM factors have been derived at an appropriate district level and applied at a zonal level for all internal, peripheral, regional and national zones.

NTEM factors have therefore extracted for origins and destinations between the 2015 base-year and the modelled future years of 2022 and 2025 for all trip purposes for the following time periods:

- Weekday AM Peak Period (07:00 - 09:59hrs)
- Weekday Inter Peak Period (10:00 - 15:59hrs)
- Weekday PM Peak Period (16:00 - 18:59hrs)

The LGV and HGV trip matrices have been constrained to NTM RTF18 growth factors, which are the same for each time period and are applied to the whole matrix. The RTF18 factors used to constrain the forecast LGV and HGV trip matrices for the forecast year of 2022 and 2025 are detailed in Table 5-3.

Table 5-3: NTM goods vehicle factors

NTM	2015 - 2022		2015 - 2025	
	LGV	HGV	LGV	HGV
RTF18	1.137	0.993	1.179	0.993

5.4 Cost assumptions

Table 5-4 and Table 5-5 show the Values of Time (VOT) of private and public transport trips which have been used in the derivation of composite costs for the trip distribution model of the NSMM demand model. The VOT are based on the TAG Data Book (May 2019). Table 5-4details the VOT for car drivers which are required to convert parking costs to time values. Similarly, Table 5-5 shows the VOT for public transport trips which are required to convert fares to time values.

Table 5-4: Values of time - car driver (pence per minute)

Mode (Purpose)	2015	2022	2025
Car (Work)	26.5	28.3	29.4
Car (Commuting)	17.7	18.9	19.7
Car (Other)	8.1	8.6	9.0

Table 5-5: Values of time - public transport (pence per minute)

Mode (Purpose)	2015	2022	2025
PT (Work)	15.0	16.0	16.6
PT (Commuting)	17.7	18.9	19.7
PT (Other)	8.1	8.6	9.0

Table 5-6 and Table 5-7 show the VOT and associated factors for calculating the Vehicle Operating Costs (VOC) used during the assignment stage as derived from the TAG Data Book (May 2019). The formula for calculating VOC is given below:

$$VOC = (a/v + b + cv + dv^2 + a_1 + b_1/v) * l * VOT$$

where VOC = vehicle operating cost (in minutes)
v = average speed (in kms per hour)
l = link length (in kms)
VOT = value of time (in pence per minute)
a, b, c and d are the factors used to calculate fuel costs
a_1 and b_1 are the factors used to calculate non-fuel costs

Table 5-6: Values of time - assignment (pence per minute)

Mode	2015			2022			2025		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Car	20.2	19.0	19.4	21.5	20.3	20.7	22.4	21.1	21.5
LGV	24.8	24.8	24.8	26.5	26.5	26.5	27.5	27.5	27.5
HGV	25.6	25.6	25.6	27.3	27.3	27.3	28.3	28.3	28.3

Table 5-7: Vehicle operating cost factors

Factor	2015			2022			2025		
	Car	LGV	HGV	Car	LGV	HGV	Car	LGV	HGV
a	48.677	41.890	378.348	43.678	41.522	400.932	41.218	40.806	413.176
b	8.579	10.450	19.776	7.730	10.275	20.957	7.413	10.145	21.597
c	-0.091	-0.151	-0.135	-0.082	-0.148	-0.143	-0.078	-0.145	-0.147
d	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
a_1	3.977	7.208	10.049	3.915	7.201	10.049	3.832	7.054	10.049
b_1	16.394	41.459	392.392	16.394	41.459	392.392	16.394	41.459	392.392

5.5 Demand model convergence

Section 6.3 of TAG Unit M2 – Variable Demand Modelling stresses the importance of demonstrating the whole model system converges to a satisfactory degree in order to have confidence that the model results are as free from error and 'noise' as possible. To ensure convergence and stability of the NSMM transport model for scheme appraisal the application of an appropriate method of successive weighted averages has been applied to the demand model.

The recommended criterion for measuring convergence between the demand and supply models is the demand/supply gap (%GAP) as defined in paragraph 6.3.4 of the TAG Unit. It is stated in paragraph 6.3.8 of the TAG Unit that %GAP values of less than 0.1% can be achieved in many cases, although in more problematic systems this may be nearer to 0.2%.

The %GAP values for the forecast NSMM demand model are detailed in Table 5-8 for the 2022 and 2025 Reference Case scenarios for each mode and time period. As can be seen from Table 5-8, the levels of convergence are in some instances slightly outside the recommended TAG values after 10 iterations. A similar level of convergence is achieved for cars, LGVs and HGVs with better convergence generally achieved for the Inter-Peak Hours compared to the AM and PM Peak-Hours. Although the public transport demand model runs have a higher %GAP value compared to the other modes, this can be attributed to the coarser nature of the public transport model but is unlikely to affect scheme appraisal. Furthermore, the final iterations of the demand model generally show a good level of stability.

Table 5-8: 2022 and 2025 Reference Case demand model convergence results (%GAP)

Year	Time Period and Mode	Iteration Number									
		1	2	3	4	5	6	7	8	9	10
2022	AM Car	0	4.85	4.38	1.30	0.54	0.48	0.28	0.36	0.35	0.27
	AM LGV	0	4.79	4.21	1.47	0.58	0.48	0.28	0.35	0.29	0.19
	AM HGV	0	2.89	2.55	0.79	0.38	0.25	0.18	0.21	0.16	0.09
	AM PT	0	5.55	5.48	0.96	0.68	0.69	0.48	0.46	0.65	0.64
	IP Car	0	4.18	4.03	0.55	0.23	0.19	0.10	0.16	0.09	0.26
	IP LGV	0	3.54	3.52	0.73	0.28	0.33	0.12	0.24	0.17	0.34
	IP HGV	0	2.36	2.45	0.48	0.16	0.24	0.11	0.23	0.15	0.35
	IP PT	0	5.73	5.63	0.52	0.20	0.18	0.08	0.12	0.08	0.17
	PM Car	0	4.33	4.04	0.76	0.36	0.30	0.24	0.21	0.14	0.23
	PM LGV	0	4.05	3.72	0.89	0.41	0.31	0.31	0.23	0.23	0.28
	PM HGV	0	2.38	2.16	0.38	0.23	0.12	0.20	0.09	0.10	0.21
	PM PT	0	7.36	7.52	0.83	0.59	0.45	0.50	0.51	0.13	0.35
2025	AM Car	0	6.23	5.33	1.85	0.81	0.77	0.43	0.32	0.33	0.26
	AM LGV	0	6.53	5.47	2.28	0.79	0.81	0.45	0.39	0.33	0.28
	AM HGV	0	3.88	3.25	1.24	0.45	0.45	0.29	0.2	0.26	0.14
	AM PT	0	6.56	5.93	1.53	0.57	0.8	0.9	0.29	0.64	0.26
	IP Car	0	4.74	4.39	0.84	0.3	0.24	0.17	0.27	0.1	0.2
	IP LGV	0	4.41	4.05	1.14	0.44	0.34	0.22	0.36	0.17	0.23
	IP HGV	0	2.7	2.56	0.68	0.29	0.2	0.21	0.37	0.09	0.18
	IP PT	0	6.28	6.13	0.81	0.31	0.26	0.1	0.18	0.09	0.16
	PM Car	0	5.29	4.63	1.49	0.41	0.6	0.24	0.27	0.28	0.22
	PM LGV	0	5.43	4.65	1.71	0.58	0.63	0.29	0.36	0.33	0.29
	PM HGV	0	2.91	2.59	0.75	0.34	0.32	0.18	0.15	0.16	0.17
	PM PT	0	8.19	8.01	1.63	0.35	0.74	0.56	0.18	0.43	0.32

6 Reference Case traffic assignment results

6.1 Network performance statistics

Table 6-1 shows the network performance statistics, that is the total distance travelled (pcu-kms), total network travel time (pcu-hrs) and average network speed for the 2015 base-year, the 2022 and 2025 Reference Case by modelled time period and vehicle type.

As can be seen from Table 6-1, there is a general increase in network travel distance and travel time and a negligible change or small improvement in the average network speed between the 2015 base-year and the 2022 Reference Case. This is obviously due to the predicted increase in traffic growth and wider routeing of traffic on the highway network but with expected resultant increases in congestion mitigated by the effects of the Etruria Valley Link Road Project and other proposed transport improvements. An increase in travel distance and travel time can also be identified between 2022 Reference Case and the 2025 Reference Case with a reduction in network speed. This is due to traffic growth without additional network capacity.

It should be noted that the change in network performance statistics between the 2015 base-year and the 2022 Reference Case, especially with regards to average network speed, are relatively small as the statistics presented relate to the whole of the modelled highway network represented by the NSMM transport model.

Table 6-1: Network performance statistics

Forecast Year	Time Period	Vehicle Type	Travel Distance (pcu-kms)	Travel Time (pcu-hrs)	Average Network Speed (kph)
2015 Base-Year	AM	Car	3219791	50350	63.9
		LGV	246180	4154	59.3
		HGV	539892	7684	70.3
	IP	Car	2303564	34824	66.1
		LGV	226733	3589	63.2
		HGV	530713	7241	73.3
	PM	Car	3334307	52722	63.2
		LGV	206579	3588	57.6
		HGV	472351	6502	72.6
2022 Reference Case	AM	Car	3423073	53639	63.8
		LGV	305762	5112	59.8
		HGV	552482	7847	70.4
	IP	Car	2461164	37322	65.9
		LGV	263042	4156	63.3
		HGV	529344	7221	73.3
	PM	Car	3533990	56014	63.1
		LGV	237857	4122	57.7
		HGV	476612	6561	72.6
2025 Reference Case	AM	Car	3497315	54947	63.6
		LGV	313912	5322	59.0
		HGV	540868	7770	69.6
	IP	Car	2525331	38355	65.8
		LGV	268755	4287	62.7
		HGV	514618	7074	72.7
	PM	Car	3611050	57406	62.9
		LGV	243075	4285	56.7
		HGV	467955	6510	71.9

6.2 Forecast traffic flows

Figure 6-1 to Figure 6-3 and Figure 6-4 to Figure 6-6 show the modelled traffic flows for the 2015 base-year and 2022 Reference Case scenarios for the AM Peak-Hour, Inter-Peak Hour and PM Peak-Hour modelled time periods, respectively. The modelled traffic flows are show in terms of values and as bandwidths, where the thickness of the bandwidth is proportional to the magnitude of the modelled traffic flows, i.e. the thicker the bandwidth the greater the traffic flows.

Figure 6-7 shows the change in AADT between the 2015 base-year and the 2022 Reference Case. Figure 6-8 to Figure 6-10 show the change in traffic flows between the 2015 base-year and the 2022 Reference Case for each of the modelled time periods, respectively. The change in traffic flows are also shown as bandwidths with a green bandwidth indicating a predicted decrease in traffic flows between 2015 and 2022 and a red bandwidth indicating a predicted increase. The thickness of the bandwidth is proportional to the magnitude of the change in flows, i.e. the thicker the bandwidth the greater the change in traffic flows between 2015 and 2022.

As can be seen from Figure 6-8 to Figure 6-10, as expected there is a general increase in traffic across the North Staffordshire conurbation which can be attributed to the proposed developments and an increase in background traffic growth. Any reductions in traffic on the highway network can be attributed to the effects of proposed transport schemes, the loss/demolition of existing land-uses and trip redistribution effects. For example, the significant reductions in traffic on the A500 (between Wolstanton and the A53 Etruria Road) and along the A53 Etruria Road (between the A500 and Festival Way) is due to the predicted impact of the Etruria Valley Link Road Project.

Figure 6-11 Shows the change in AADT traffic flows between 2022 Reference Case and 2025 Reference Case. Figure 6-12 to Figure 6-14 show the change in model traffic flows between the 2022 and 2025 Reference Case scenarios for the AM, Inter-Peak and PM modelled periods. Flows change between 2022 Reference Case and 2025 Reference Case is small. This is to be expected given the closeness of forecast years and the identical networks. No additional transport schemes are anticipated to be implemented between 2022 and 2025 as detailed in Table 4-1

Figure 6-15 to Figure 6-17, Figure 6-18 to Figure 6-20 and Figure 6-21 to Figure 6-23 show the locations of links and junctions which are predicted to experience congestion problems in the 2015 base-year, the 2022 Reference Case and the 2025 Reference Case scenarios for the AM Peak-Hour, Inter-Peak Hour and PM Peak-Hour modelled time periods, respectively. Links are identified as being the source of congestion problems where the ratio of the modelled traffic flow to the capacity of the link are greater than 81%. For these assessments, the capacities of the links have been based on the Advice Note TA 79/99 – Traffic Capacity of Urban Roads (May 1999). Therefore, it should be borne in mind that these values are based on theoretical capacities which may not always reflect the ultimate or actual capacity of the road which may be affected by other local operational conditions and characteristics. Junctions are identified as being the source of congestion problems where the overall average junction delay is greater than 20 seconds.

As can be seen from Figure 6-15 to Figure 6-20, there is only a slight worsening in congestion problems predicted to be experienced between 2015 and 2022 which can be attributed to the relatively low increase in traffic growth predicted between these years. The same findings can be identified between the 2025 Reference Case and 2022 Reference Case. Figure 6-18 to Figure 6-23 show little change in congestion issues between the 2022 Reference Case and 2025 Reference Case.

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Figure 6-1 2015 Base-Year AM peak-hour traffic flows (PCUs)

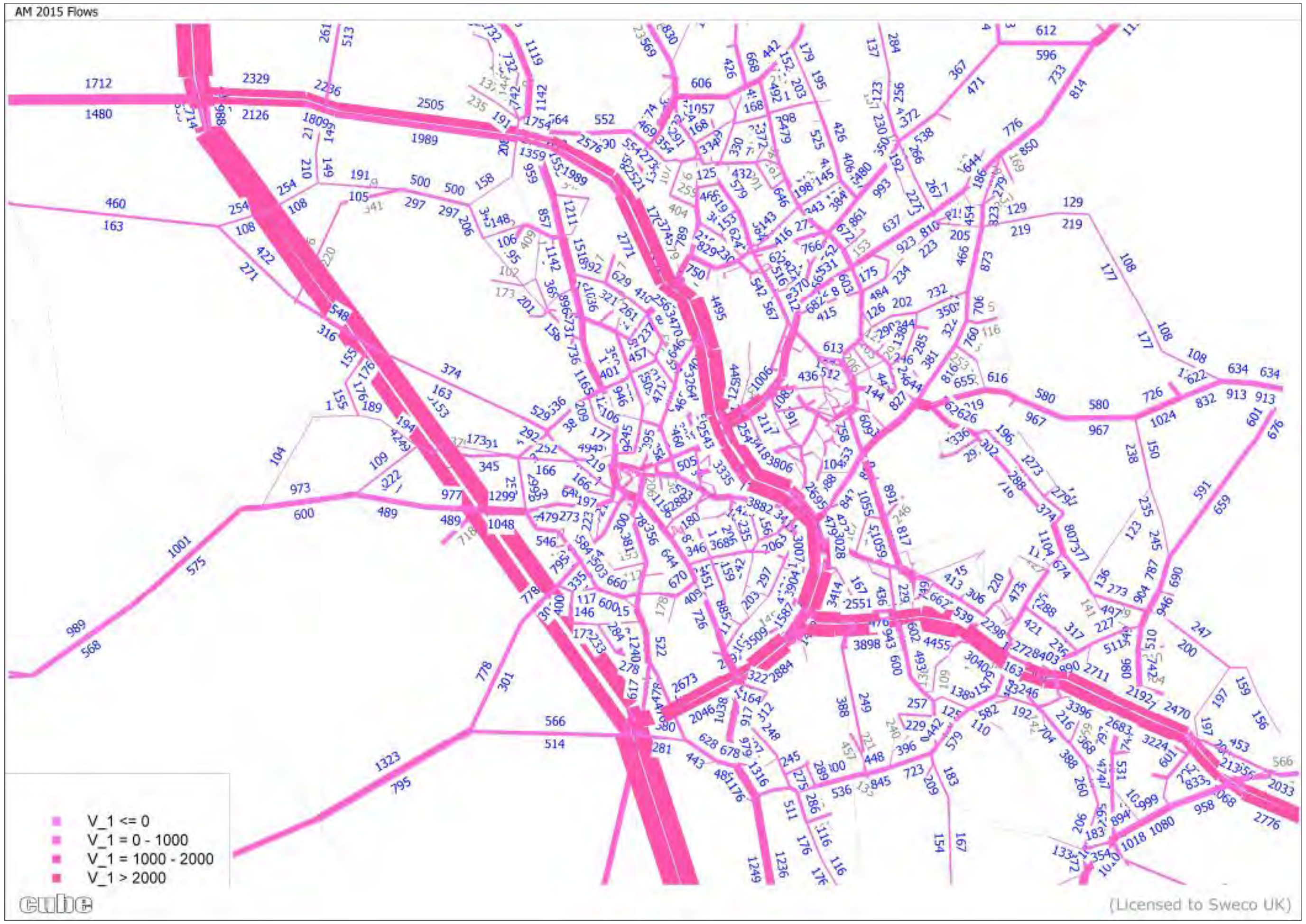

Figure 6-2: 2015 Base-Year Inter-Peak hour traffic flows (PCUs)

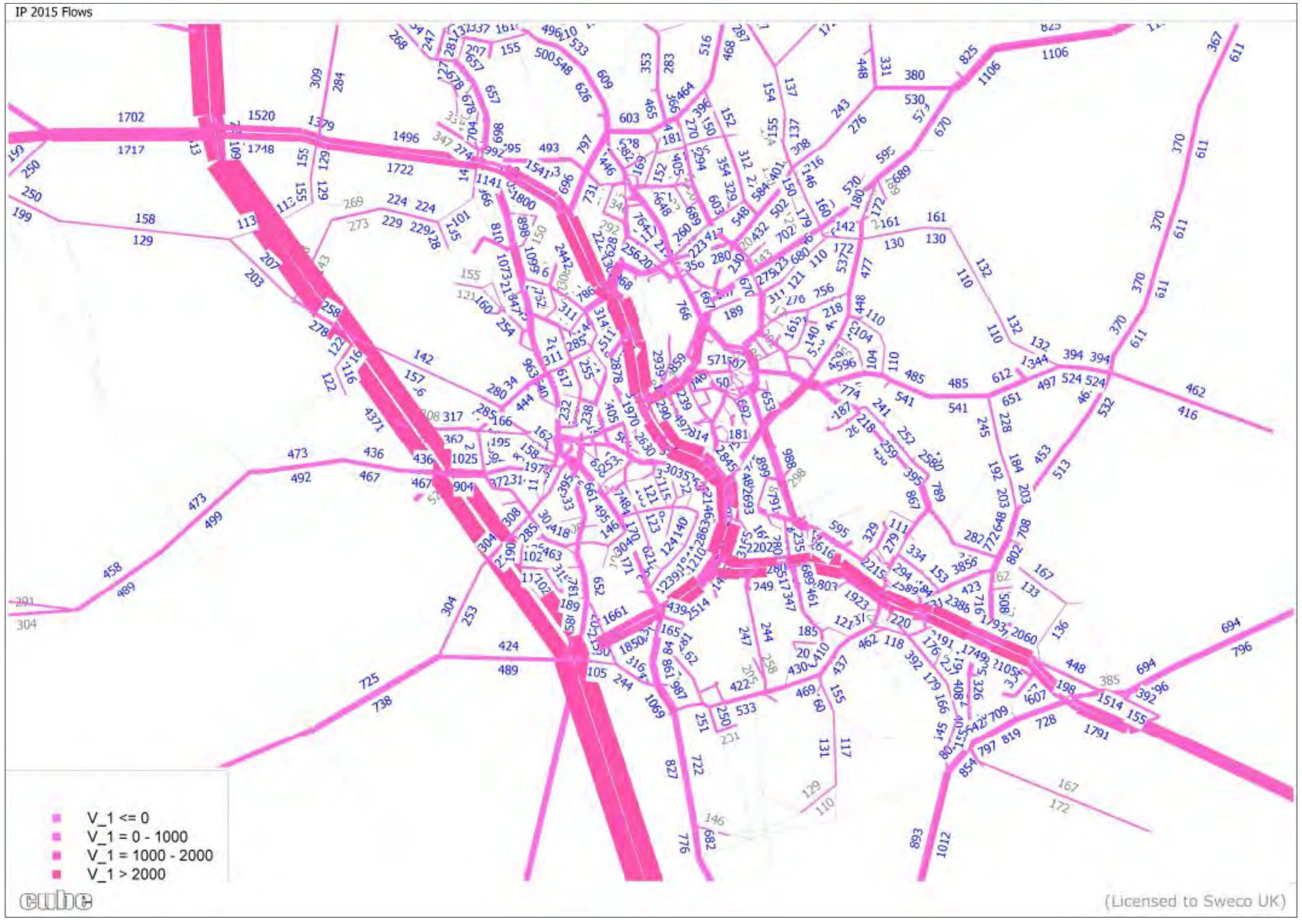

Figure 6-3: 2015 Base-Year PM peak-hour traffic flows (PCUs)

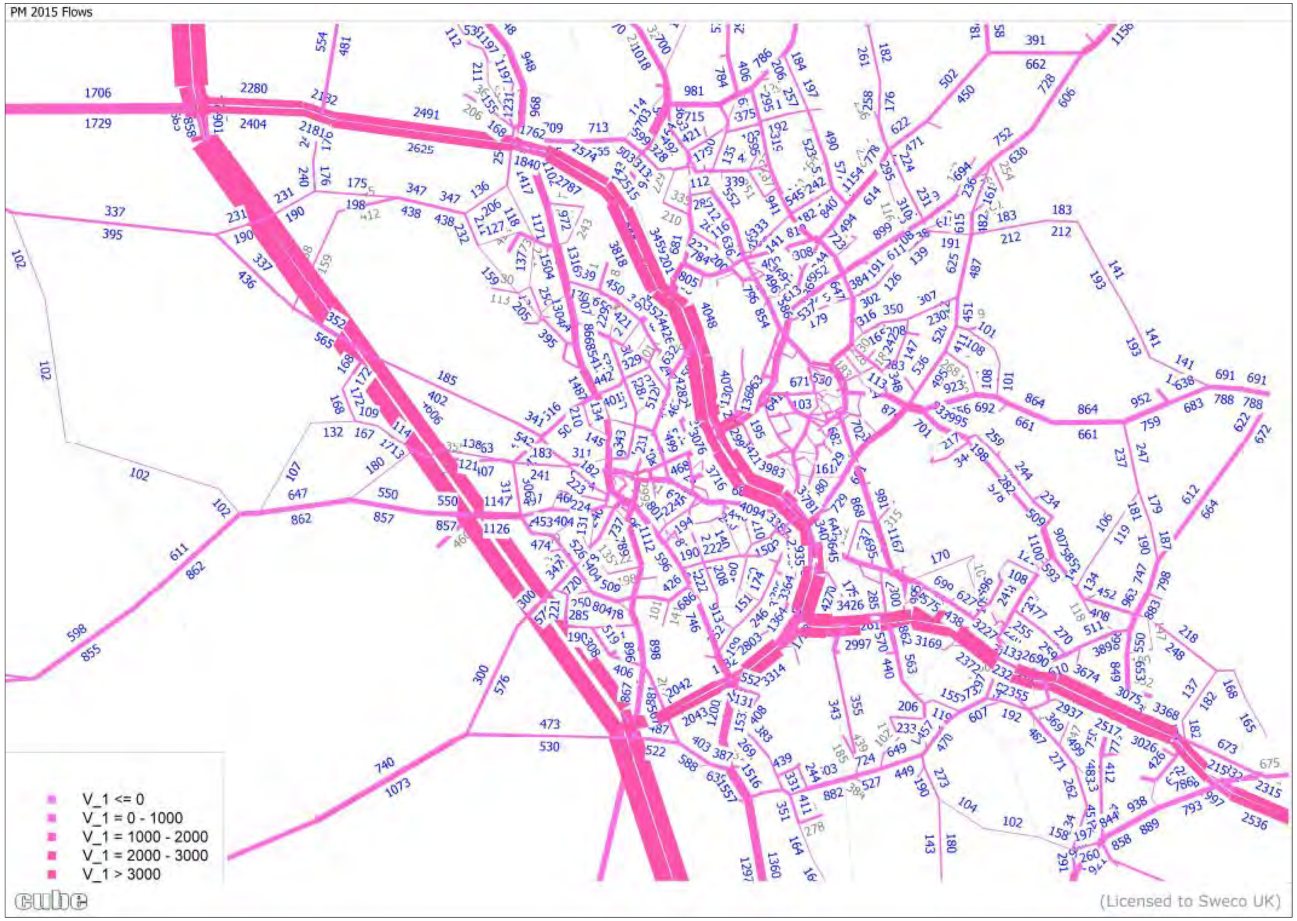

Figure 6-4: 2022 Reference Case AM peak-hour traffic flows (PCUs)

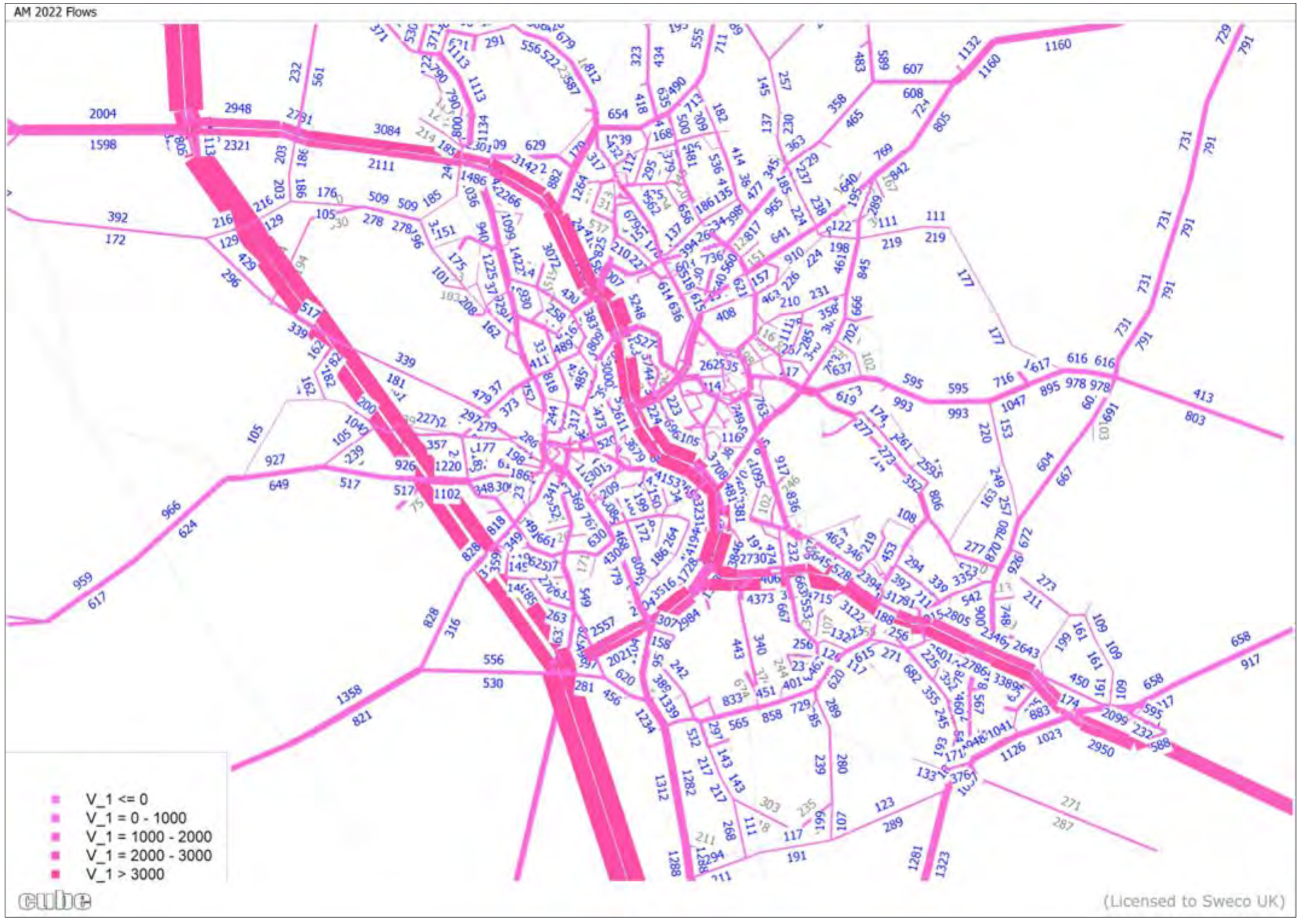

Figure 6-5: 2022 Reference Case Inter-Peak hour traffic flows (PCUs)

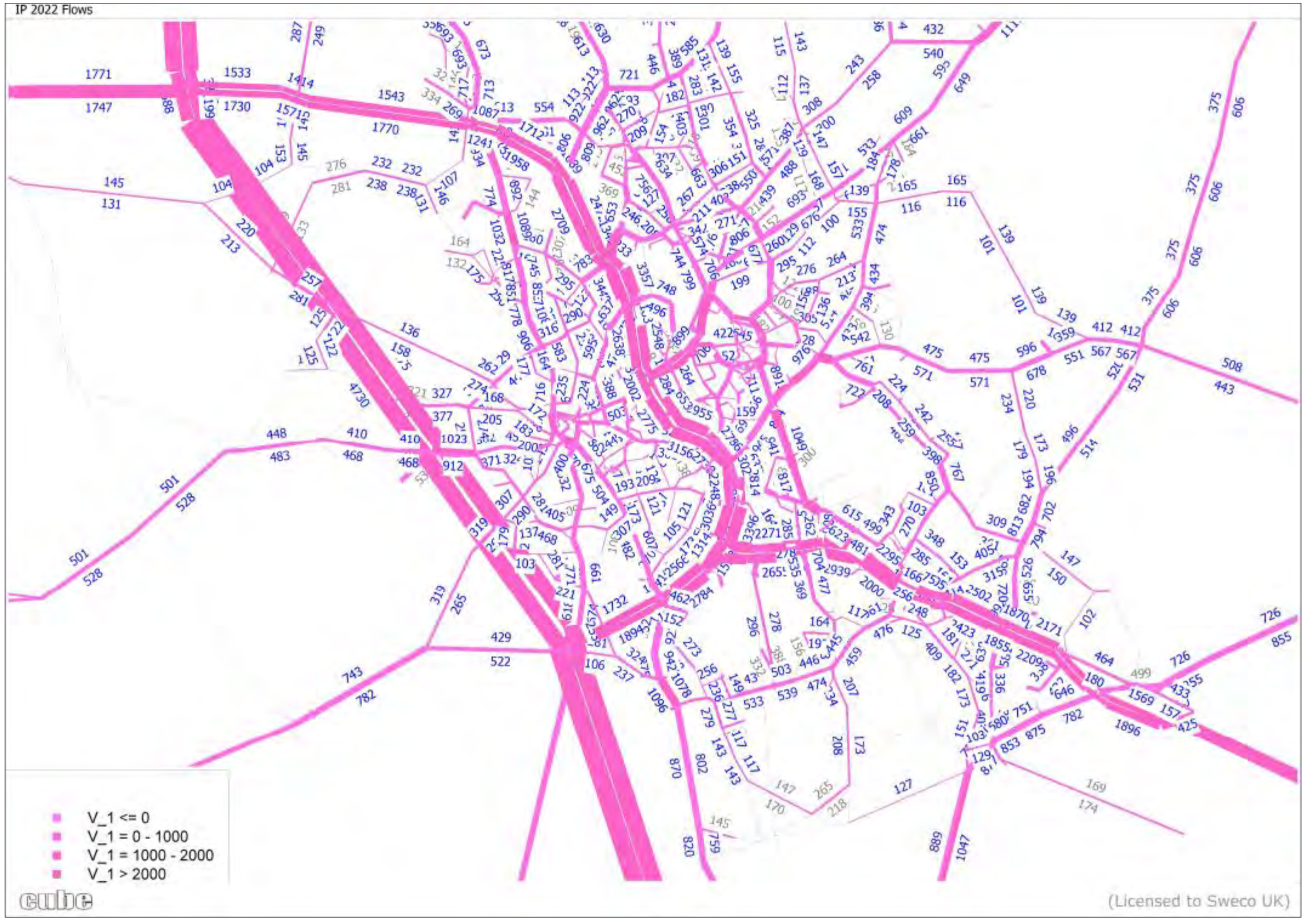

Figure 6-6: 2022 Reference Case PM peak-hour traffic flows (PCUs)

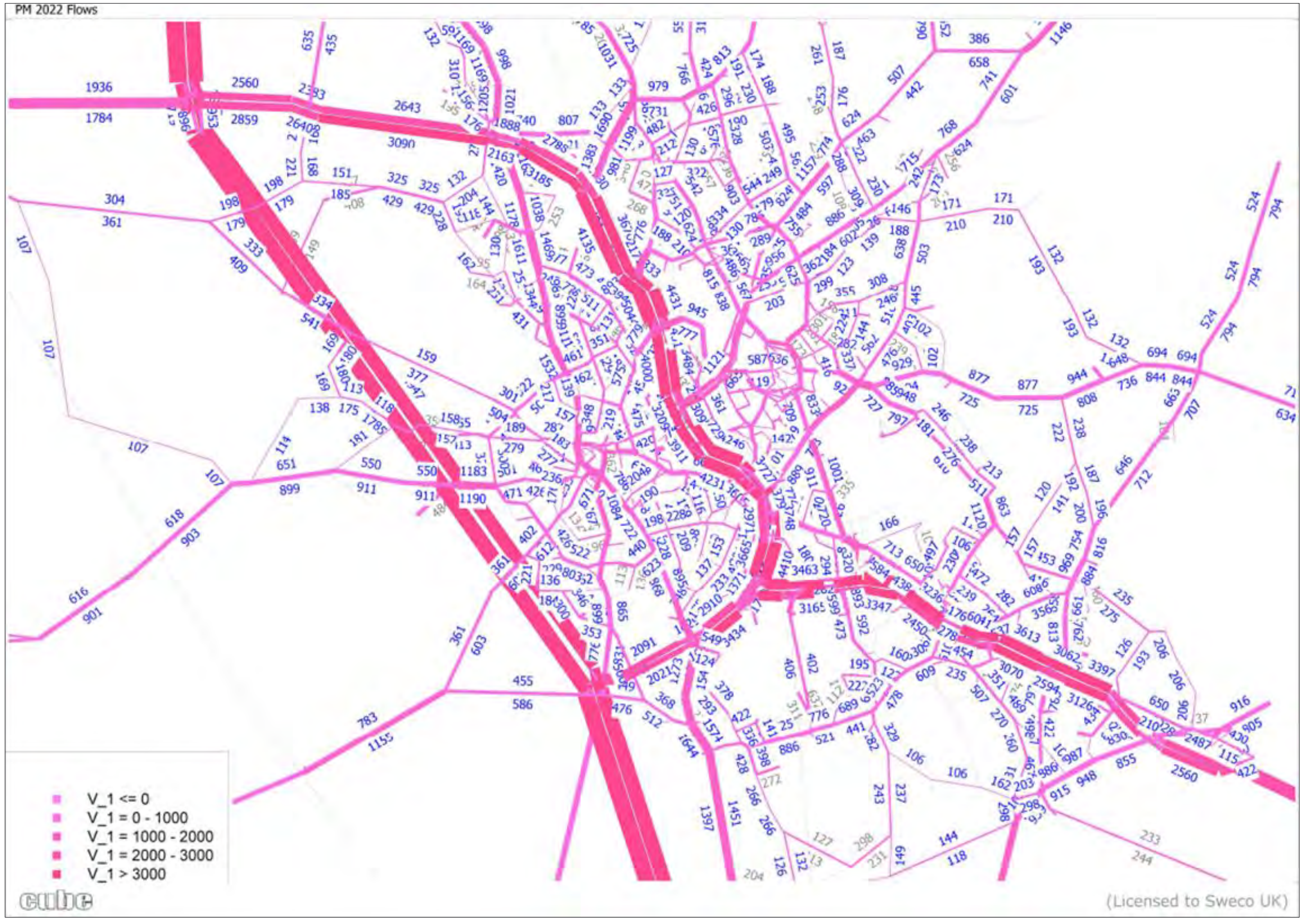

Figure 6-7: Change in AADT traffic flows between 2015 Base-Year and 2022 Reference Case (vehicles)

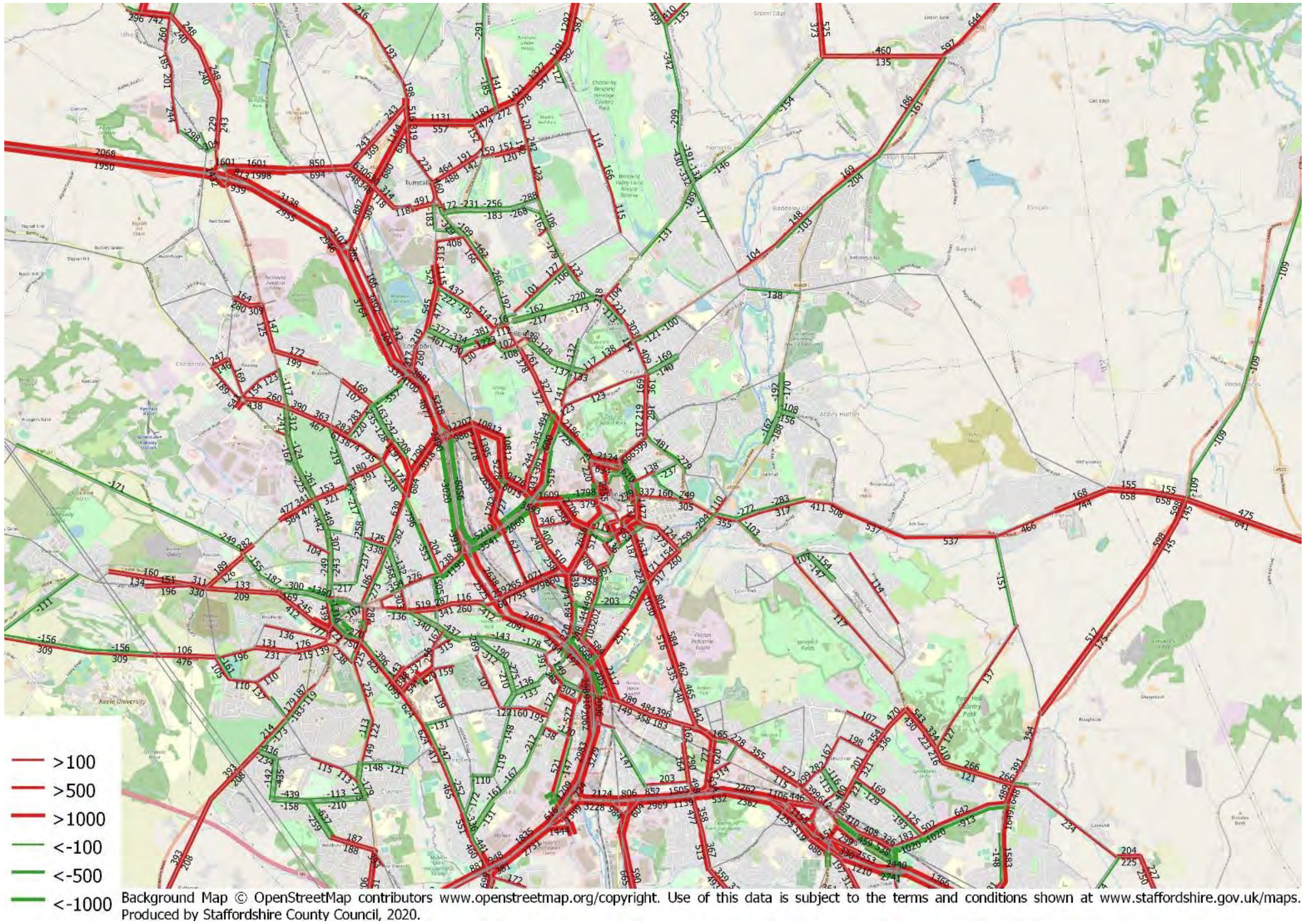

Figure 6-8: Change in AM peak-hour traffic flows between 2015 Base-Year and 2022 Reference Case (vehicles)

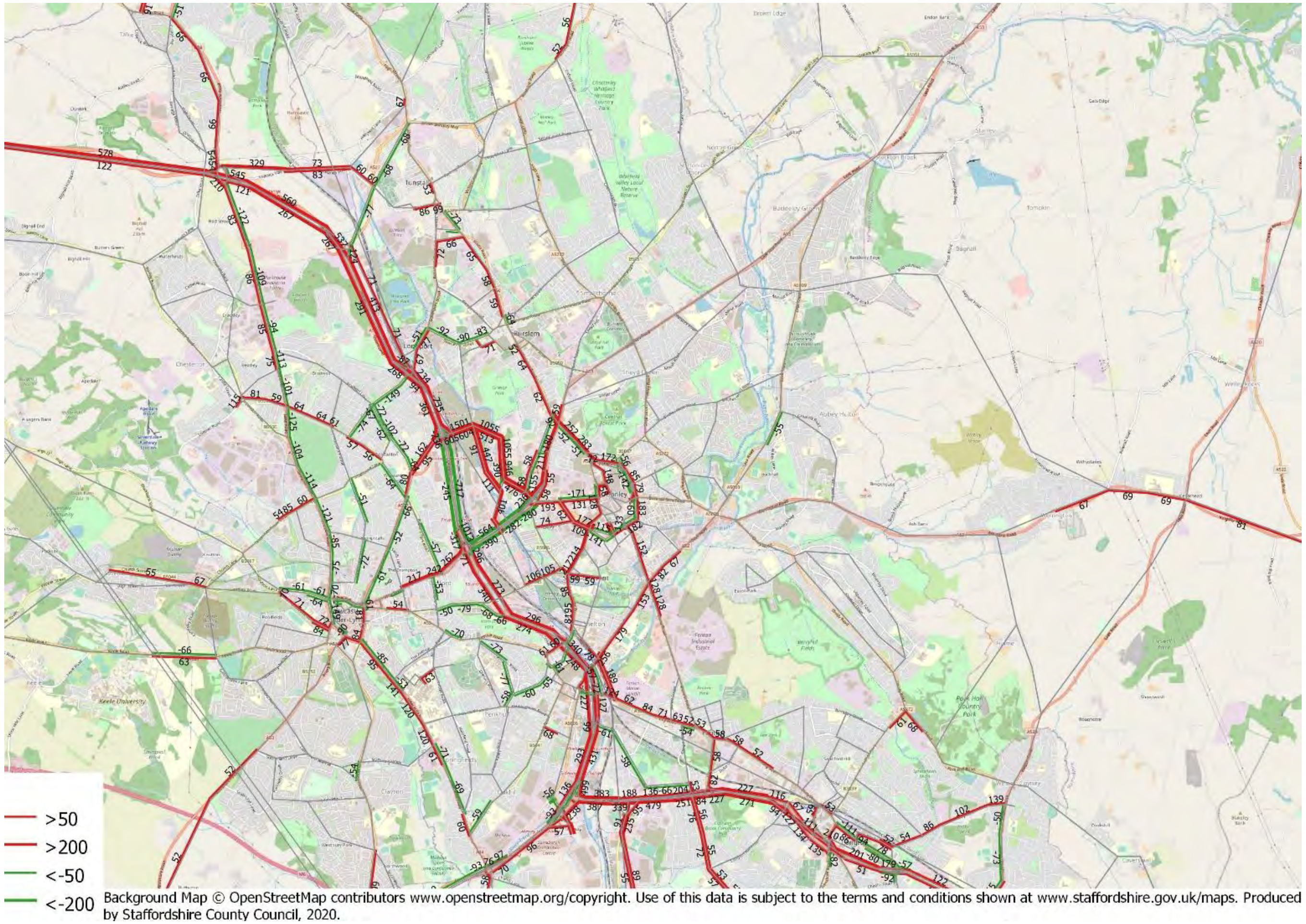

Figure 6-9: Change in Inter-Peak hour traffic flows between 2015 Base-Year and 2022 Reference Case (vehicles)

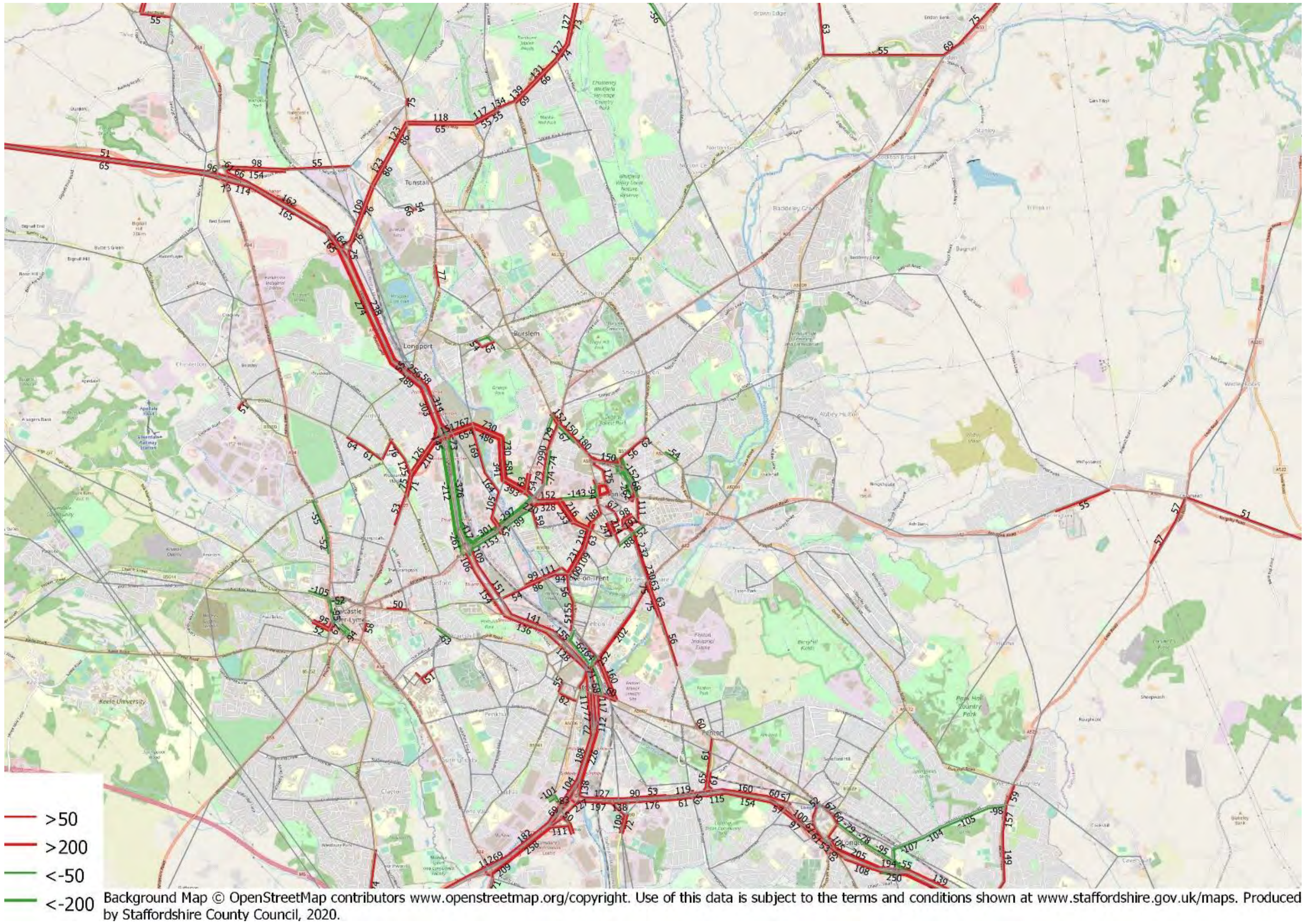

Figure 6-10: Change in PM peak-hour traffic flows between 2015 Base-Year and 2022 Reference Case (vehicles)

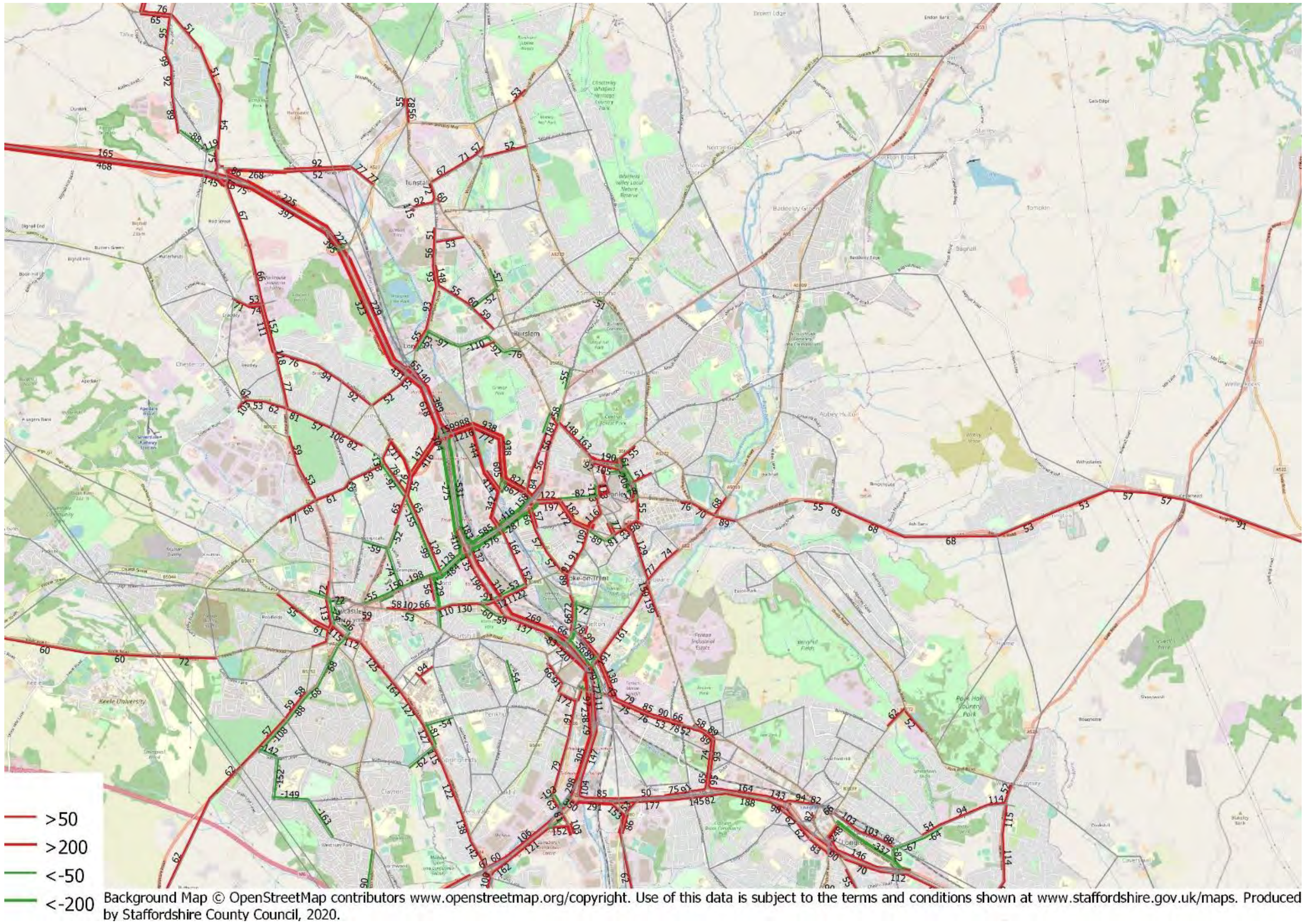

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Figure 6-11: Change in AADT traffic flows between 2022 Reference and 2025 Reference Case (vehicles)

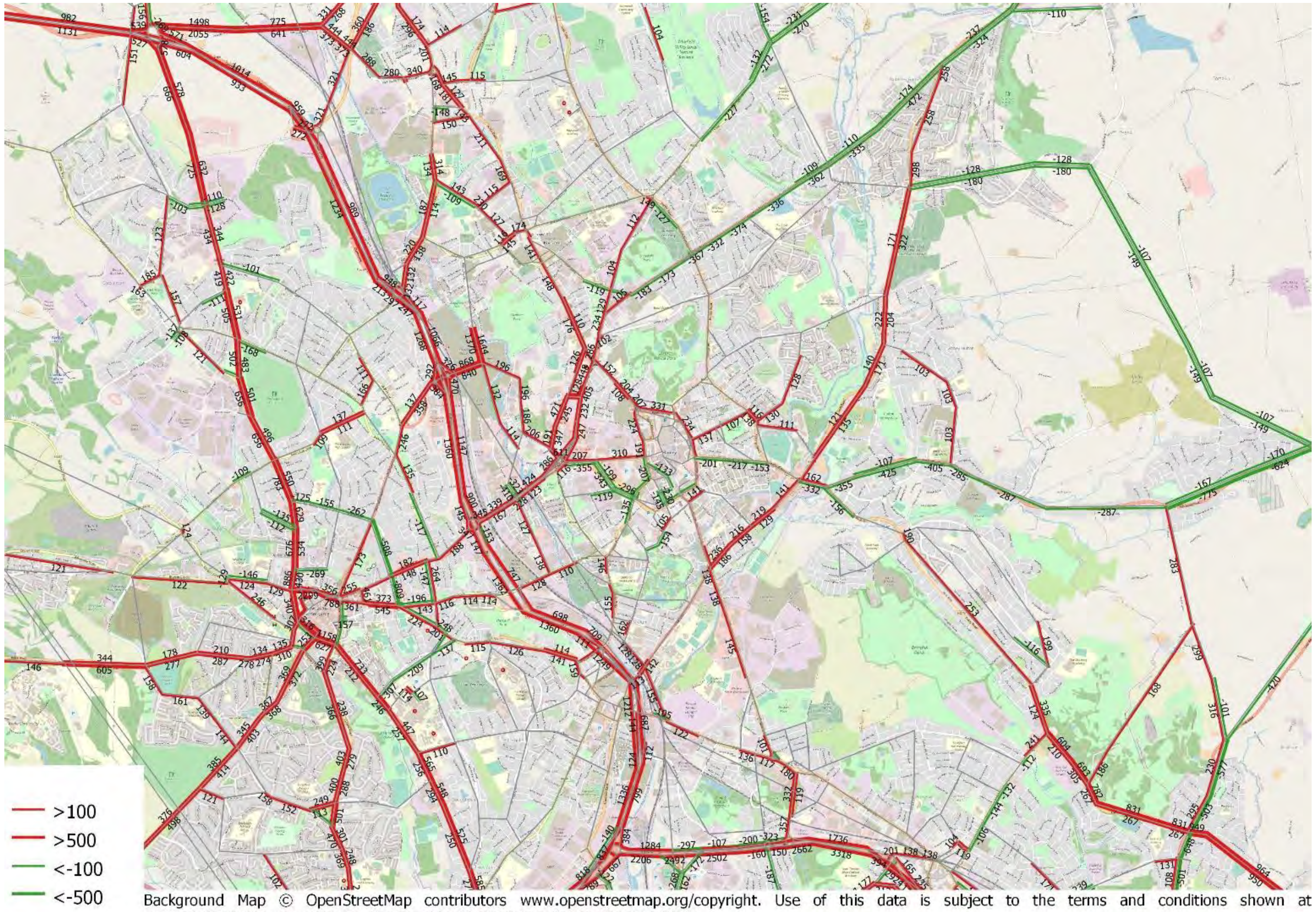

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Figure 6-12: Change in AM Peak-Hour traffic flows between 2022 Reference and 2025 Reference Case (vehicles)

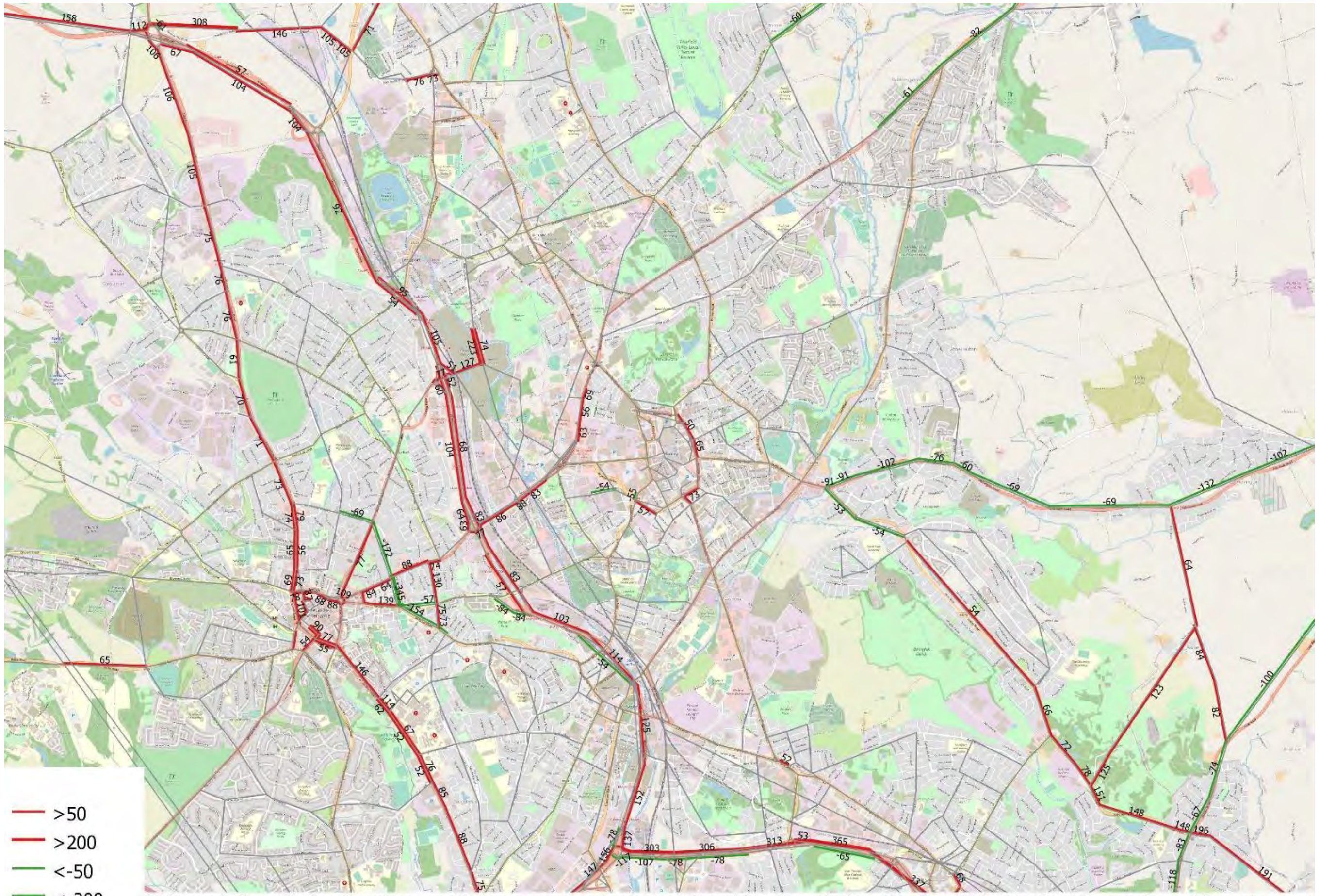

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Figure 6-13: Change in Inter-Peak Hour traffic flows between 2022 Reference and 2025 Reference Case (vehicles)

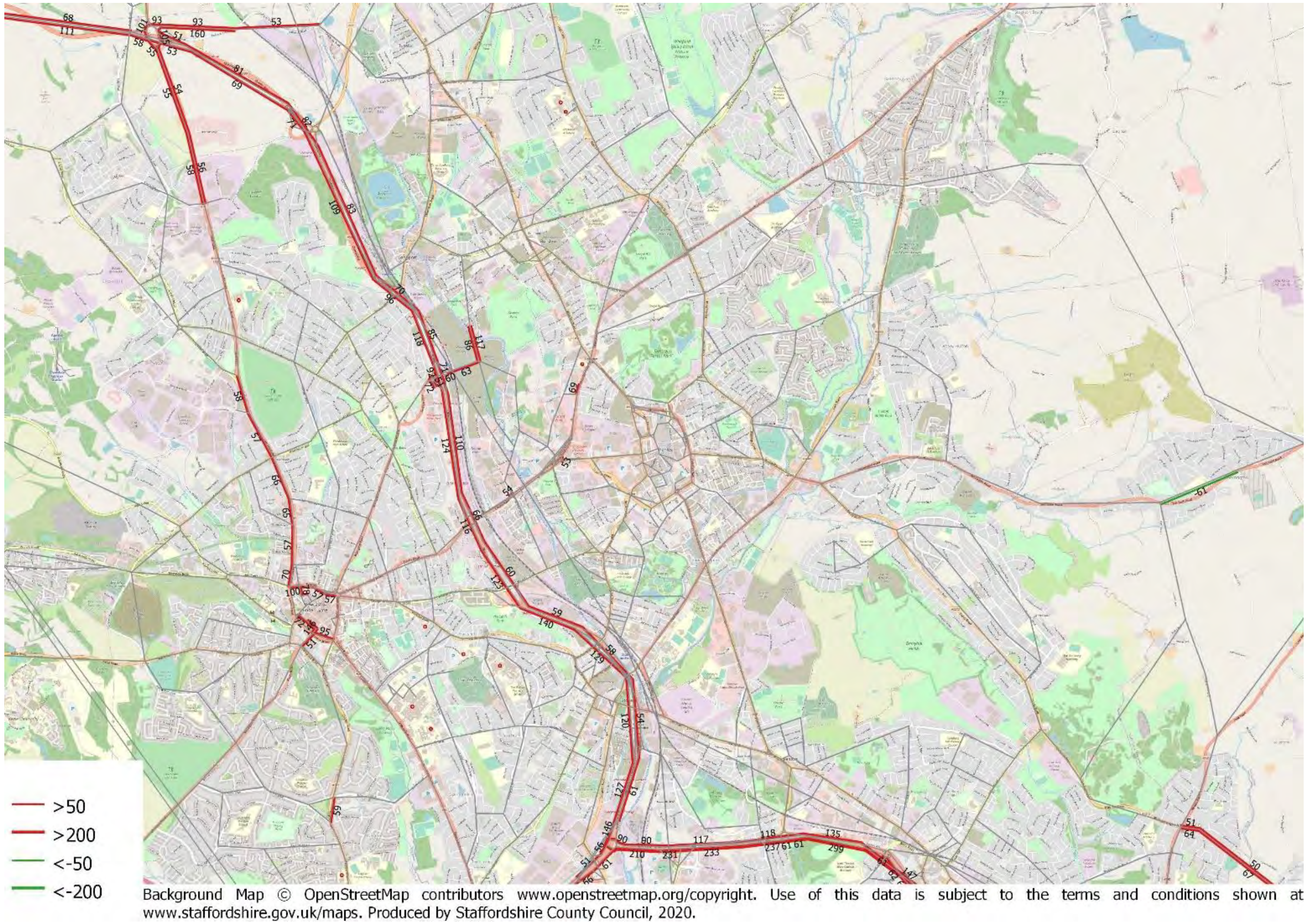

Figure 6-14: Change in PM Peak-Hour traffic flows between 2022 Reference and 2025 Reference Case (vehicles)

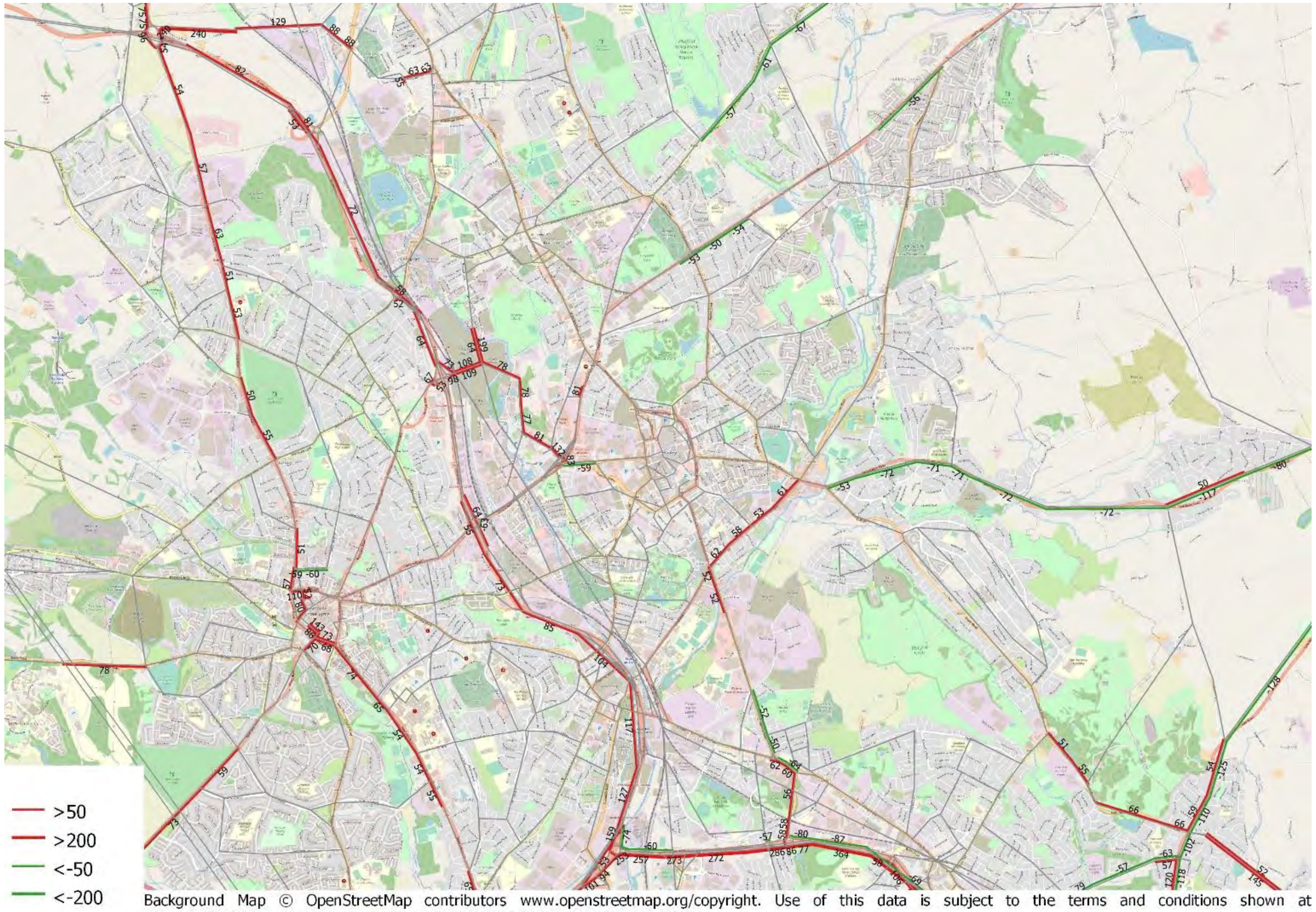

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Figure 6-15: 2015 Base-Year AM peak-hour overcapacity links and significant junction delays

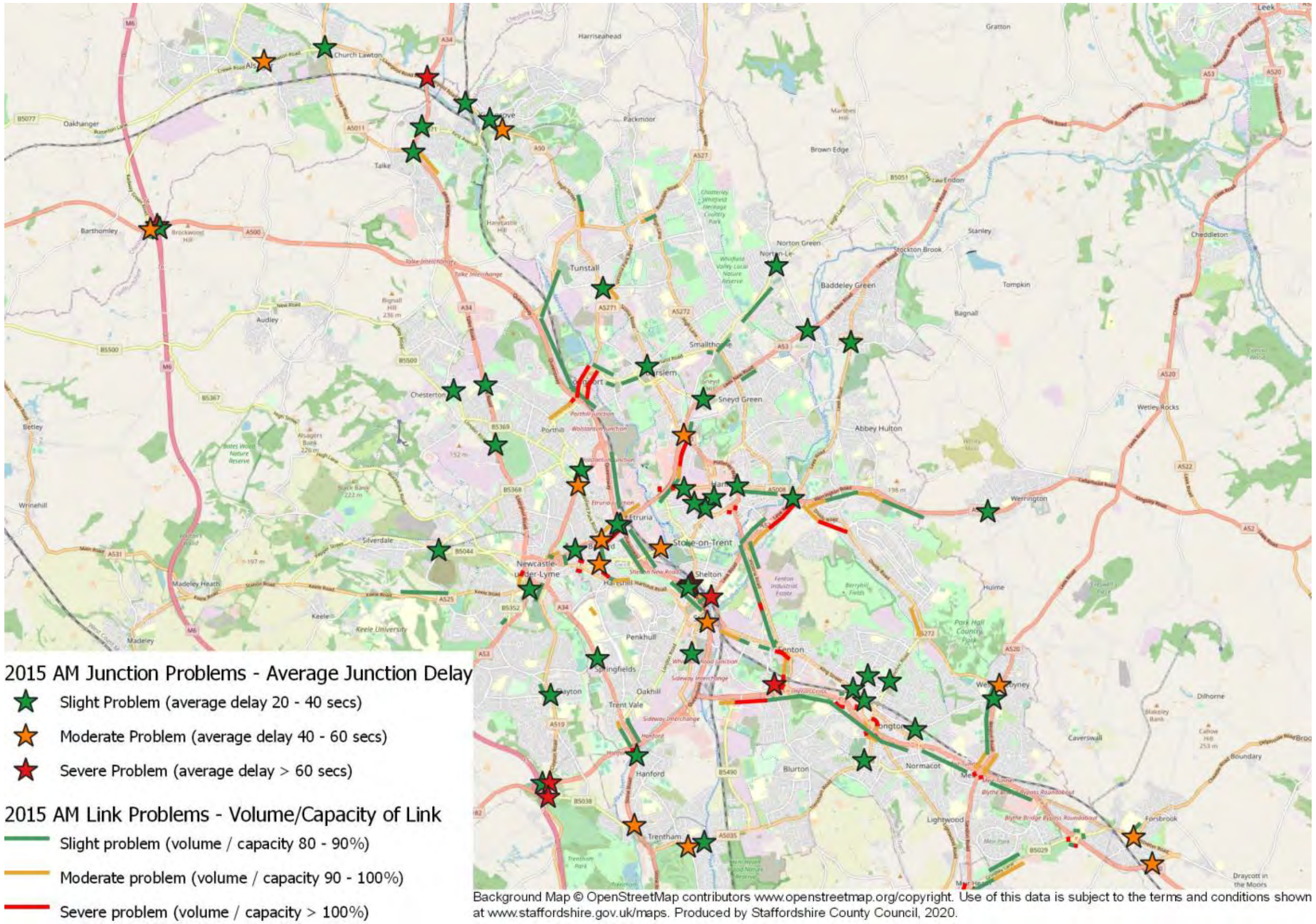


Figure 6-16: 2015 Base-Year inter-peak hour overcapacity links and significant junction delays

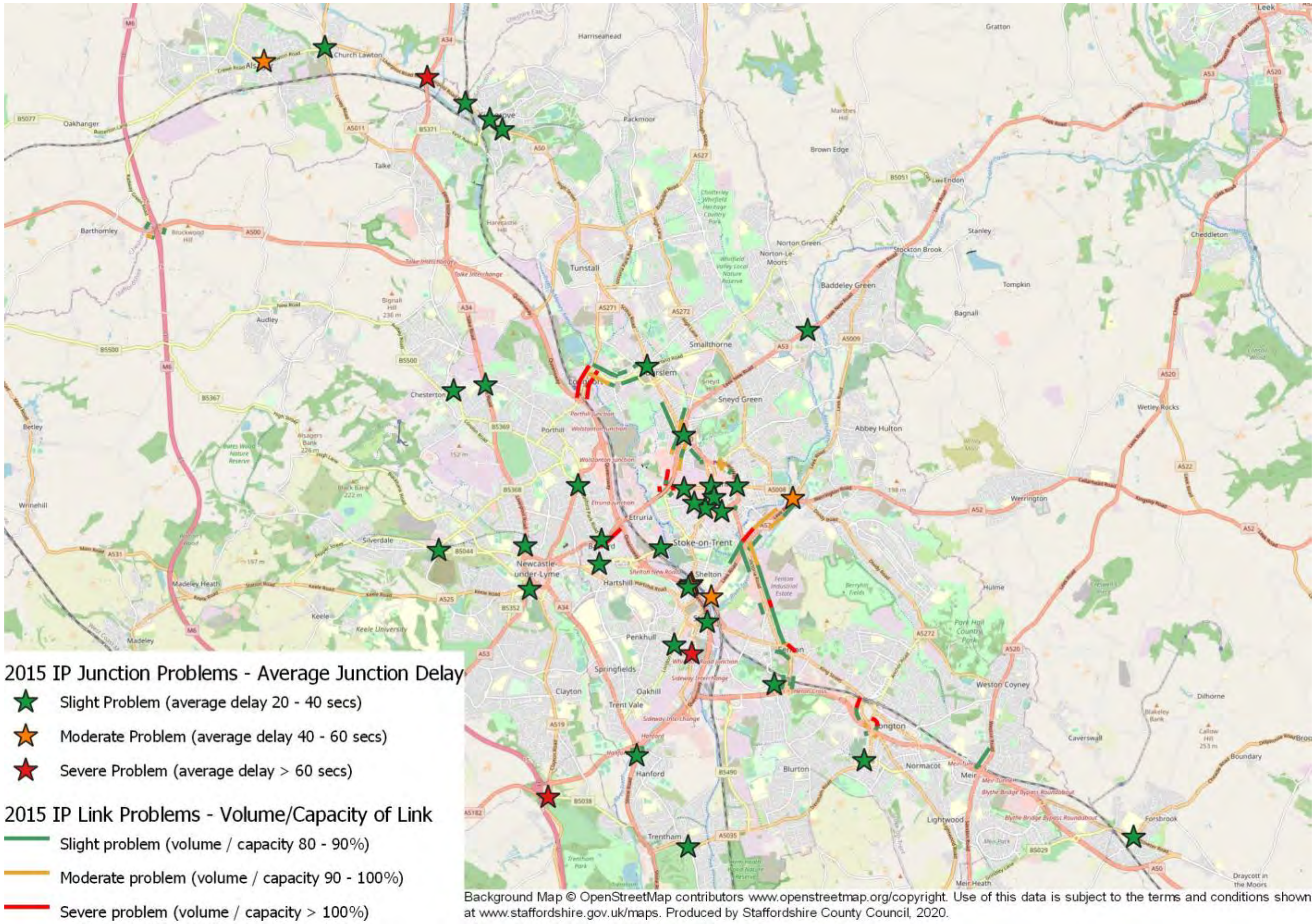


Figure 6-17: 2015 Base-Year PM peak-hour overcapacity links and significant junction delays

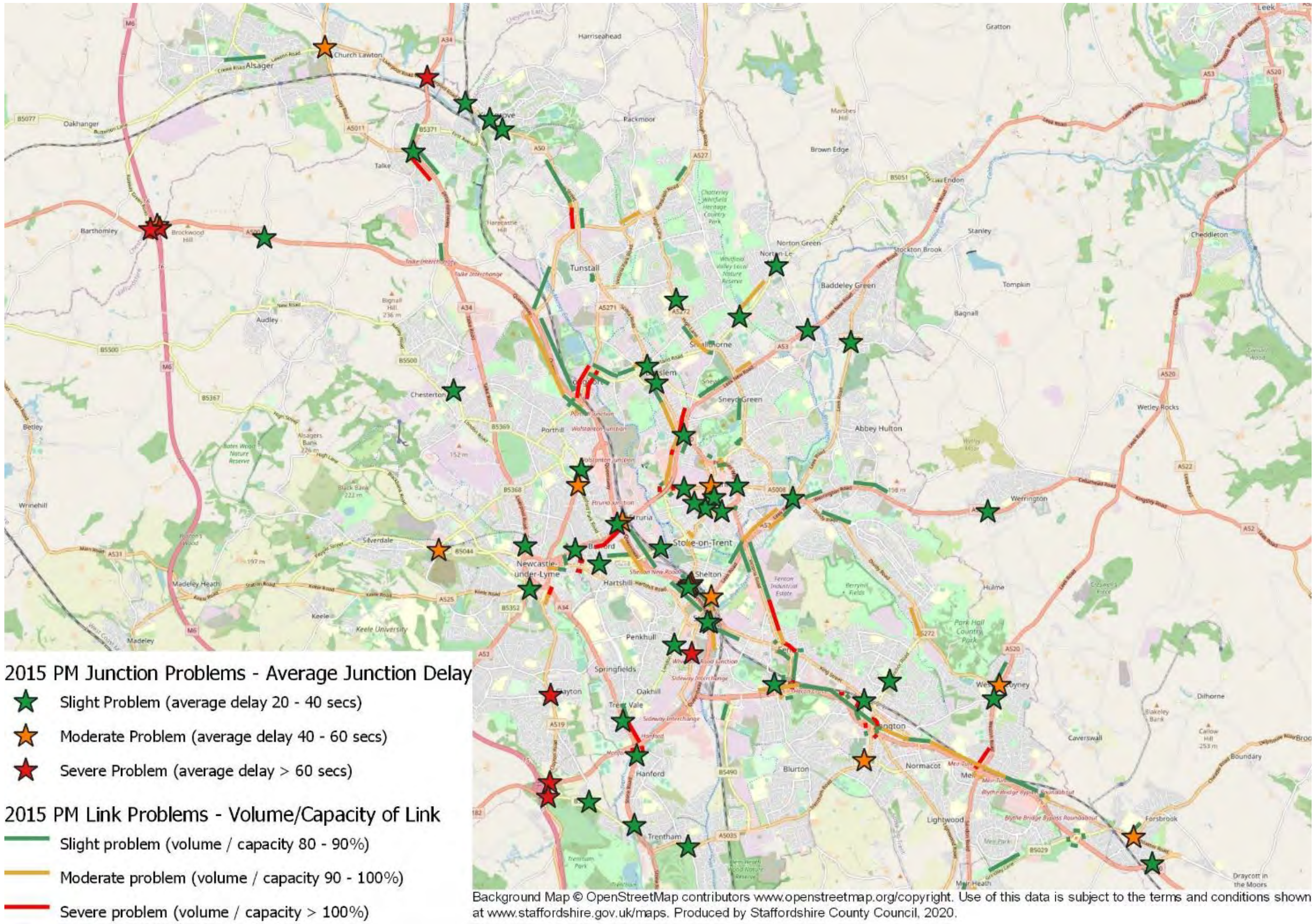


Figure 6-18: 2022 Reference Case AM peak-hour overcapacity links and significant junction delays

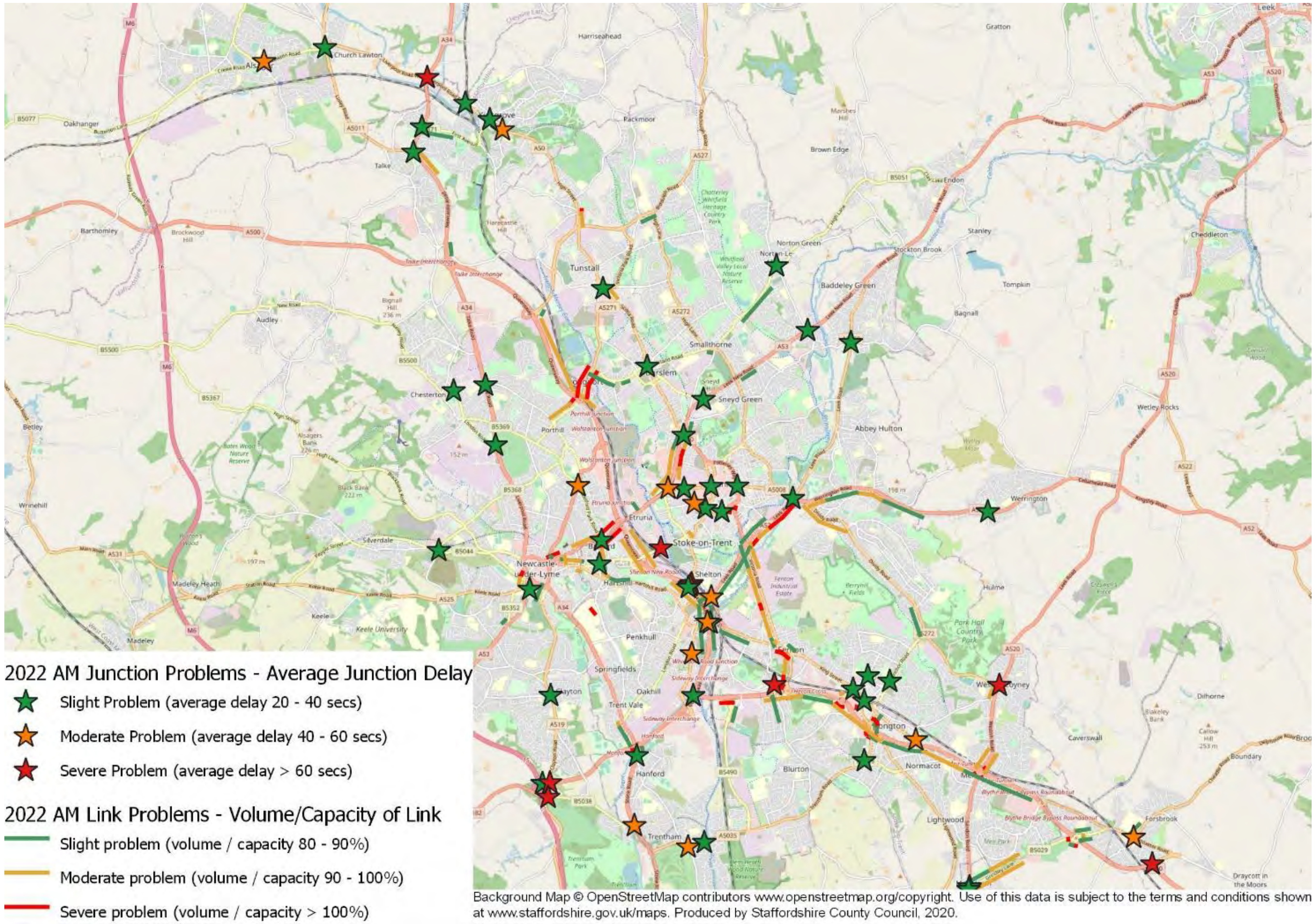


Figure 6-19: 2022 Reference Case IP peak-hour overcapacity links and significant junction delays

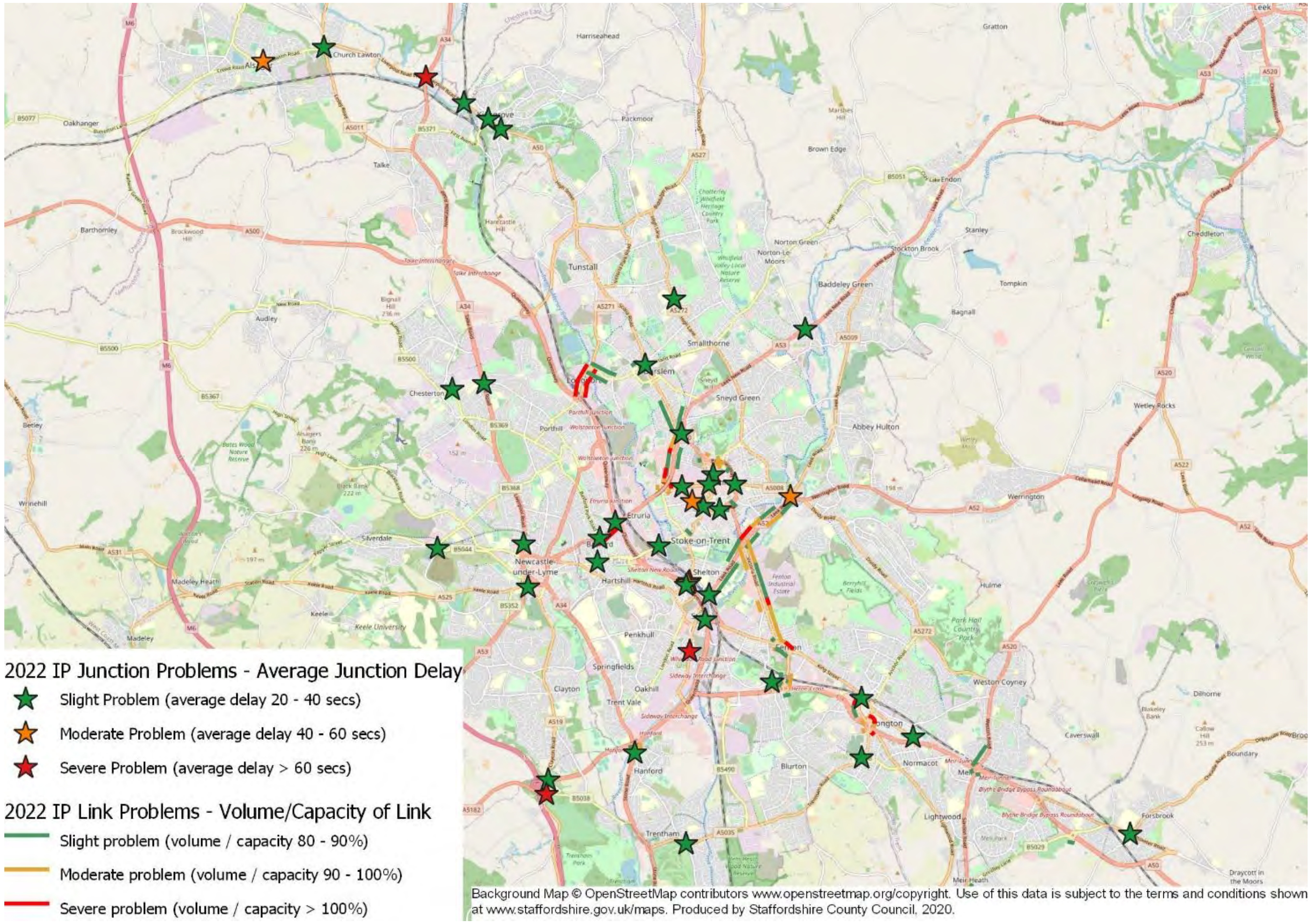


Figure 6-20: 2022 Reference Case PM peak-hour overcapacity links and significant junction delays

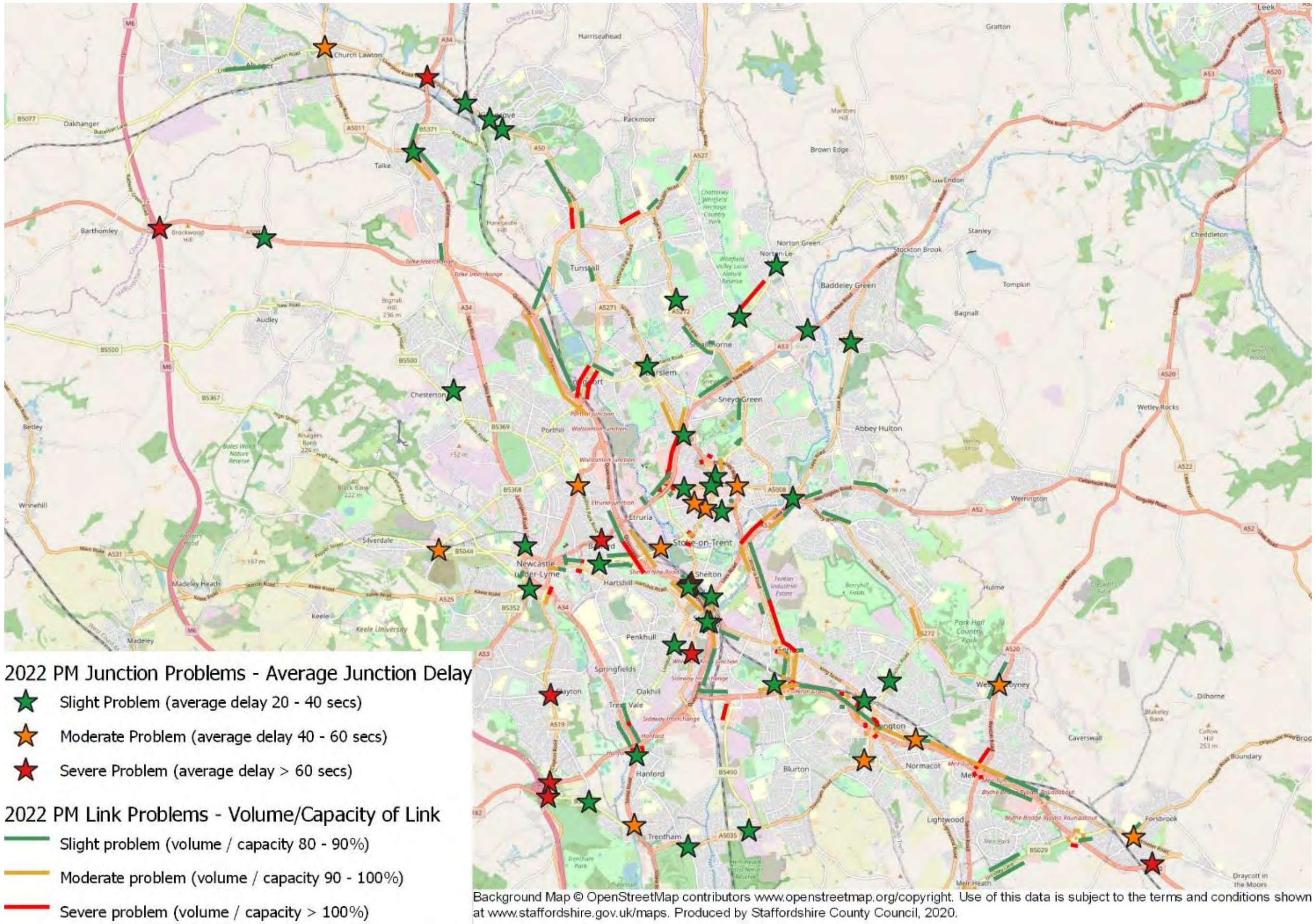


Figure 6-21: 2025 Reference Case AM peak-hour overcapacity links and significant junction delays

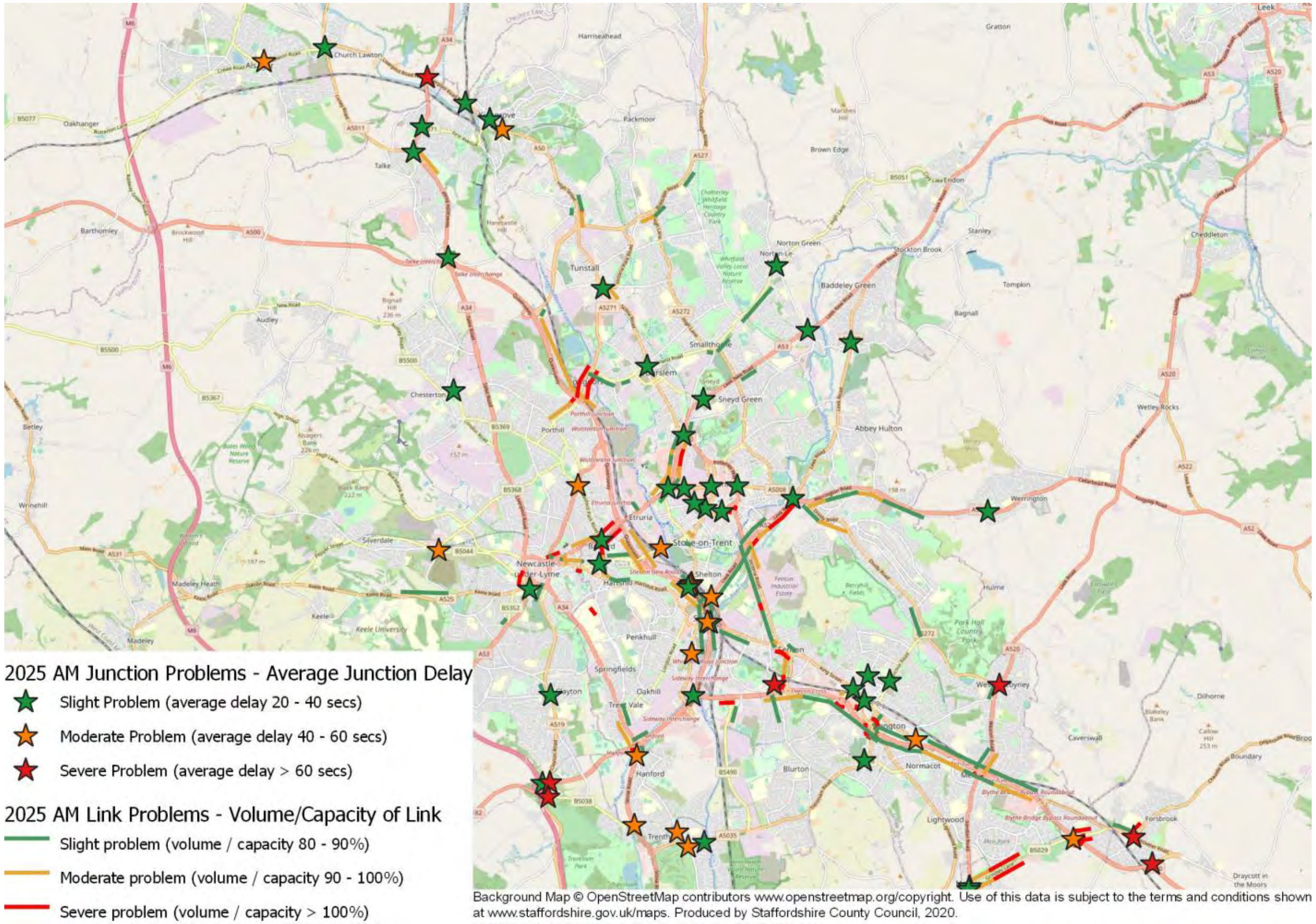


Figure 6-22: 2025 Reference Case IP peak-hour overcapacity links and significant junction delays

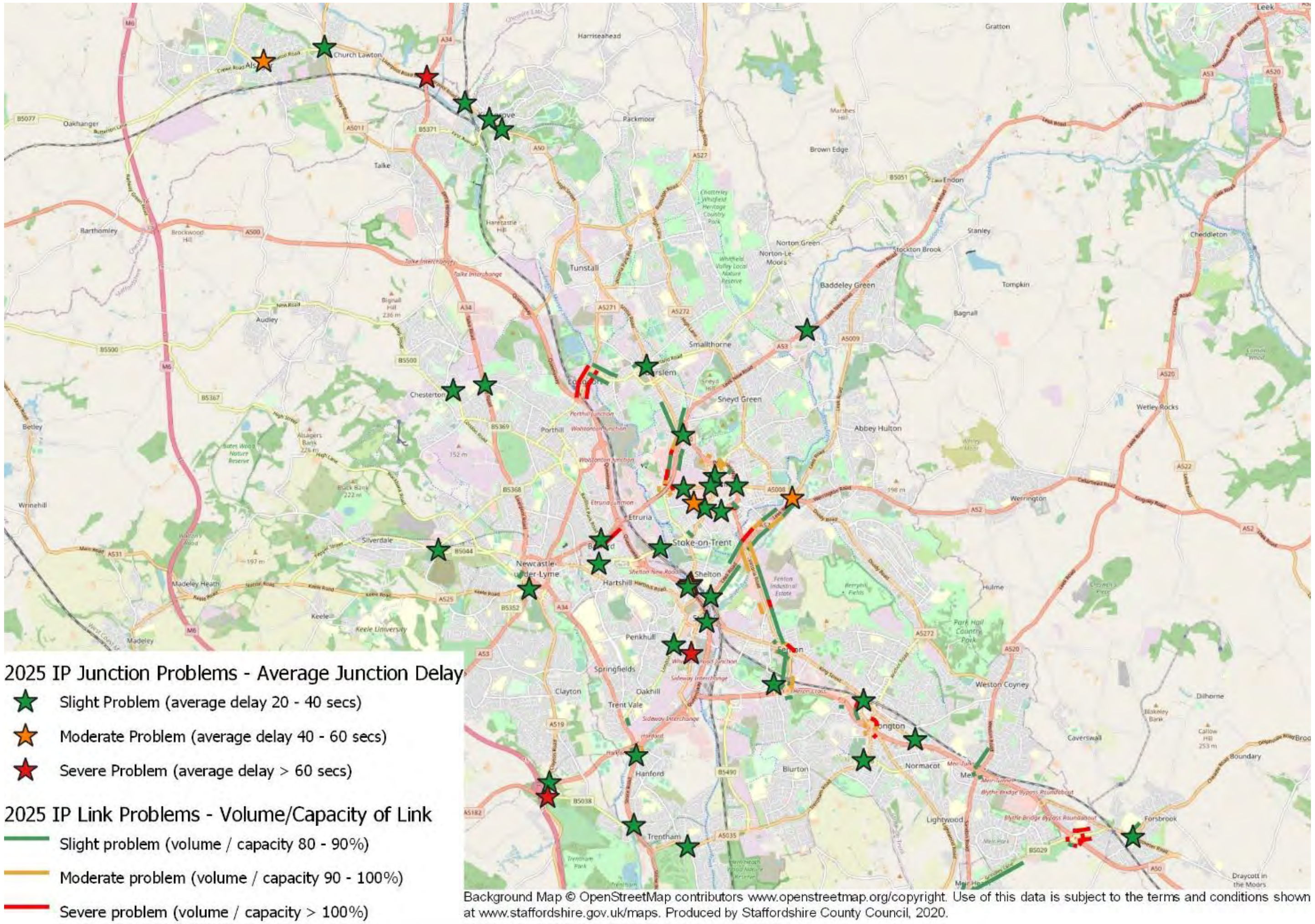
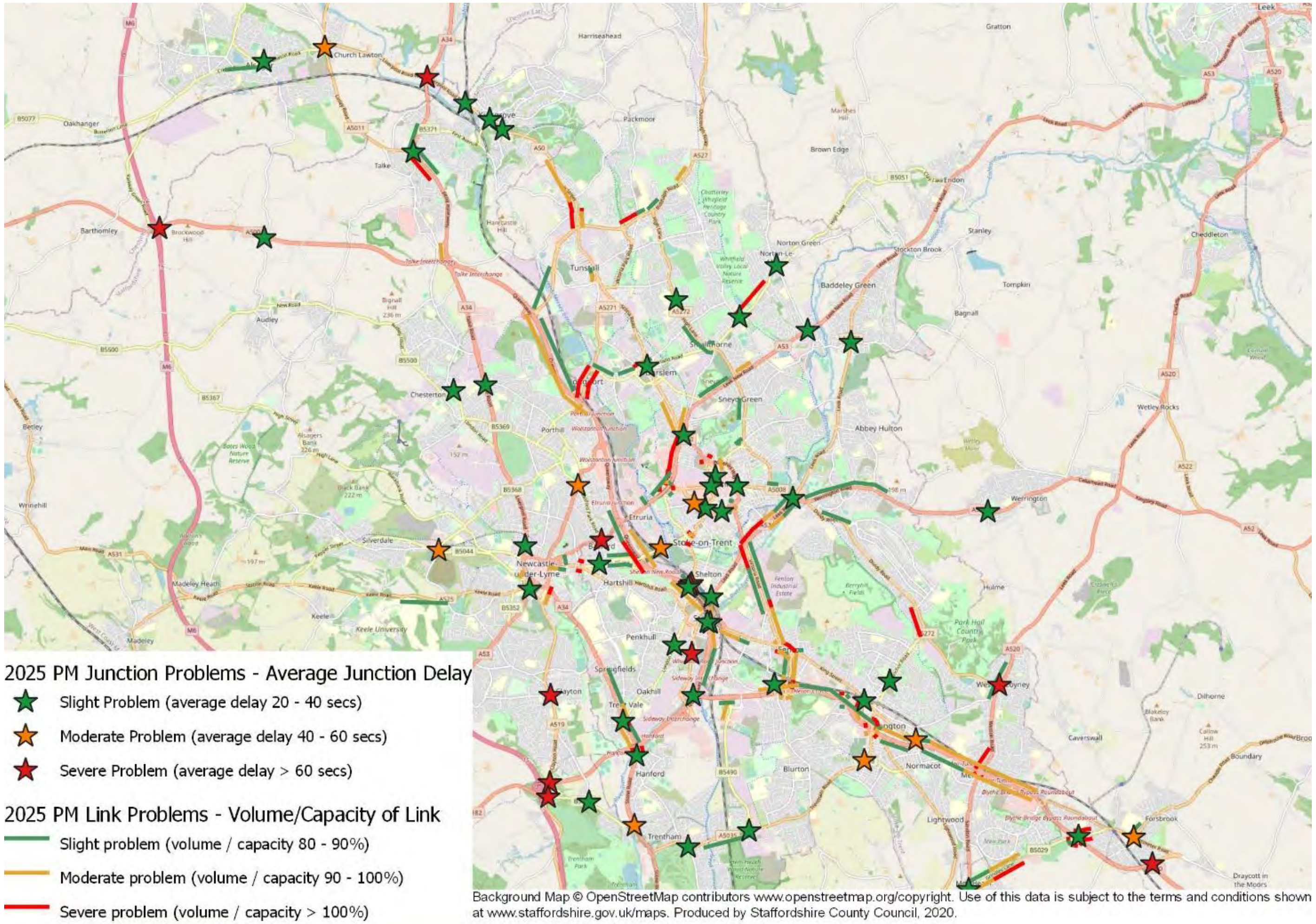


Figure 6-23: 2025 Reference Case PM peak-hour overcapacity links and significant junction delays



6.3 Forecast vehicle compliance splits and traffic growth

Table 6-2 shows existing and predicted vehicle compliance splits for North Staffordshire. These are based on ANPR surveys of the existing vehicle fleet and the application of Defra's Emissions Factor Toolkit (EFT, Version 9.1b) to predict vehicle compliance splits in the 2022 and 2025 forecast years. The predicted compliance splits have been used to disaggregate the forecast 2022 and 2025 vehicle matrices into compliant and non-compliant vehicle types prior to assignment. As can be seen from Table 6-2, the EFT is forecasting a large shift to compliance for HGVs, taxis and coaches/buses by 2022. Between 2022 and 2025 the EFT forecasts a large shift to compliance for coaches/buses and cars. By 2025 HGV compliance is estimated to be at 96%.

Table 6-3 shows the resultant change in compliant and non-compliant trip matrix totals by vehicle type between the 2015 base-year, the 2022 Reference Case and the 2025 Reference Case from the application of the results of the ANPR surveys and EFT for each modelled time period.

Finally, Table 6-4 shows the trip matrix totals for the 2015 base-year, 2022 Reference Case and the 2025 Reference Case by vehicle type for each modelled time period and the resultant predicted traffic growth.

Table 6-2: Existing and forecast vehicle compliance splits

Year	Car		Taxi		LGV		HGV		Bus/Coach	
	Compliant	Non-Compliant	Compliant	Non-Compliant	Compliant	Non-Compliant	Compliant	Non-Compliant	Compliant	Non-Compliant
Existing	61%	39%	20%	80%	32%	68%	62%	38%	19%	81%
2022	67%	33%	52%	48%	55%	45%	87%	13%	49%	51%
2025	77%	23%	59%	41%	62%	38%	96%	4%	74%	26%
Change Existing - 2022	7%	-7%	32%	-32%	23%	-23%	25%	-25%	30%	-30%
Change 2022-2025	10%	-10%	7%	-7%	7%	-7%	9%	-9%	25%	-25%

Table 6-3: 2015 Base-Year, 2022 and 2025 Reference Case trip matrix totals by vehicle type and compliance

Vehicle Type	Compliance	AM Peak-Hour					Inter-Peak Hour					PM Peak-Hour				
		2015	2022	2025	% Diff. 2015-2022	% Diff. 2022-2025	2015	2022	2025	% Diff. 2015-2022	% Diff. 2022-2025	2015	2022	2025	% Diff. 2015-2022	% Diff. 2022-2025
Car	Compliant	47,481	54,526	63,905	15%	17%	40,402	46,940	55,163	16%	18%	51,154	58,626	68,677	15%	17%
	Non-Compliant	30,356	26,856	19,088	-12%	-29%	25,831	23,120	16,477	-10%	-29%	32,705	28,876	20,514	-12%	-29%
Taxi	Compliant	28	85	98	204%	15%	24	73	85	204%	16%	30	91	105	203%	15%
	Non-Compliant	128	78	68	-39%	-13%	109	67	59	-39%	-12%	138	84	73	-39%	-13%
LGV	Compliant	2,690	5,710	6,711	112%	18%	2,547	5,348	6,273	110%	17%	2,435	5,069	5,934	108%	17%
	Non-Compliant	6,277	4,672	4,113	-26%	-12%	5,944	4,375	3,844	-26%	-12%	5,682	4,147	3,637	-27%	-12%
HGV	Compliant	2,696	3,762	4,162	40%	11%	2,351	3,266	3,622	39%	11%	1,528	2,134	2,363	40%	11%
	Non-Compliant	1,652	562	173	-66%	-69%	1,441	488	151	-66%	-69%	937	319	98	-66%	-69%
Total		**91,308**	**96,251**	**98,318**	**5%**	**2%**	**78,649**	**83,677**	**85,674**	**6%**	**2%**	**94,609**	**99,346**	**101,401**	**5%**	**2%**

Table 6-4: 2015 Base-Year, 2022 and 2025 Reference Case trip matrix totals by vehicle type

Vehicle Type	AM Peak-Hour					Inter-Peak Hour					PM Peak-Hour				
	2015	2022	2025	% Diff. 2015-2022	% Diff. 2022-2025	2015	2022	2025	% Diff. 2015-2022	% Diff. 2022-2025	2015	2022	2025	% Diff. 2015-2022	% Diff. 2022-2025
Car	77,837	81,382	82,993	5%	2%	66,233	70,060	71,640	6%	2%	83,859	87,502	89,191	4%	2%
Taxi	156	163	166	4%	2%	133	140	144	5%	3%	168	175	178	4%	2%
LGV	8,967	10,382	10,824	16%	4%	8,491	9,723	10,117	15%	4%	8,117	9,216	9,571	14%	4%
HGV	4,348	4,324	4,335	-1%	0%	3,792	3,754	3,772	-1%	0%	2,465	2,453	2,461	0%	0%
Total	**91,308**	**96,251**	**98,318**	**5%**	**2%**	**78,649**	**83,677**	**85,674**	**6%**	**2%**	**94,609**	**99,346**	**101,401**	**5%**	**2%**

7 Option testing

7.1 Preferred Option

A detailed description of the Preferred Option is as follows:

1. A50 Victoria Road bus gate

A bus gate will be installed on the A50 Victoria Road exit of the King Street/City Road/Victoria Road junction. Traffic will be restricted to buses, cyclists and taxis between Monday and Friday from 7am to 10am and 4pm to 7pm.

The splitter island will be widened, and the kerbs re-aligned to provide a single lane bus gate. An ANPR camera will be located at the bus gate to monitor compliance and two rotating prism signs will be installed at the entrance to the bus gate. The prism signs will enable the display of multiple messages and will be blank when the bus gate is not in use.

Bus gate advanced direction signing will be provided on the local highway network on all approaches to the Victoria Road/City Road and A50/King Street junctions, including Prism and Variable Message Signs.

The scheme costs include installation, the Traffic Regulation Order, ten-years of maintenance, monitoring and operation, and decommissioning at the end of the project. It is expected that the cameras may need to be replaced after five years.

An Ultra-Low Emission Vehicle (ULEV) exemption, allowing ULEVs to drive through the bus gate, will be assessed, and if considered deliverable, will be added to the scheme in the Full Business Case (FBC).

2. A53 Etruria Road bus gate

A two-lane bus gate will be installed on the A53 Etruria Road westbound exit of the A53/A500 roundabout, with appropriate amendments to the existing road markings at the bus gate and on the circulatory carriageway. Traffic will be restricted to buses, cyclists and taxis between Monday and Friday from 7am to 10am and 4pm to 7pm. Two rotating prism signs will be installed at the entrance to the bus gate to enable the display of multiple messages and will be blank when the bus gate is not in use. Two ANPR cameras will be installed to manage compliance.

Advanced direction signing will include prism signs on all approaches to the A500/A53 Etruria Road roundabout. Changes to destination signs on the A500 mainline carriageway in both directions are also proposed. This will include appropriate re-routing to the hospital and will also include variable message signs.

The scheme costs include installation, the Traffic Regulation Order, ten-years of maintenance, monitoring and operation, and decommissioning at the end of the project. It is expected that the cameras may need to be replaced after five years.

A ULEV exemption, allowing ultra-low emission vehicles to drive through the bus gate will be assessed and if considered deliverable will be added to the scheme in the FBC.

3. Traffic Management east and west of Victoria Road

Traffic management measures will be required on roads to the east and west of Victoria Road in order to ensure that the adjacent local communities are not adversely impacted by traffic re-routeing through these areas when the bus gates are in operation.

The following measures will be required to the East of Victoria Road:

- Replace existing worn and ineffective road humps in Beville Street, Stanier Street, Wileman Street, Philip Street, Elliot Road, Wedgwood Road, Warrington Street and Vivian Road and enhance the impact of the scheme by providing additional humps and carriageway re-surfacing.
- Provide new road humps and carriageway re-surfacing along Park Street, Minerva Road, Frederick Street, Cumberland Street and Clarence Street.
- Introduce one-way operation (direction of travel west to east) in Wileman Street (part) and Stanier Street (part).
- Provide an environmental weight restriction on the traffic calmed routes to prevent inappropriate large vehicles travelling through the area.
- Extend 20 mph zone to cover the whole traffic calmed area.

The following measures will be required to the West of Victoria Road:

- Replace existing worn and ineffective road humps in Manor Street, George Street, Edward Street and Hitchman Street and enhance the impact of the scheme by providing additional humps and carriageway re-surfacing.
- Provide new road humps and carriageway re-surfacing in Maud Street, Fountain Street and William Street. This includes two raised tables to improve safety at Christ Church C of E Primary School.
- Enhance signage to improve the enforcement of the existing environmental weight restriction in Manor Street.
- Closure of Hitchman Street at its junction with Victoria Road, maintaining access for pedestrians and cyclists.
- The existing western footway along Victoria Road at Hitchman Street will be extended to enhance the pedestrian environment.
- A 20mph zone to include the whole traffic calmed area.

4. Transport improvements along A53 Etruria Road

The bus gate on A53 Etruria Road will significantly reduce traffic flows in the peak periods along this corridor and improve bus reliability. This will necessitate the review of signal timings at junctions along the corridor in order to maximise air quality benefits.

The increase in spare capacity along the corridor will create the opportunity for the provision of signalised pedestrian crossing facilities on all arms of the A53/Gladstone Street/Basford Park Road junction and the A53/Albert Street/Sandy Lane junction.

An existing bus stop along the A53 Etruria Road is located on the hill where it is observed that traffic can queue behind buses serving the stop. It is recommended that the bus stop is relocated to the east of Kingsfield Oval, opposite the New Vic Theatre where it is likely to have a reduced impact on air quality. Accessibility will be enhanced through the provision of bus access kerbs and levelled footways. Real Time Bus Passenger Information (RTPI) will also be provided along the A53 corridor.

5. Bus retrofit programme

To deliver compliance on Bucknall New Road and Victoria Road the buses that use these routes will be retrofitted to achieve Euro VI emission standards. This involves the installation of the appropriate exhaust modification depending on vehicle type and age and associated e-cooling fan to minimise ongoing maintenance. This will be an expansion of the existing bus retrofit programme being delivered on the A53 as part of the separate NuLBC Ministerial Direction.

75% of buses that travel along the Bucknall New Road corridor and all buses travelling along Victoria Road require this improvement to ensure that compliance is achieved. Funding will be required for the retrofitting of 50 buses to ensure that the appropriate number of scheduled services can continue to operate on Bucknall New Road and Victoria Road. The two main operators are First Bus and D&G, and the smaller operators include Scraggs and Stantons of Stoke.

To market the cleaner bus fleet, enhance their visibility and encourage greater bus use, it is recommended that all buses that have been retrofitted are provided with a new branding in the form of a partial bus wrap. To monitor bus operator, use of retrofit vehicles, ANPR cameras will be installed on Victoria Road, Bucknall New Road, at the junction with St Ann Street, and on the A53 to the east of the junction with Albert Street/Sandy Lane.

6. Bus infrastructure improvements

Enhanced bus infrastructure will be installed on routes that pass through or are parallel to the exceedance locations. This includes bus routes:

- To Abbey Hulton, Milton, Bentilee and Longton that converge at Bucknall New Road
- Along Victoria Road and parallel routes along College Road and A5007 City Road
- Along A53 Etruria Road between Newcastle town centre and Hanley City Centre, and parallel routes along the A52 and Shelton New Road

The improvements are required to ensure that bus patronage is maximised along corridors that are at risk of air quality exceedances and where traffic modelling suggests that traffic flows and journey times may increase as traffic re-routes to avoid the bus gates. The cost of the package includes the installation and ten-year maintenance of:

- 89 RTPI screens
- 17 new bus shelters of which 8 are replacement and 9 are new facilities
- 27 accessible kerbs at bus stops
- Installation of CCTV at 71 bus stops

The proposed transport schemes for the Preferred Option have been developed in order to address NO_2 exceedances. A multitude of options have been tested in the NSMM transport model in order to produce the optimal package of measures. In addition to the transport schemes included in the Reference Case, the schemes that were modelled in the NSMM transport model for the Preferred Option are outlined in Table 7-1. Not all the measures could be tested in the NSMM transport model such as the bus infrastructures improvement and some of the local traffic management measures due to the nature of these schemes and the strategic nature of the NSMM transport model.

Table 7-1: Preferred Option transport schemes

Location	Preferred Option
A53 Etruria Road	A53 westbound peak restriction (except bus, cycle and taxi) plus pedestrian phases at both Albert St and Basford Park traffic lights.
Bucknall New Road	75% bus retrofit along Bucknall New Road
Victoria Road	Victoria Road northbound peak restrictions on southern end of Victoria Road (except bus, cyclists and taxi) 100% bus retrofit

7.2 Modelling of options

In addition to the Preferred Option, several options were tested using the NSMM model. Table 7-2 outlines the different model runs undertaken for the 2022 forecast year (the compliance year) and details the respective mitigation measures.

The predicted NO_2 concentrations for 2022 are outlined for each option modelled in Table 7-3. Option 4 achieves compliance at all exceedance locations without generating additional exceedances elsewhere or using a charging scheme (such as option 1, 3 and 5). Option 7 (the Preferred Option) was then generated which combines Option 4 with bus network enhancements. The bus network enhancement, given their nature, were not modelled, so in transport modelling terms Option 4 and 7 are the same. Table 7-4 provides an assessment of each option.

Table 7-2: Modelled options

	Option 1 (Benchmark)	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7 (Preferred Option)
CAZ	CAZ D Daily charge for trips through, within, to or from the CAZ D area: Cars/Taxis --£5 LGVs --£9 HGVs --£35 Buses --£5	No CAZ	Local CAZ D around Victoria Road Daily charge for trips through, within, to or from the CAZ D area: Cars/Taxis --£5 LGVs --£9 HGVs --£35 Buses --£0	No CAZ	CAZ C Daily charge for trips through, within, to or from the CAZ C area: LGVs --£9 HGVs --£35 Buses --£5	No CAZ	No CAZ
A53		Basford Park right turn ban	A53 westbound peak restrictions (except bus, cyclists and taxi)	A53 westbound peak restriction (except bus, cyclists and taxi) Pedestrian phases at both Albert Street and Basford Park traffic lights		As option 4, plus further complementary measures including: • Improved bus stops and shelters • Bus wrap advertising • Real-time information Travel planning • Vegetation planting/removal • Cycling/walking infrastructure • EV infrastructure	As option 4, plus further bus network enhancements including: • Improved bus stops and shelters • Bus wrap advertising • Real-time information

Bucknall New Road	100% bus retrofit for Bucknall New Road to mitigate impact of CAZ D	50% bus retro fit on Bucknall New Road	100% bus retro fit on Bucknall New Road	75% bus retrofit along Bucknall New Road		As option 4, plus further complementary measures as above	As option 4, plus further bus network enhancements
Victoria Road	100% bus retrofit for Victoria Road to mitigate impact of CAZ D	Existing Academy Link Road with junction improvements at both ends (only NB north of Academy) Victoria Rd northbound peak restrictions on the southern end of Victoria Road (except bus, cyclists and taxi) 100% bus retrofit on Victoria Road	Local CAZ D 100% bus retrofit on Victoria Road to mitigate impact of local CAZ D	Victoria Road northbound peak restrictions on southern end of Victoria Road (except bus, cyclists and taxi) 100% bus retrofit		As option 4, plus further complementary measures as above	As option 4, plus further bus network enhancements

Table 7-3: predicted NO2 concentrations 2022

	Reference Case	Option 1 (Benchmark)	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7 (Preferred Option)
A53	43	33	42	40	39	38	39	39
Bucknall New Road	42	31	41	37	39	35	39	39
Victoria Road	46	36	40	35	39	41	39	39

Table 7-4: Assessment of options

	Option 1 (Benchmark)	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7 (Preferred Option)
Impact on NO_2 concentrations	Full compliance Effect of rerouting: Increase in concentrations in London Road (Newcastle-under-Lyme) and Newport Lane, Newcastle Street and Moorland Road (Stoke-on-Trent)	A53 and Bucknall New Road remain in exceedance New exceedance: entrance to the Intu Potteries car park	No exceedances Victoria Road No more exceedances (decrease by around 10 µg/m³) Increase in Leek Road (by around 1 µg/m³)	No exceedances. All locations below the legal limit, suggesting that this option provides the most practical non-CAZ option. This option will be used to inform the Preferred Option.	Delivers compliance on A53 and Bucknall New Road, but Victoria Road is in exceedance at 41.3 µg/m³, and two other locations (Longport road and entrance to Potteries car park, Hanley) fall into exceedance.	No exceedances. All locations are below the legal limit. However, complementary measures will not be used.	No exceedances. All locations are below the legal limit suggesting that this option provides the most practical non-CAZ option. This option has therefore been progressed to the Preferred Option
Summary of assessment	Benchmark required by JAQU, against which the Preferred Option must be tested for delivery against the primary outcome of achieving compliance in the shortest possible time. This forms the default option, if a Preferred Option cannot be found that delivers the primary aim. Benchmark option	Does not quite achieve compliance at 2 of the 3 exceedances. Therefore officers have developed a more robust traffic-based option (option 4), for testing. Dismissed as an option.	Achieves compliance, but still includes a CAZ D. Therefore it is not in line with JAG instructions to identify a non-CAZ Preferred Option. Dismissed as an option.	Developed following review of option 2 results. Delivers a traffic-based solution that delivers full compliance. This option has been built upon to produce the Preferred Option. Dismissed as an option	Tested to determine whether a less severe CAZ C could be used as an alternative benchmark. Dismissed as an option.	Developed following the review of option 4 results. Combined with complementary measures delivers full compliance but complementary measures will not be used. Dismissed as an option.	Developed following the review of option 4 results. Combined with bus network enhancements delivers full compliance and is deliverable in the shortest possible time, compared to option 1. Preferred Option

7.3 Preferred Option traffic growth

Table 7-5 shows the 2022 and 2025 trip matrix totals by vehicle type and compliance for the Preferred Option. Table 7-6 shows the 2022 and 2025 trip matrix totals for each vehicle type for the Preferred Option.

Table 7-5: 2022 and 2025 Preferred Option trip matrix totals by vehicle type and compliance

Vehicle Type	Compliance	AM Peak-Hour		Inter-Peak Hour		PM Peak-Hour	
		2022	2025	2022	2025	2022	2025
Car	Compliant	54,526	63,905	46,940	55,163	58,626	68,677
	Non-Compliant	26,856	19,088	23,120	16,477	28,876	20,514
Taxi	Compliant	85	98	73	84.7	91	105
	Non-Compliant	78	68	67	58.8	84	73
LGV	Compliant	5,710	6,711	5,348	6,273	5,069	5,934
	Non-Compliant	4,672	4,113	4,375	3,845	4,147	3,637
HGV	Compliant	3,762	4,162	3,266	3,622	2,134	2,363
	Non-Compliant	562	173	488	151	319	98
Total		**96,251**	**98,318**	**83,677**	**85,674**	**99,346**	**101,401**

Table 7-6: 2022 and 2025 Preferred Option trip matrix totals by vehicle type

Vehicle Type	AM Peak-Hour		Inter-Peak Hour		PM Peak-Hour	
	2022	2025	2022	2025	2022	2025
Car	81,382	82,993	70,060	71,640	87,502	89,191
Taxi	163	166	140	144	175	178
LGV	10,382	10,824	9,723	10,117	9,216	9,571
HGV	4,324	4,335	3,754	3,772	2,453	2,461
Total	**96,251**	**98,318**	**83,677**	**85,674**	**99,346**	**101,401**

7.4 Forecast traffic flows – Preferred Option

Figure 7-1 shows the change in forecast daily traffic flow between the 2022 Reference Case and the 2022 Preferred Option. Figure 7-2 and Figure 7-3 show the difference in forecast traffic flows for the 2022 Reference Case against the 2022 Preferred Option for the AM and PM modelled periods. The following can be seen from the Figures:

- A large reduction in daily and peak flows on the A53 westbound and on Victoria Road northbound due to the traffic restrictions of the bus gate in the Preferred Option

- The Victoria Road bus gate results in traffic re-routing on a variety of routes including A5272 Dividy Road, Grove Road/Whieldon Road and the A50/A500 to avoid the area
- The A53 bus gate results in traffic re-routing onto the A527 Grange Lane to the north of the A53 and A52 Hartshill Road and B5045 Shelton New Road to the south
- There is little flow change in the inter-peak with the Preferred Option as the bus gates are only operational in the peak periods

Figure 7-4 shows the change forecast daily traffic flow (AADT) between the 2025 Reference Case and the 2025 Preferred Option. Figure 7-5 and Figure 7-6 show the equivalent for the AM and PM modelled periods. The re-routing trends for 2025 are very similar to 2022. Table 7-7 shows a similar level of flow reduction along the A53 and Victoria Road in 2022 and 2025, with the reduction being slightly higher in 2025.

Figure 7-7 shows the overcapacity links and junction delays for the 2022 Preferred Option. Links are identified as being the source of congestion problems where the ratio of the modelled traffic flow to the capacity of the link are greater than 81%. For these assessments, the capacities of the links have been based on the Advice Note TA 79/99 – Traffic Capacity of Urban Roads (May 1999). Therefore, it should be borne in mind that these values are based on theoretical capacities which may not always reflect the ultimate or actual capacity of the road which may be affected by other local operational conditions and characteristics. Junctions are identified as being the source of congestion problems where the overall average junction delay is greater than 20 seconds. When compared with Figure 6-18 the 2022 Reference Case over capacity links and junction delays, Figure 7-7 unsurprisingly shows big improvements on the A53 westbound between the A500 roundabout to Basford Park Road and Victoria Road northbound with the bus gates operational in the Preferred Option.

Given the spread of redistributed traffic there is little wider deterioration in network performance with the Preferred Option. The main adverse impact is close to the Victoria Road bus gate where there is an increase in delays at the junction of City Road and Manor Street. This is caused by the increase in right turners from City Road to Manor Street, avoiding the bus gate in both modelled periods.

Table 7-7: Change in AADT between Reference Case and Preferred Option

Location	AADT	
	2022	2025
A53 Westbound	-4690	-4795
Victoria Road Northbound	-3728	-3757

Figure 7-1: Change in AADT traffic flows between 2022 Reference Case and 2022 Preferred Option (vehicles)

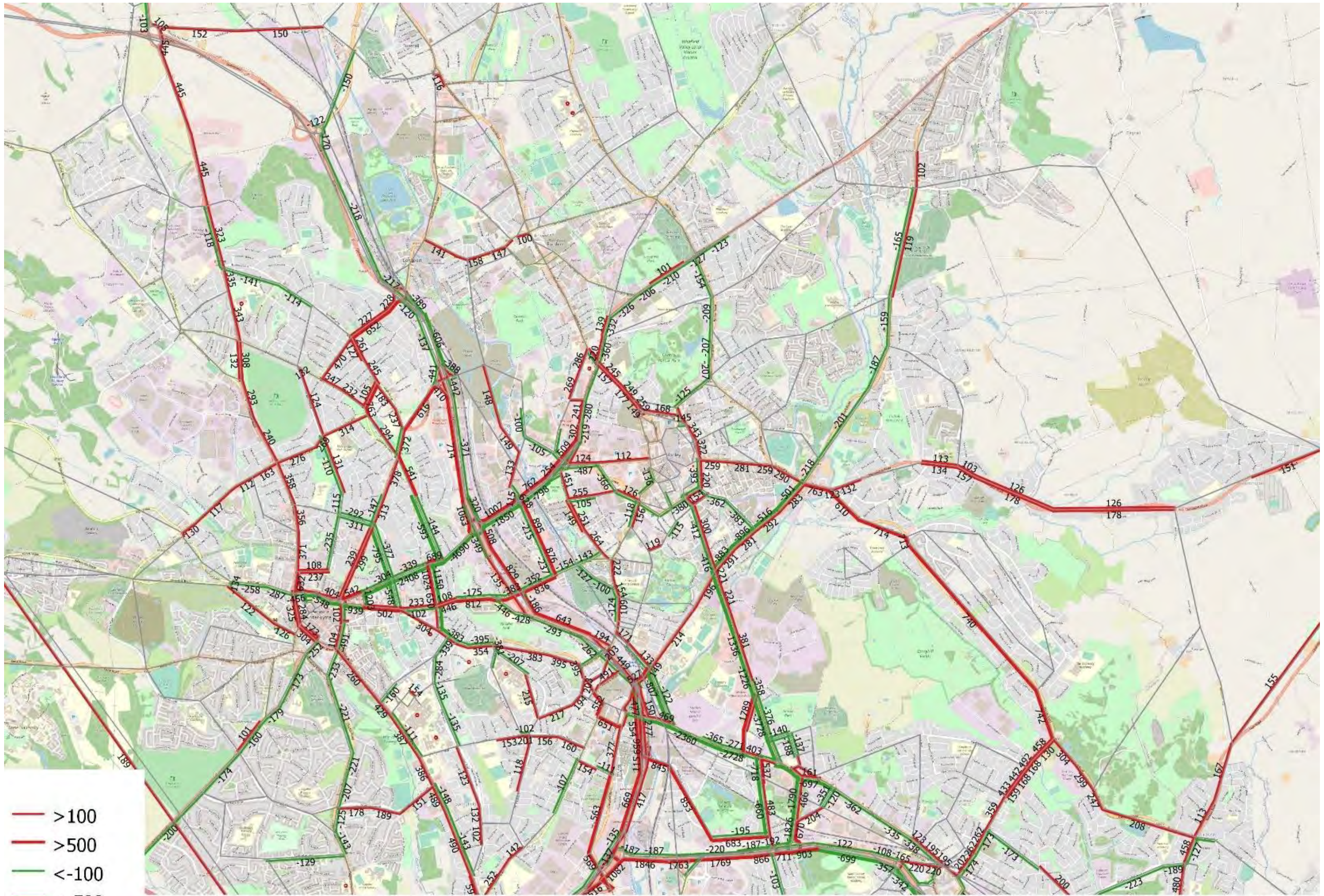


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Figure 7-2: Change in AM peak-hour traffic flows between 2022 Reference Case and 2022 Preferred Option (vehicles)

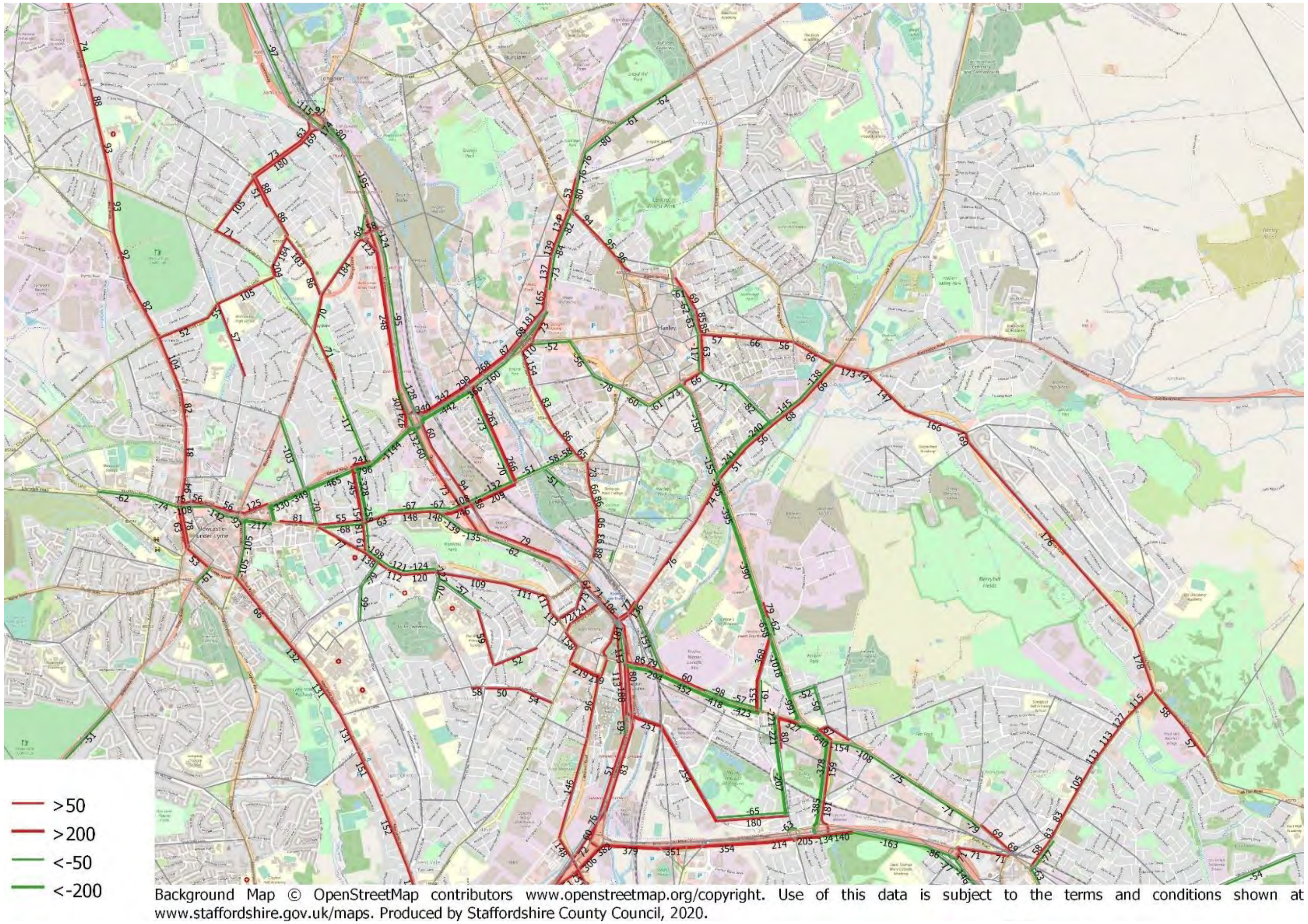

Figure 7-3: Change in PM peak-hour traffic flows between 2022 Reference Case and 2022 Preferred Option (vehicles)

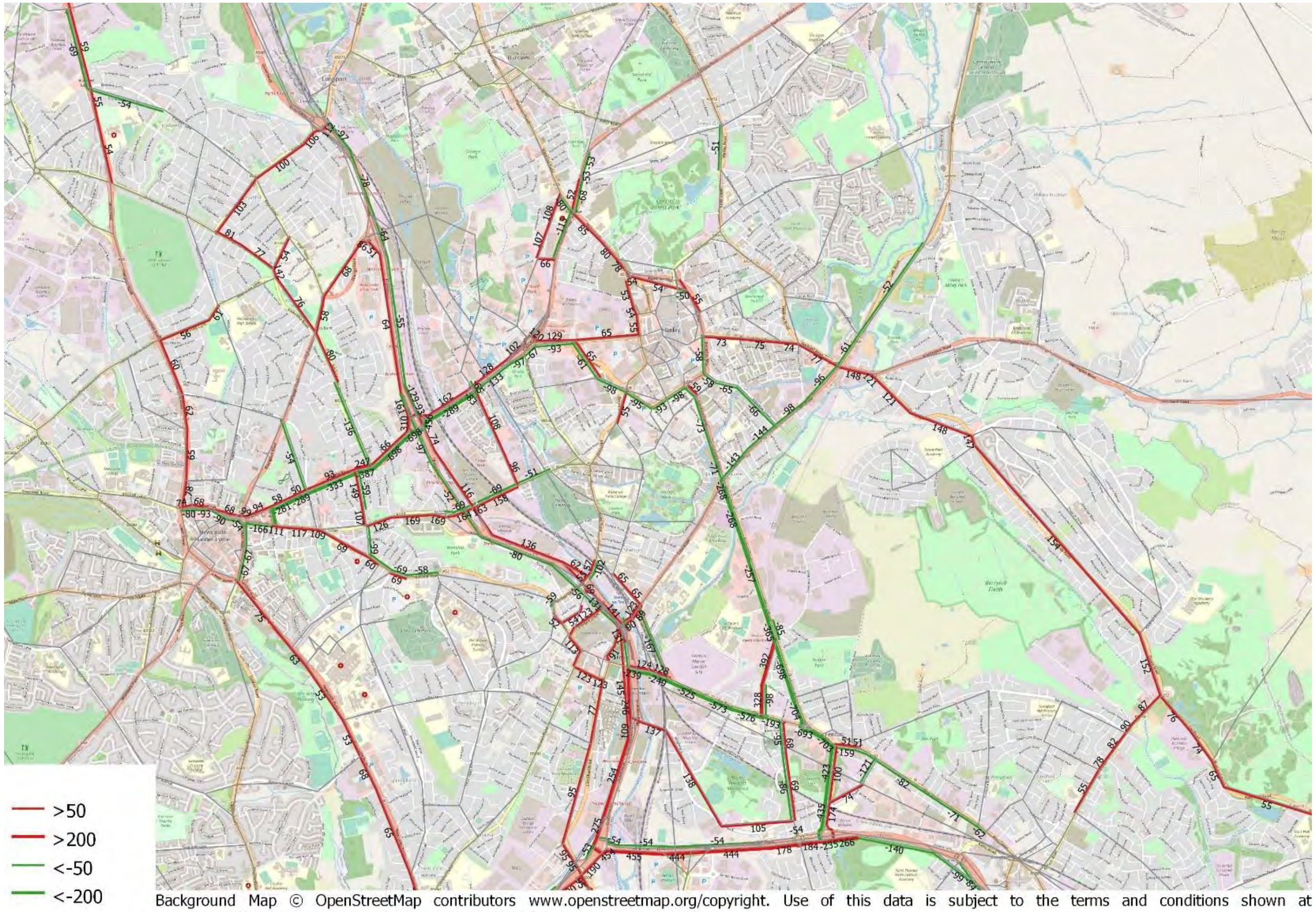

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Figure 7-4: Change in AADT traffic flows between 2025 Reference Case and 2025 Preferred Option (vehicles)

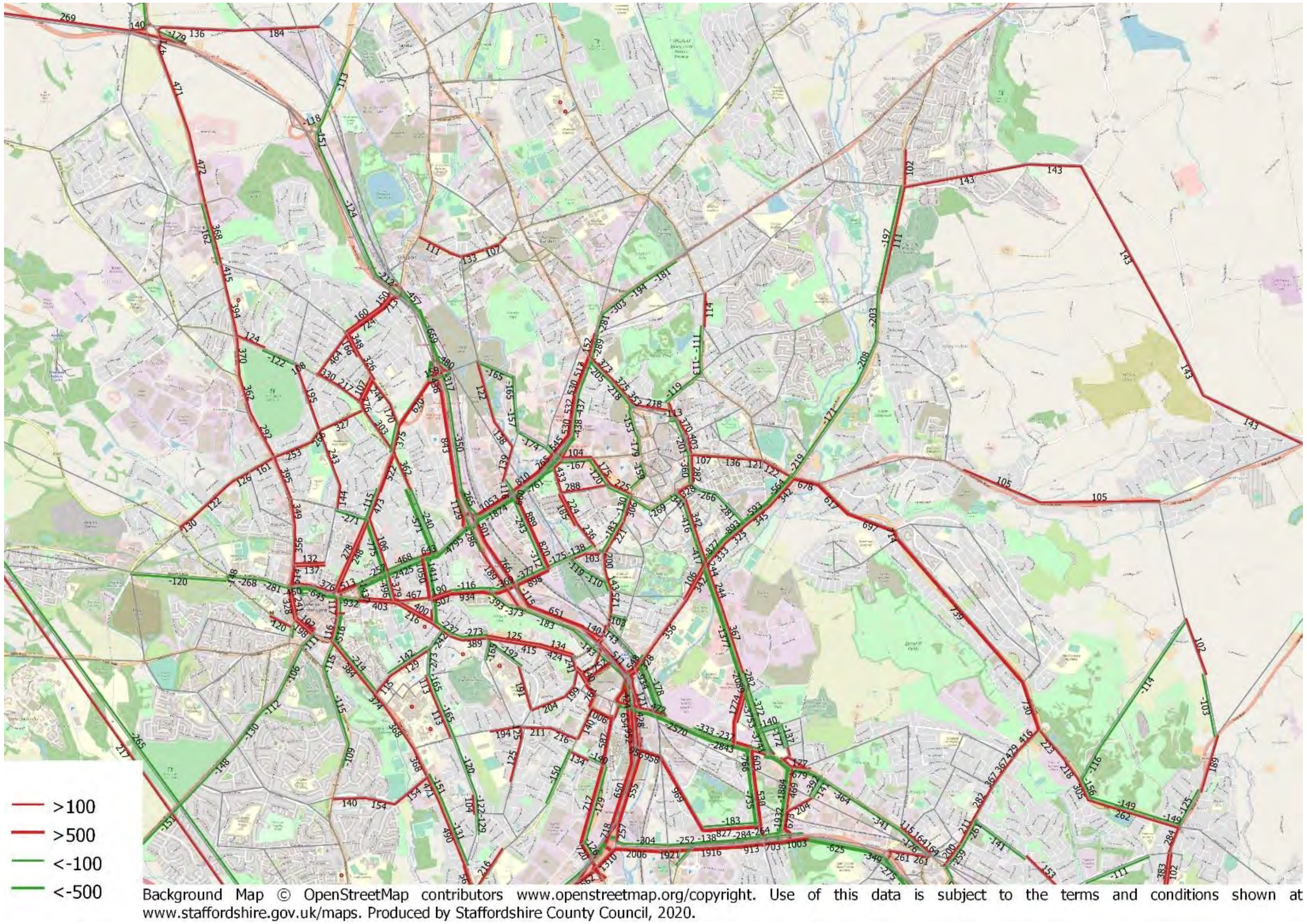

Figure 7-5: Change in AM peak-hour traffic flows between 2025 Reference Case and 2025 Preferred Option (vehicles)

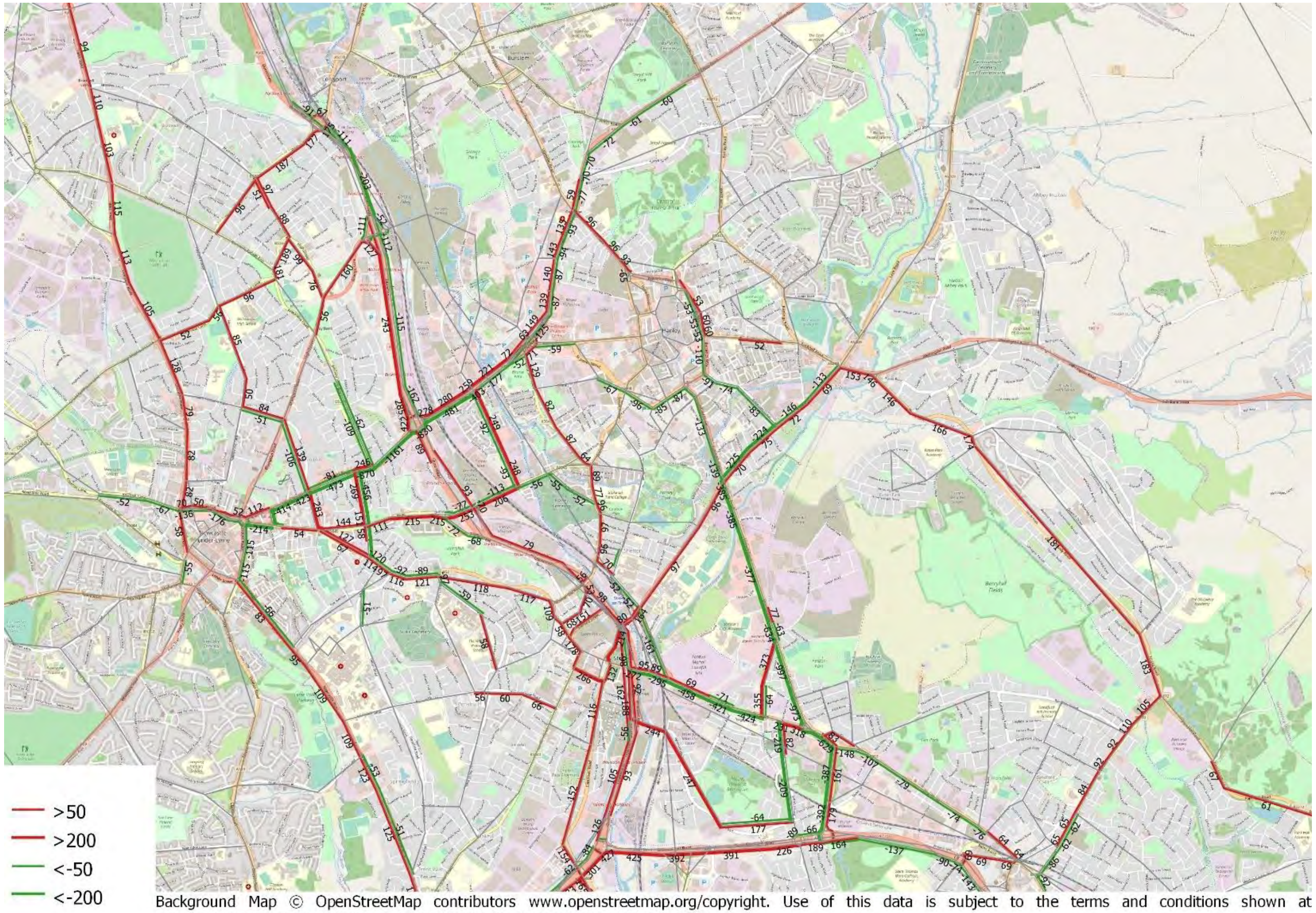

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Figure 7-6: Change in PM peak-hour traffic flows between 2025 Reference Case and 2025 Preferred Option (vehicles)

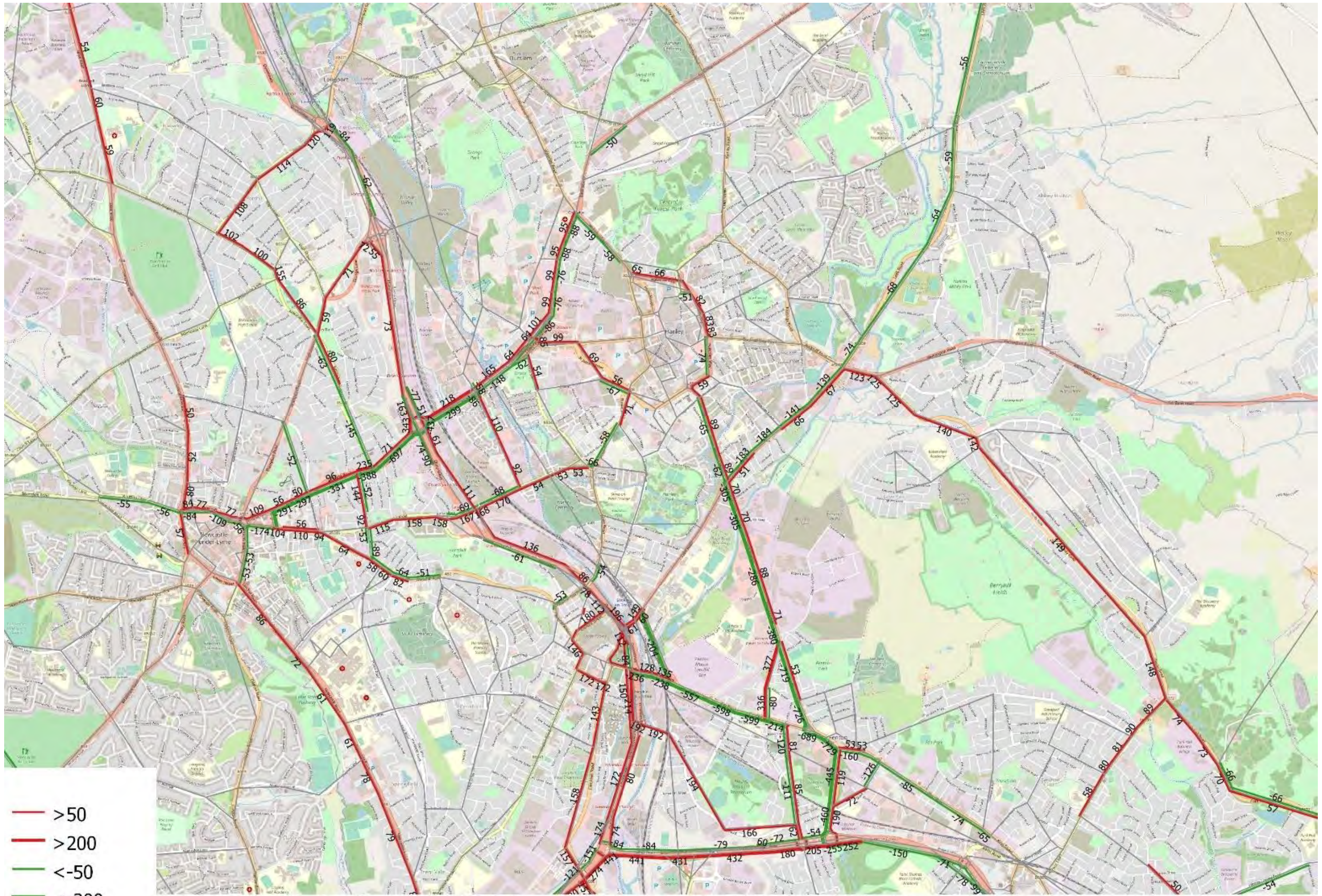

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Figure 7-7: 2022 Preferred Option AM peak-hour overcapacity links and significant junction delays

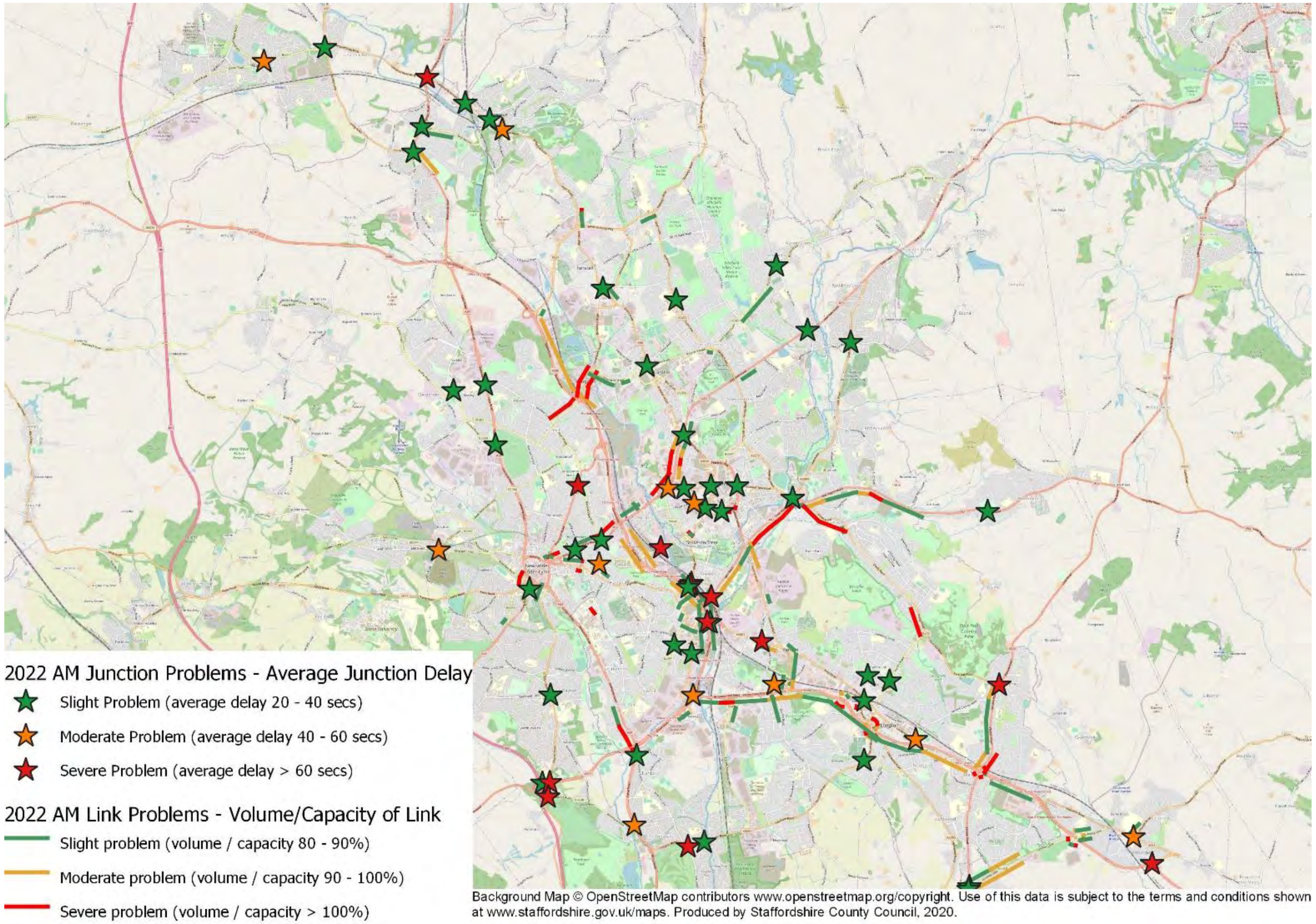
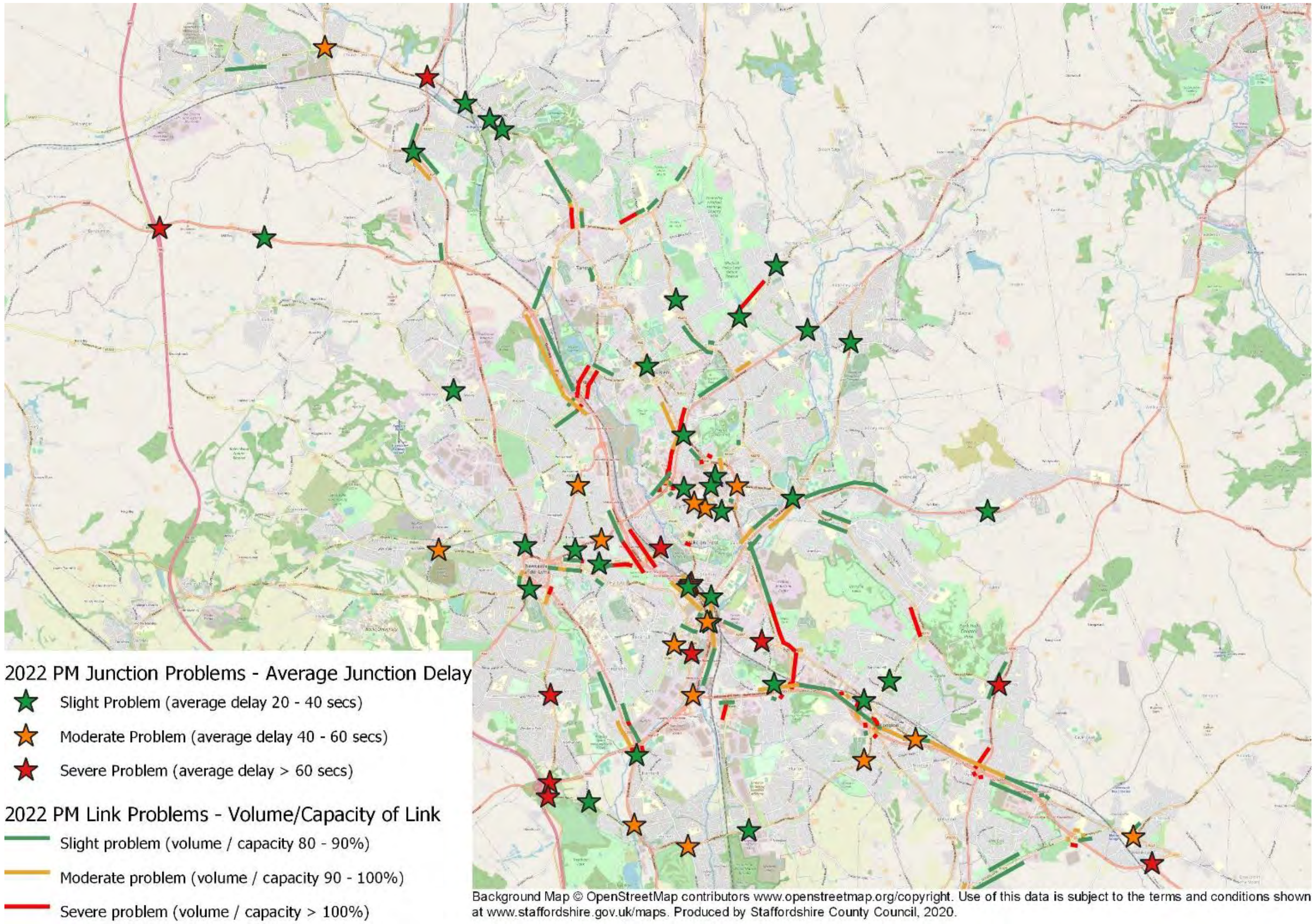


Figure 7-8: 2022 Preferred Option PM peak-hour overcapacity links and significant junction delays



8 Benchmark CAZ D traffic assignment results

8.1 Benchmark CAZ D modelling

A charging CAZ, type D, with a daily charge for all non-compliant vehicles, has been assessed as a benchmark option. The extent of the benchmark charging Benchmark CAZ D modelled is shown in Figure 8-1, it includes east of Newcastle-under-Lyme, the A50 Victoria Road, Bucknall New Road, the A53 between Newcastle-under-Lyme and Hanley and the City Centre (Hanley) but excludes Stoke-on-Trent railway station.

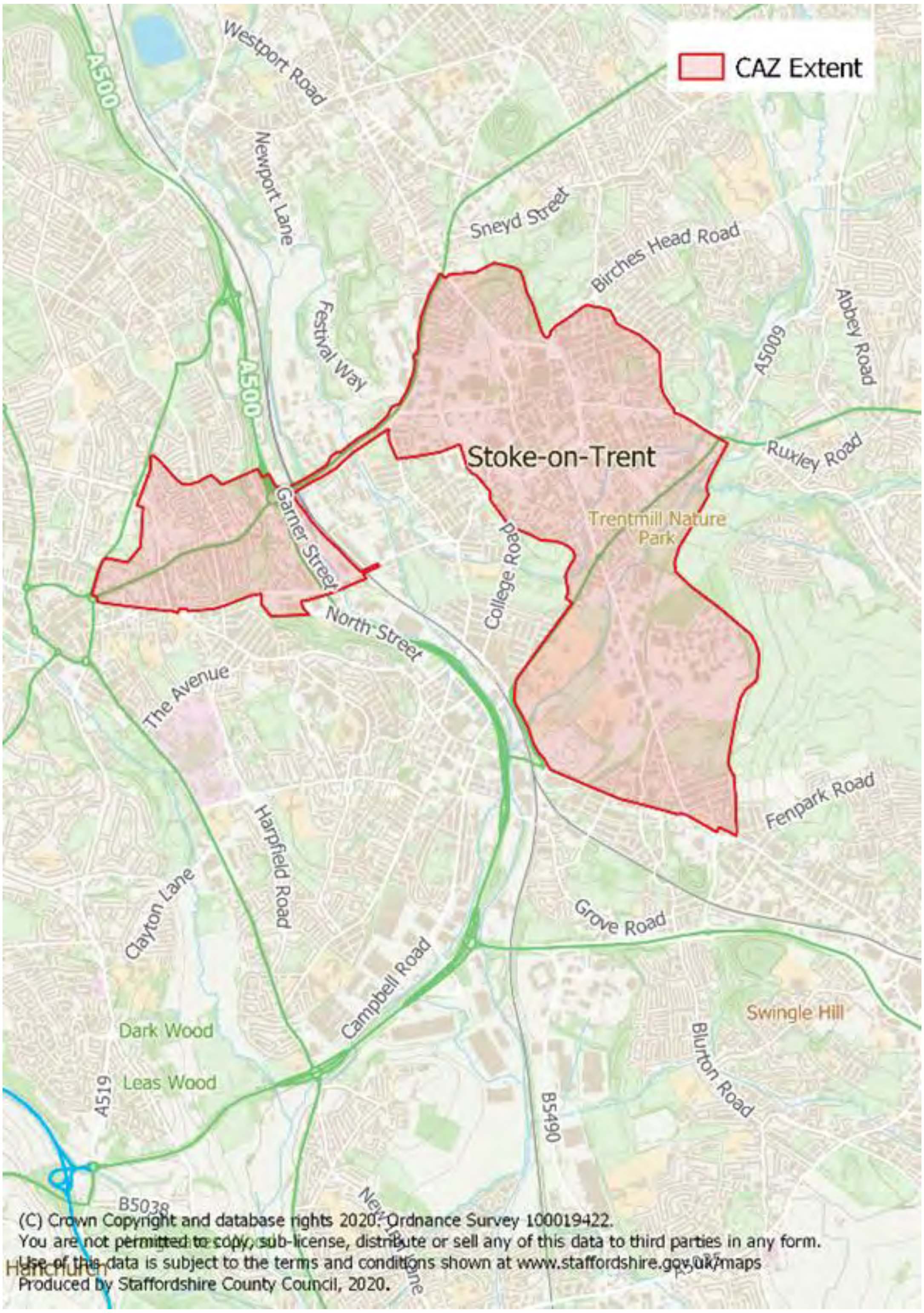
The methodology for modelling a charging Benchmark CAZ D is detailed in the T3 report. The modelling of the charging CAZ builds upon the 2022 Reference Case and includes the schemes shown in Table 4-1. The daily charges applied by vehicle type for the CAZ are shown in Table 8-1.

As seen in Table 7-3 the Benchmark CAZ achieves NO_2 compliance at all exceedance locations.

Table 8-1: Benchmark CAZ D charges by vehicle type (option 1)

Vehicle Type	CAZ Daily Charge
Cars/Taxis/Buses	£5
LGVs	£9
HGVs	£35

Figure 8-1: Benchmark CAZ D charging cordon



8.2 Benchmark CAZ D comparison

The forecast demand responses for the North Staffordshire charging CAZ which have been applied in the NSMM transport model have been derived from the stated preference surveys described in a separate technical note. The demand responses have been compared with the responses for Bath and London for cars, taxis, LGVs and HGVs to ensure that they are appropriate. The demand responses are split into the following categories:

- Change route/destination – this includes vehicles avoiding the CAZ or redistributing to a destination away from the charging CAZ area
- Pay charge – this includes vehicles that do not alter journey plans instead choosing to pay the charge
- Cancel Trip/Mode Shift – this includes vehicles choosing to either cancel their trip or change mode of transport
- Upgrade/Switch Vehicle – This includes purchasing a compliant vehicle, retro-fitting a non-compliant vehicle or using an alternative available compliant vehicle

Table 8-2 to Table 8-5 show a comparison between demand responses forecast for North Staffordshire, London and Bath. The values for London are JAQU derived and provided as part of the JAQU Third Wave Evidence Package[1]. Table 8-2 identifies that forecast demand responses for North Staffordshire mostly fall between London and Bath. The percentage choosing to upgrade/switch vehicle is higher in North Staffordshire as opposed to London where a higher percentage choose to either cancel their trip or choose an alternative mode of transport. London of course has a wider choice of alternative transport options including an extensive public transport network. A higher percentage of those paying the charge for all vehicle types can be seen in London compared with North Staffordshire and Bath. With lower numbers choosing to upgrade or switch their vehicle. The higher percentage of those willing to pay the CAZ charge in London is reasonable as London is an affluent area.

Table 8-2: Demand response comparison for car

Car	North Staffordshire	London	Bath
Change Route/Destination	19%	23%	20%
Pay Charge	15%	16%	5%
Cancel Trip/Mode shift	21%	39%	18%
Upgrade/Switch Vehicle	45%	22%	57%

[1] JAQU Third Wave Evidence Package

Table 8-3: Demand response comparison for taxi

Taxi	North Staffordshire	London	Bath
Change Route	0%	23%	0%
Pay Charge	3%	16%	4%
Cancel Trip/Mode shift	24%	39%	0%
Upgrade/Switch Vehicle	73%	22%	96%

Table 8-4: Demand response comparison for LGV

LGV	North Staffordshire	London	Bath
Change Route	27%	17%	12%
Pay Charge	28%	42%	17%
Cancel Trip/Mode shift	2%	16%	4%
Upgrade/Switch Vehicle	43%	25%	67%

Table 8-5: Demand response comparison for HGV

HGV	North Staffs	London	Bath
Change Route	14%	13%	5%
Pay Charge	15%	29%	11%
Cancel Trip/Mode shift	5%	13%	2%
Upgrade/Switch Vehicle	66%	44%	82%

8.3 Benchmark CAZ D charge sensitivity test

Five pounds is the assumed daily Benchmark CAZ D charge for non-compliant cars and taxis to travel to, from, through or within the cordon. A sensitivity test was carried out doubling the daily charge to ten pounds. Table 8-6 shows the change in demand responses for car drivers if the daily charge was doubled. The higher charge results in less car drivers paying the charge and an increase in cancelled trips or a change in mode of transport and a higher percentage upgrading or switching to compliant vehicles. Table 8-7 shows that for taxi drivers there would be an increase in cancelled trips and a reduction in taxis paying the increased charge.

Table 8-8 shows the change in demand responses for LGVs with a doubling of the daily CAZ charge to eighteen pounds. The higher charge results in a decrease in LGVs paying the charge and an increase in rerouting to avoid paying the charge.

Table 8-9 shows the change in demand responses for HGVs with a doubling of the daily CAZ charge to seventy pounds. The higher charge results in a decrease in those willing to pay the charge with an increase in cancelled trips and switching or upgrading to compliant vehicles. It also shows no change in re-routing perhaps given the vehicle operating cost implications of a longer route.

Table 8-6: Benchmark CAZ D car charge sensitivity test

Car	£5 charge	£10 charge	% Diff
Change Route	11%	11%	0%
Change Destination	8%	6%	-2%
Pay Charge	15%	3%	-12%
Cancel Trip/Mode shift	21%	22%	2%
Upgrade/Switch Vehicle	45%	58%	13%

Table 8-7: Benchmark CAZ D taxi charge sensitivity test

Taxi	£5 charge	£10 charge	% Diff
Change Route	0%	0%	0%
Pay Charge	3%	1%	-2%
Cancel Trip	24%	26%	2%
Upgrade/Switch Vehicle	73%	73%	0%

Table 8-8: Benchmark CAZ D LGV charge sensitivity test

LGV	£9 charge	£18 charge	% Diff
Change Route	27%	31%	4%
Pay Charge	28%	25%	-3%
Cancel Trip	2%	1%	-1%
Upgrade/Switch Vehicle	43%	43%	0%

Table 8-9: Benchmark CAZ D HGV charge sensitivity test

HGV	£35 charge	£70 charge	% Diff
Change Route	14%	14%	0%
Pay Charge	15%	7%	-8%
Cancel Trip	5%	9%	4%
Upgrade/Switch Vehicle	66%	72%	6%

8.4 Benchmark CAZ D traffic growth

Table 8-10 shows the Benchmark CAZ D trip matrix totals for 2022 and 2025 by compliant and non-complaint vehicle type, based on the core daily charge assumptions in Table 8-1. The Benchmark CAZ D scenario for 2022 and 2025 shows a reduction in non-compliant vehicles when compared with the 2022 Reference Case with a higher number of vehicles converting to compliant cars. Table 8-11 presents the total trip matrices by vehicle for the 2022 Reference Case, the 2022 Benchmark CAZ D and the 2025 Benchmark CAZ D. The 2022 and 2025 Benchmark CAZ D scenario shows a reduction in total trips when compared with the 2022 Reference Case as a result of cancelled trips or shift to other modes.

Table 8-10: 2022 and 2025 Benchmark CAZ D trip matrix totals by vehicle type and compliance

Vehicle Type	Compliance	AM Peak-Hour			Inter-Peak Hour			PM Peak-Hour		
		2022 RC	2022	2025	2022 RC	2022	2025	2022 RC	2022	2025
Car	Compliant	54,526	57,747	66,236	46,940	49,906	57,269	58,626	62,271	71,203
	Non-Compliant	26,856	21,107	14,927	23,120	17,827	12,720	28,876	22,371	16,006
Taxi	Compliant	85	92	105	73	82	92	91	101	133
	Non-Compliant	78	63	59	67	55.6	48.6	84	71	62
LGV	Compliant	5,710	6,336	7,241	5,348	5,991	6,787	5,069	5,649	6,400
	Non-Compliant	4,672	3,609	3,215	4,375	3,284	2,972	4,147	3,163	2,847
HGV	Compliant	3,762	3,855	4,186	3,266	3,342	3,641	2,134	2,170	2,372
	Non-Compliant	562	442	141.8	488	389	125	319	272	87
Total		**96,251**	**93,249**	**96,110**	**83,677**	**80,875**	**83,654**	**99,346**	**96,067**	**99,109**

Table 8-11: 2022 and 2025 Benchmark CAZ D trip matrix totals by vehicle type

Vehicle Type	AM Peak-Hour			Inter-Peak Hour			PM Peak-Hour		
	2022 RC	2022	2025	2022 RC	2022	2025	2022 RC	2022	2025
Car	81,382	78854	81163	70,060	67733	69989	87,502	84642	87209
Taxi	163	155	164	140	137	141	175	172	195
LGV	10,382	9945	10456	9,723	9275	9758	9,216	8812	9247
HGV	4,324	4296	4328	3,754	3731	3766	2,453	2441	2459
Total	**96,251**	**93,249**	**96,110**	**83,677**	**80,875**	**83,654**	**99,346**	**96,067**	**99,109**

8.5 Demand response

Table 8-12 shows the demand response in vehicle numbers to the introduction of a charging Benchmark CAZ D in 2022 for the AM, IP and PM modelled periods. As can be seen from Table 8-12 most vehicles are upgraded or switched to a compliant vehicle. A high number of car drivers cancel their trip or change mode, goods vehicles do not have this choice and are more likely to pay the charge. A high proportion of LGVs also choose to change route to avoid the charge.

Table 8-12: Demand response to implementation of charging Benchmark CAZ D

Action	Vehicle			
	AM			
	Cars	LGV	HGV	Taxi
Change Route	794	393	20	0
Change Destination	559	0	0	0
Pay Charge	1,050	408	21	0
Cancel Trip/Mode shift	1,478	29	7	3
Upgrade/Switch Vehicle	3,221	626	93	8
	IP			
	Cars	LGV	HGV	Taxi
Change Route	743	404	16	0
Change Destination	523	0	0	0
Pay Charge	971	419	17	0
Cancel Trip/Mode shift	1,355	30	6	3
Upgrade/Switch Vehicle	2,966	643	76	9
	PM			
	Cars	LGV	HGV	Taxi
Change Route	909	364	8	0
Change Destination	639	0	0	0
Pay Charge	1191	378	8	0
Cancel Trip/Mode shift	1,668	27	3	3
Upgrade/Switch Vehicle	3,645	580	36	9
Total pay	3,212	1,204	47	1
Total Cancel Trip/Mode Split	4,502	86	16	8
Total Upgrade/Switch Vehicle	9,832	1,849	205	26

8.6 Forecast traffic flows

Figure 8-2 shows the change in forecast daily traffic flow (AADT) between the 2022 Reference Case and the 2022 Benchmark CAZ D. Figure 8-3 to Figure 8-5 show the difference in traffic flow in the AM, IP and PM modelled periods between the 2022 Reference Case and the 2022 Benchmark CAZ D. Figure 8-2 generally shows a large reduction in forecast daily traffic with the implementation of the charging Benchmark CAZ D.

Figure 8-6 shows the change in forecast daily traffic flow (AADT) between the 2025 Reference Case and the 2025 Benchmark CAZ D. Figure 8-7 to Figure 8-9 show the change in traffic flow in the AM, IP and PM modelled periods between the 2025 Reference Case and the 2025 Benchmark CAZ D. When compared with Figure 8-2, Figure 8-6 shows a lower level of reduction in 2025 with Benchmark CAZ D compared with 2022 Benchmark CAZ D, this is logical as the number of compliant vehicle rises in 2025 (in the Reference Case) as a result more vehicles would be able to travel through the CAZ without being charged.

Figure 8-10 and Figure 8-11 depict the overcapacity links and junction delay for the AM Peak-Hour and the PM Peak-Hour. Figure 8-10 compared with Figure 6-18 shows a reduction in over capacity links along Victoria Road with reduction in junction delays around Hanley. Comparing Figure 8-11 with Figure 6-20 shows similar results.

Figure 8-2: Change in AADT traffic flows between 2022 Reference Case and 2022 Benchmark CAZ D (vehicles)

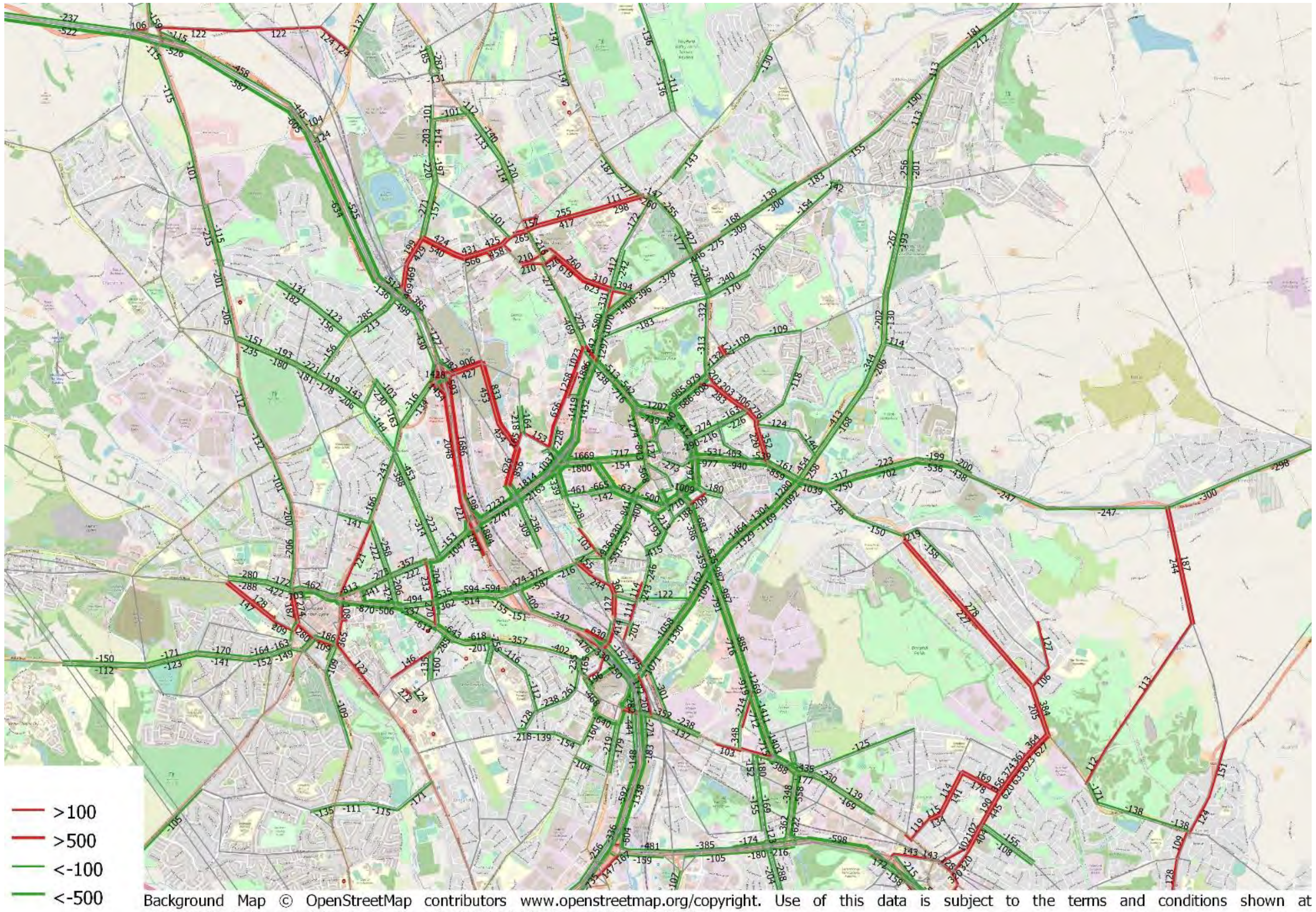


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Figure 8-3: Change in AM peak-hour traffic flows between 2022 Reference Case and 2022 Benchmark CAZ D (vehicles)

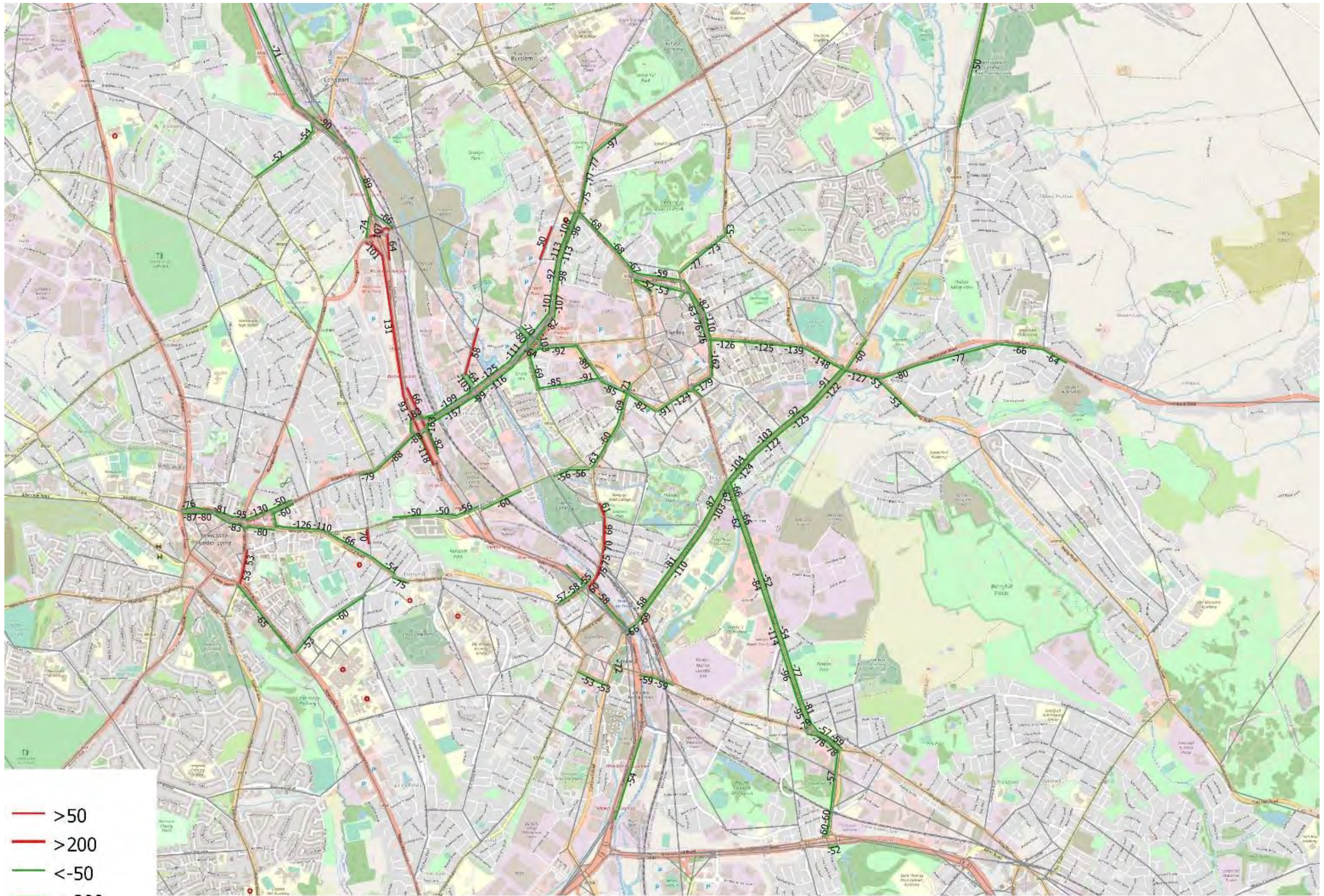

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Figure 8-4: Change in Inter-Peak hour traffic flows between between 2022 Reference Case and 2022 Benchmark CAZ D (vehicles)

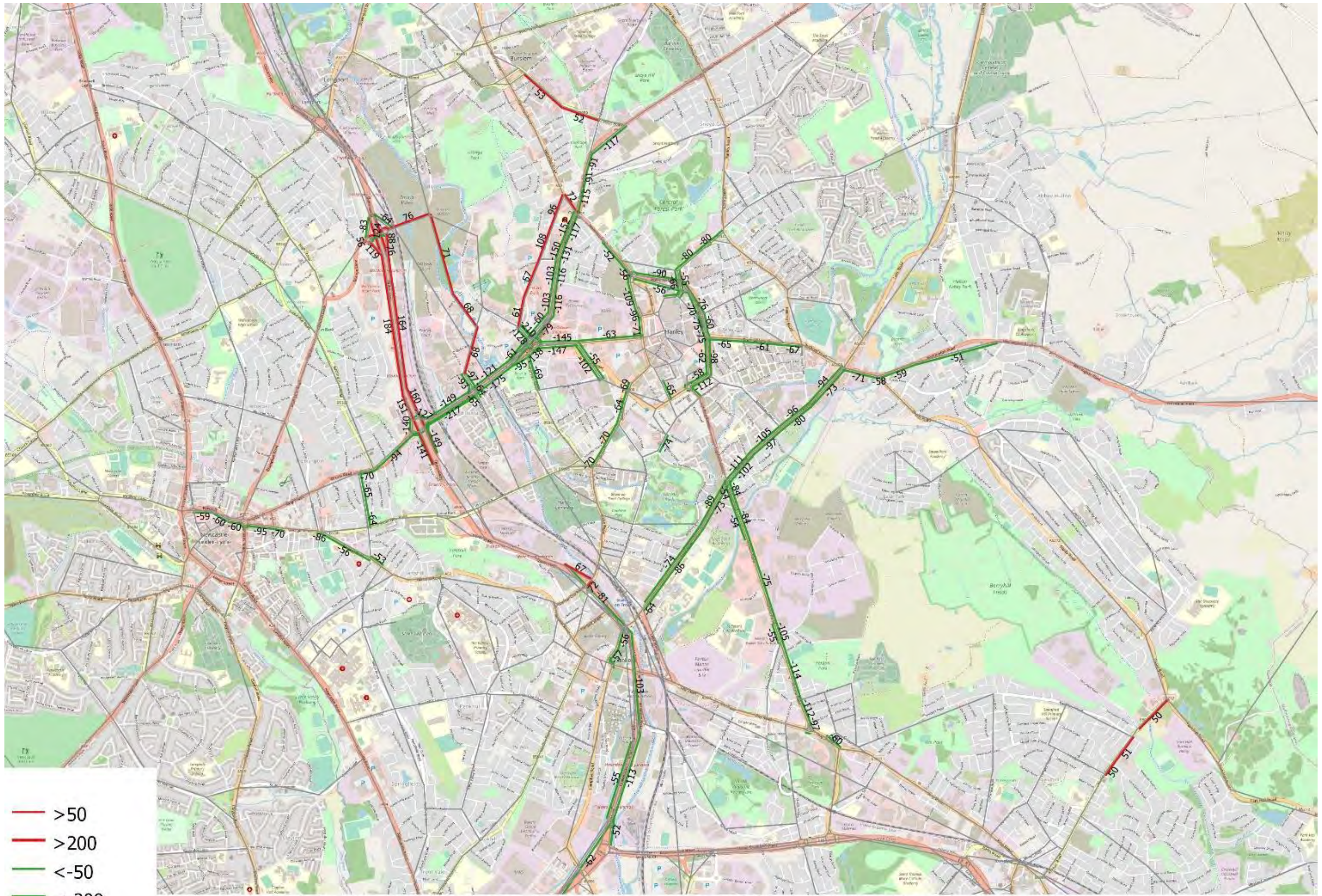

Figure 8-5: Change in PM peak-hour traffic flows between 2022 Reference Case and 2022 Benchmark CAZ D (vehicles)

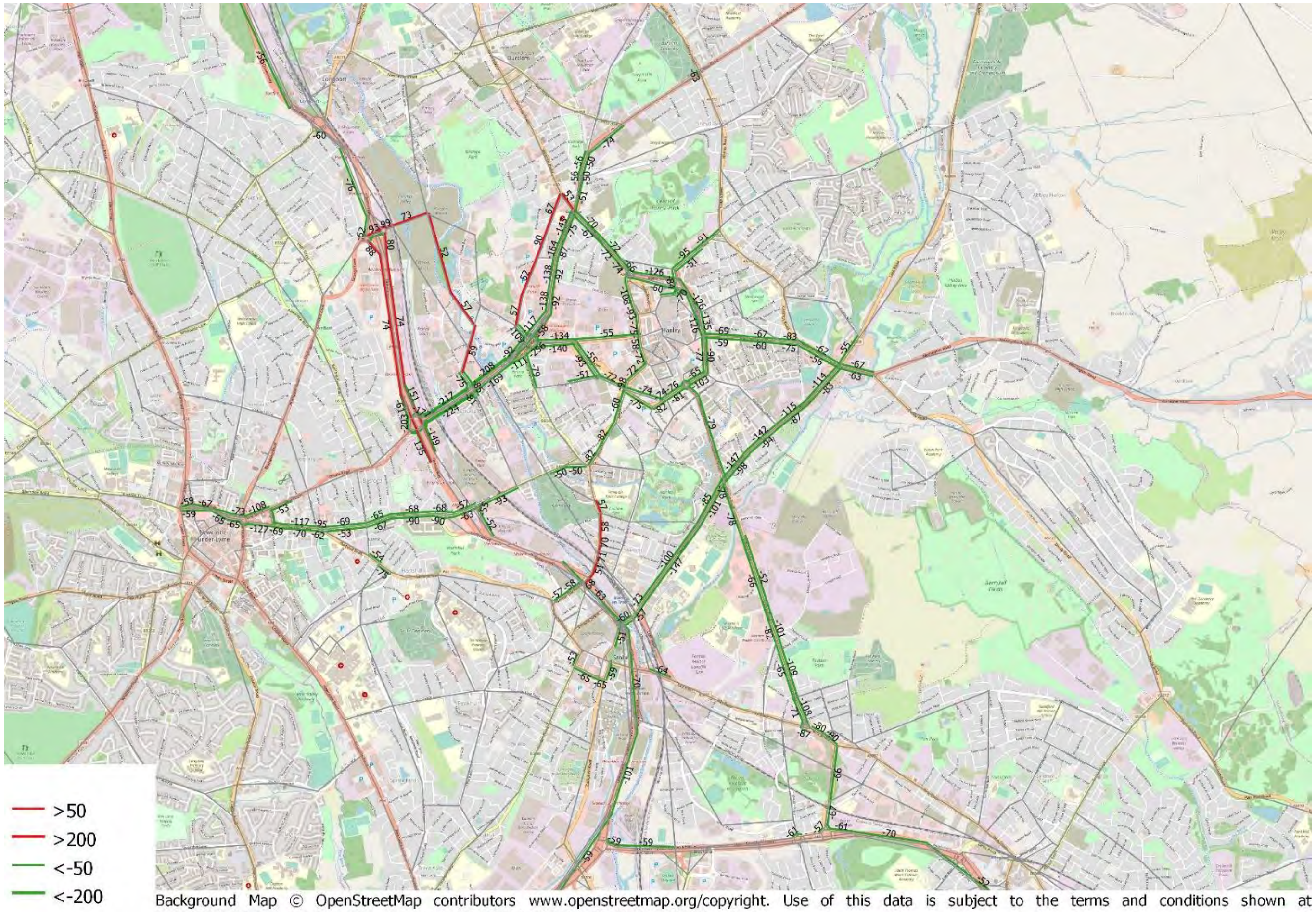

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Figure 8-6: Change in AADT traffic flows between 2025 Reference Case and 2025 Benchmark CAZ D (vehicles)

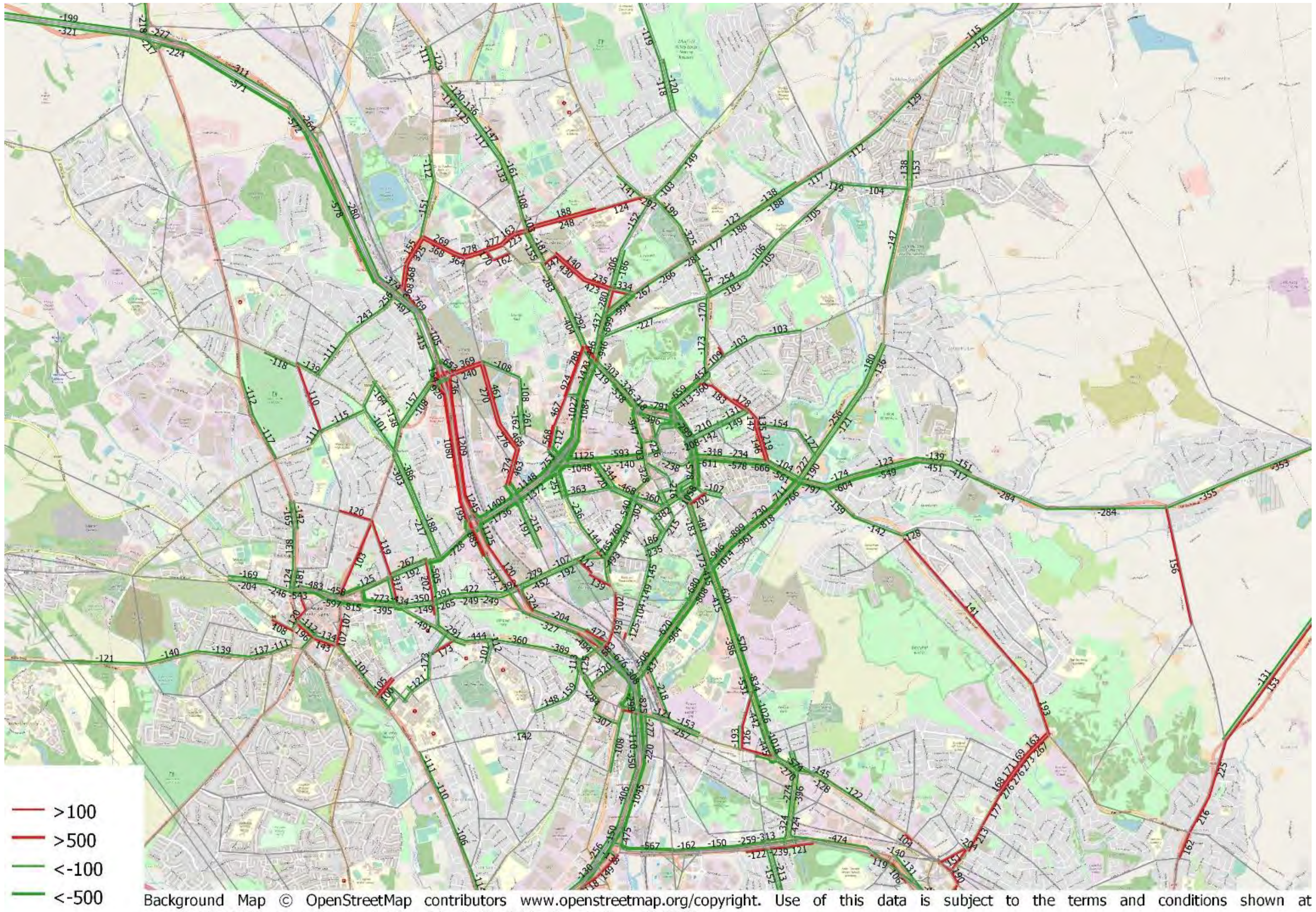

Figure 8-7: Change in AM peak-hour traffic flows between 2025 Reference Case and 2025 Benchmark CAZ D (vehicles)

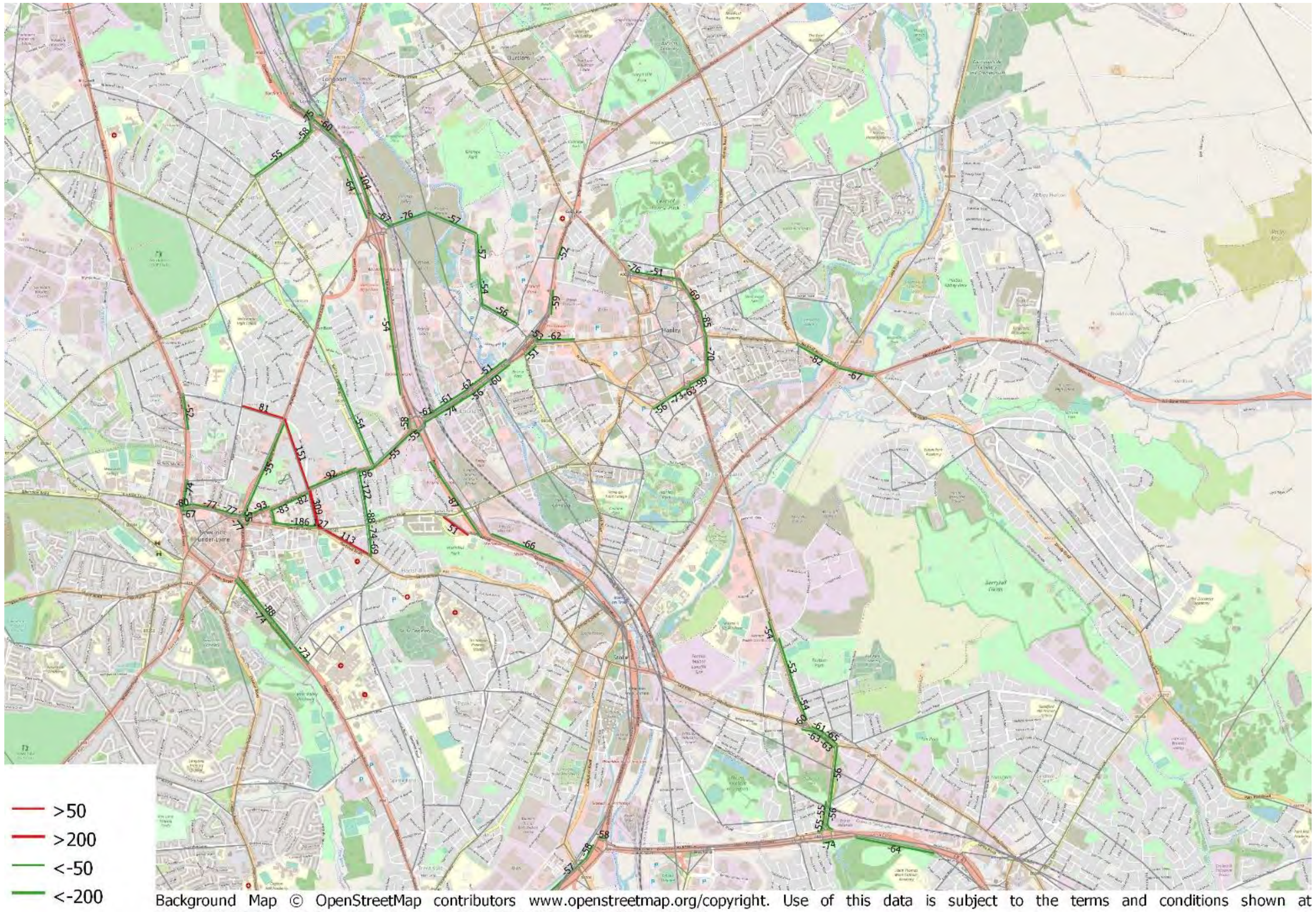

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Figure 8-8: Change in Inter-Peak hour traffic flows between 2025 Reference Case and 2025 Benchmark CAZ D (vehicles)

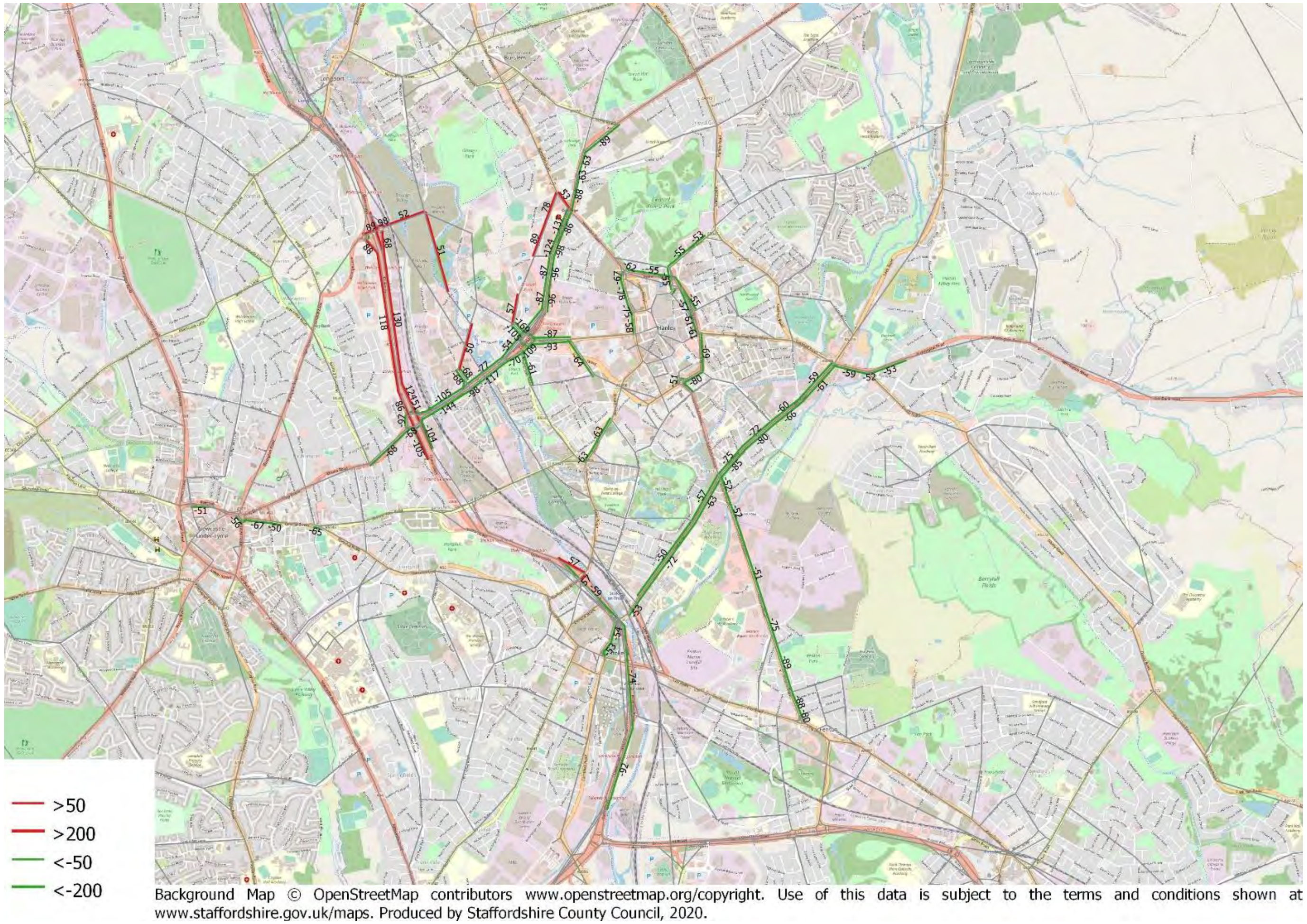


Figure 8-9: Change in PM peak-hour traffic flows between 2025 Reference Case and 2025 Benchmark CAZ D (vehicles)

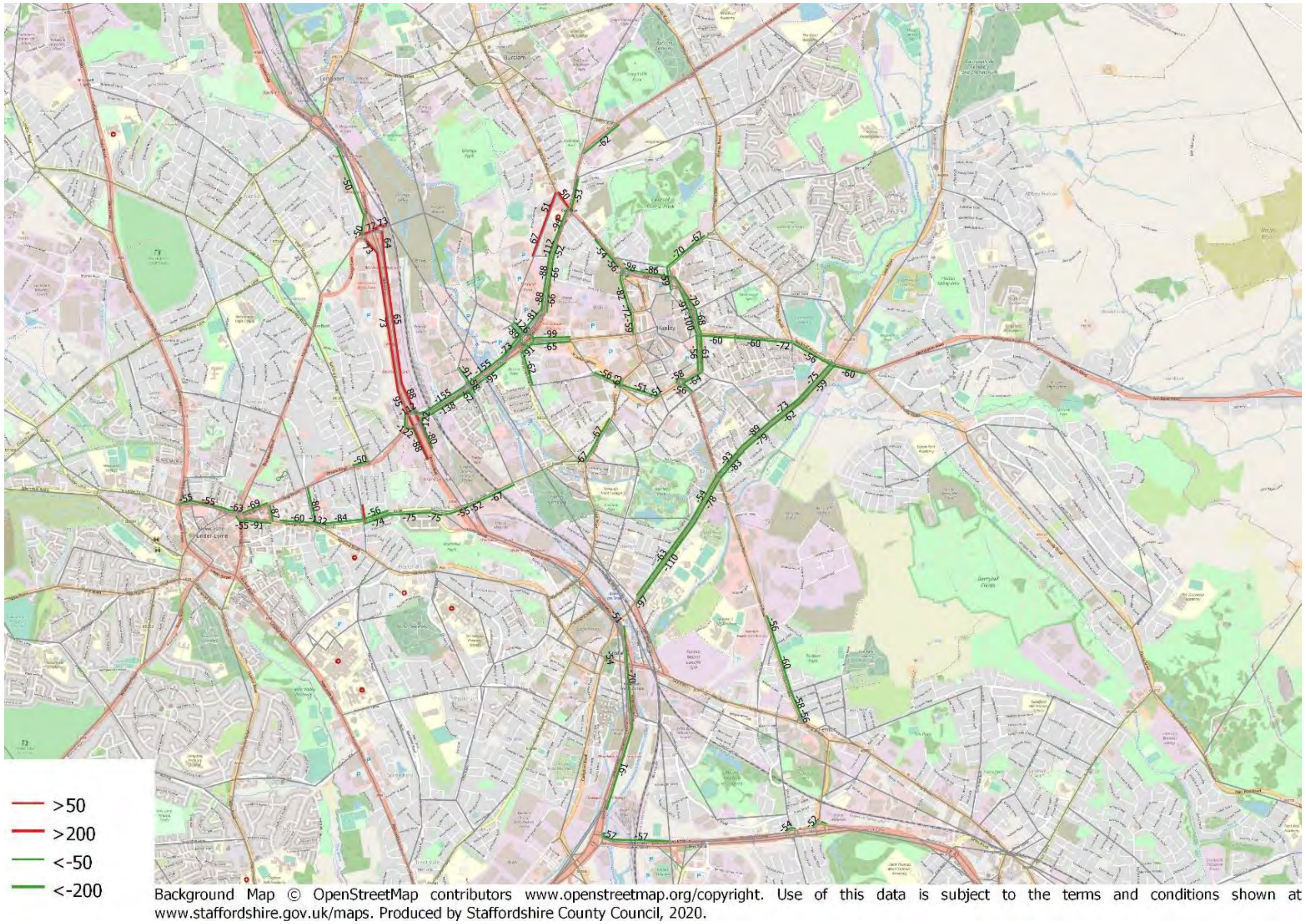


Figure 8-10: 2022 Benchmark CAZ D AM peak-hour overcapacity links and significant junction delays

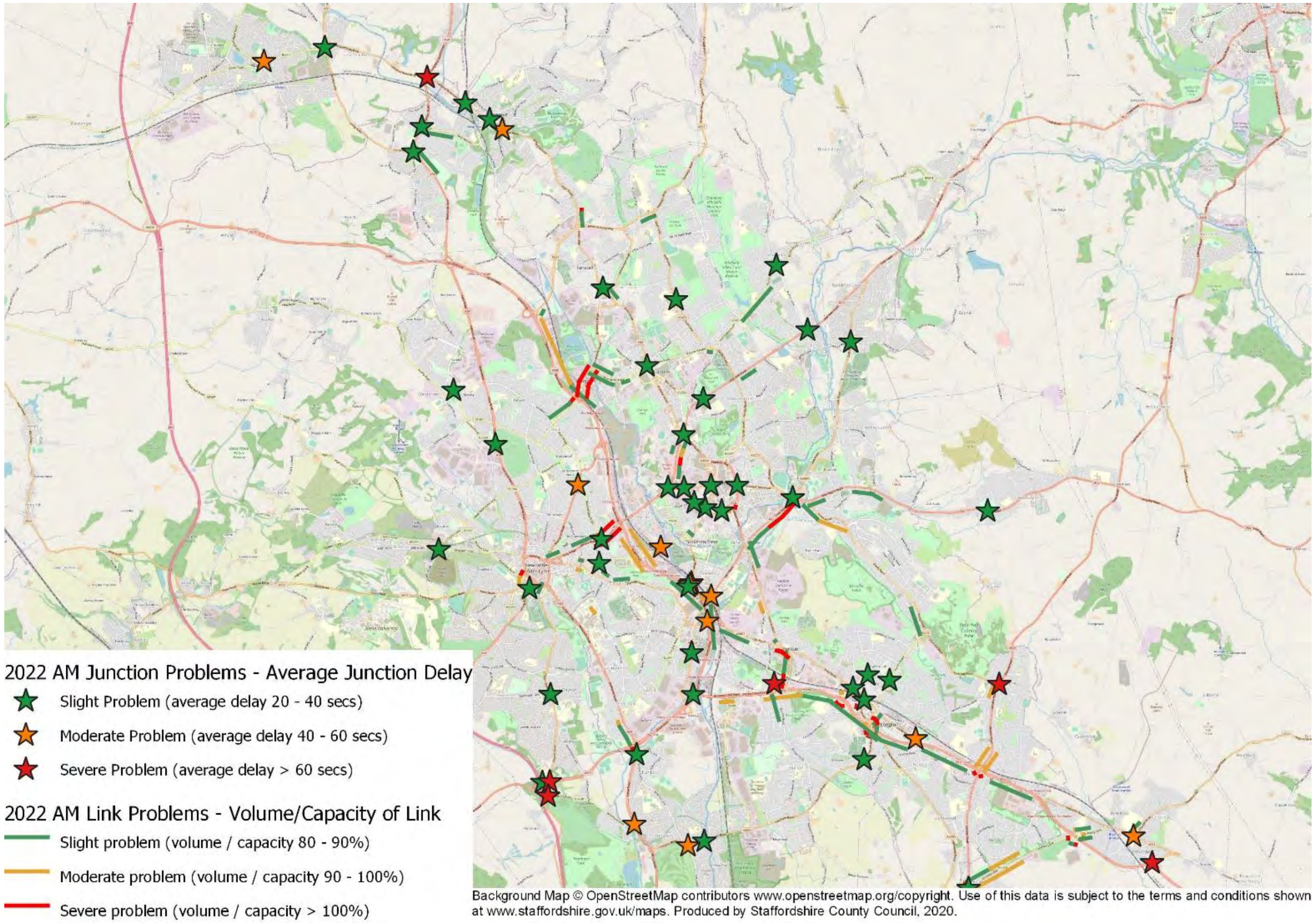
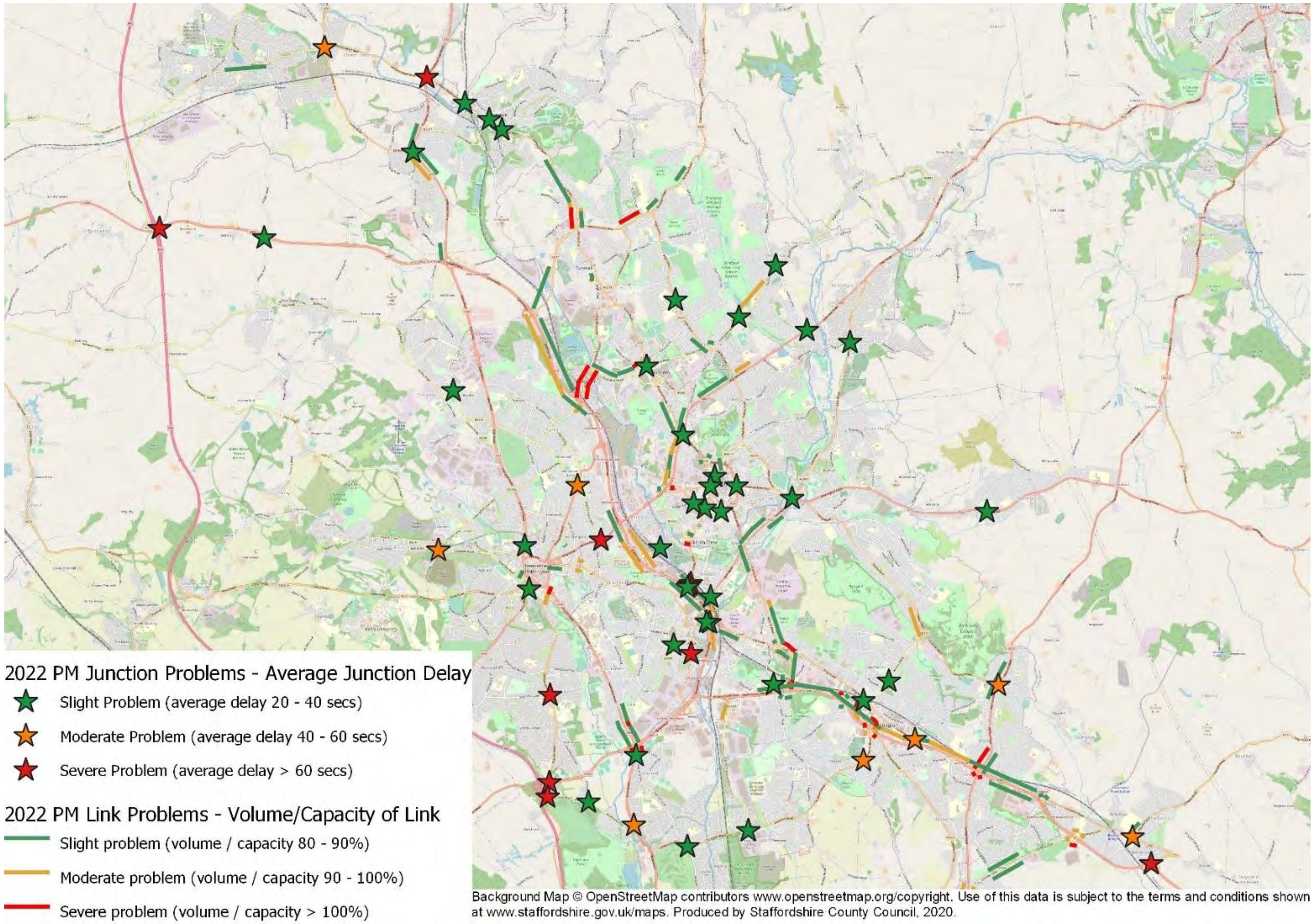


Figure 8-11: 2022 Benchmark CAZ D PM peak-hour overcapacity links and significant junction delays



9 No vehicle upgrade with a charging CAZ

The JAQU guidance requires a sensitivity test when modelling a charging CAZ. The test assumes that no vehicles would be upgraded to a compliant vehicle in response to the implementation of a charging CAZ. This sensitivity test has been undertaken on the core Benchmark CAZ D option described in chapter 9. The percentages of the other remaining demand responses to a charging CAZ have therefore been prorated upwards.

9.1 Demand response

Table 9-1 presents the demand responses to the implementation of a charging CAZ with the premise of a 0% uptake in compliant vehicles. As there are no assumed vehicles upgraded to compliant ones the number of cars cancelling their trips almost doubles when compared with the core Benchmark CAZ D. The number of LGVs paying the charge doubles with the zero-upgrade assumption as do the number of HGVs.

Table 9-1: Demand response to implementation of charging Benchmark CAZ D with no upgrade

Action	Vehicle			
	AM			
	Cars	LGV	HGV	Taxi
Change Route	1,440	684	57	0
Change Destination	1,041	0	0	0
Pay Charge	1,918	714	62	1
Cancel Trip/Mode shift	2,704	58	21	9
Upgrade/Switch Vehicle	0	0	0	0
	IP			
	Cars	LGV	HGV	Taxi
Change Route	1,344	703	47	0
Change Destination	969	0	0	0
Pay Charge	1,771	733	50	1
Cancel Trip/Mode shift	2,474	60	17	10
Upgrade/Switch Vehicle	0	0	0	0
	PM			
	Cars	LGV	HGV	Taxi
Change Route	1,645	634	23	0
Change Destination	1,186	0	0	0
Pay Charge	2,174	661	24	1
Cancel Trip/Mode shift	3,047	54	8	11
Upgrade/Switch Vehicle	0	0	0	0
Total Pay Charge	5,862	2,107	136	4
Total Cancel Trip/Mode Shift	8,225	172	47	31

9.2 Benchmark CAZ D no vehicle upgrade traffic growth

Table 9-2 and Table 9-3 show the trip matrix totals for the no vehicle upgrade Benchmark CAZ D for 2022 and 2025. When compared with the 2022 Reference Case and the 2022 Benchmark CAZ D in Table 8-10 and Table 8-11, the total number of vehicles in the trip matrix for the no vehicle upgrade sensitivity test in all of the time periods has dropped due to an increase in cancelled trips. The number of non-compliant vehicles is higher than in the Benchmark CAZ D trip matrix totals, given the increase number of vehicles paying the charge in the sensitivity test.

Table 9-2: 2022 and 2025 Benchmark CAZ D No-Upgrade trip matrix totals by vehicle type and compliance

Vehicle Type	Compliance	AM Peak-Hour		Inter-Peak Hour		PM Peak-Hour	
		2022	2025	2022	2025	2022	2025
Car	Compliant	54,526	63,905	46,940	55,163	58,626	68,676
	Non-Compliant	22,235	15,743	18,874	13,463	23,654	16,895
Taxi	Compliant	85	98	73	85	91	105
	Non-Compliant	68	59	56	49	71	62
LGV	Compliant	5,710	6,711	5,348	6,273	5,069	5,934
	Non-Compliant	3,900	3,461	3,583	3,211	3,433	3,064
HGV	Compliant	3,762	4,162	3,266	3,622	2,134	2,363
	Non-Compliant	479	151.7	420	133	286	90
Total		**90,764**	**94,290**	**78,559**	**81,997**	**93,364**	**97,188**

Table 9-3: 2022 and 2025 Benchmark CAZ D No-Upgrade trip matrix totals by vehicle type

Vehicle Type	AM Peak-Hour		Inter-Peak Hour		PM Peak-Hour	
	2022	2025	2022	2025	2022	2025
Car	76761	79648	65814	68626	82280	85571
Taxi	153	157	129	133	162	167
LGV	9610	10172	8931	9483	8502	8998
HGV	4241	4314	3686	3755	2420	2453
Total	**90,764**	**94,290**	**78,559**	**81,997**	**93,364**	**97,188**

9.3 Forecast Traffic Flows

Figure 9-1 shows the change in forecast daily traffic (AADT) flows between the 2022 Reference Case and the 2022 no vehicle upgrade CAZ sensitivity test. Figure 9-2 to Figure 9-4 show the difference in traffic flows for the AM, IP and PM modelled periods. Figure 9-1 shows high levels of reduction in traffic flows within the CAZ boundary. When compared with Figure 8-2, the 2022 Benchmark CAZ D zero upgrade shows a much higher reduction in traffic flows along the A53 with higher volumes along the A500 and re-routing along Dividy Road.

Figure 9-5 displays the change in forecast daily traffic (AADT) flows between the 2025 Reference Case and the 2025 Zero Upgrade CAZ. Figure 9-6 to Figure 9-8 show the difference in forecast traffic flows for the AM, IP and PM modelled periods. Figure 9-5 shows a high increase in traffic along the A500 when compared with Figure 8-6. Higher levels of reduction in vehicles can be seen on the A53 and along Victoria Road.

Figure 8-10 shows the 2022 Benchmark CAZ D no upgrade AM Peak-Hour over capacity links and junction delays. When compared with the 2022 Reference Case AM overcapacity links and junction delays plot, seen in Figure 6-18, reduced delays at the A53/Basford Park junction can be identified. In addition, the westbound link along the A53 between the A500 roundabout and Basford Park Road is no longer overcapacity. This is to be expected as seen from Table 9-1 most trips are cancelled thereby reducing the number of vehicles on the network. Figure 9-10 shows the 2022 Benchmark CAZ D no upgrade PM Peak-Hour over capacity links and junction delays. When compared with Figure 8-11, the overcapacity links and junction delays for the Benchmark CAZ D with assumed upgrade, Figure 9-10 shows little change in junction delays but shows a reduction in over capacity links along Victoria Road.

Figure 9-1: Change in AADT traffic flows between 2022 Reference Case and 2022 Benchmark CAZ D – no-upgrade (vehicles)

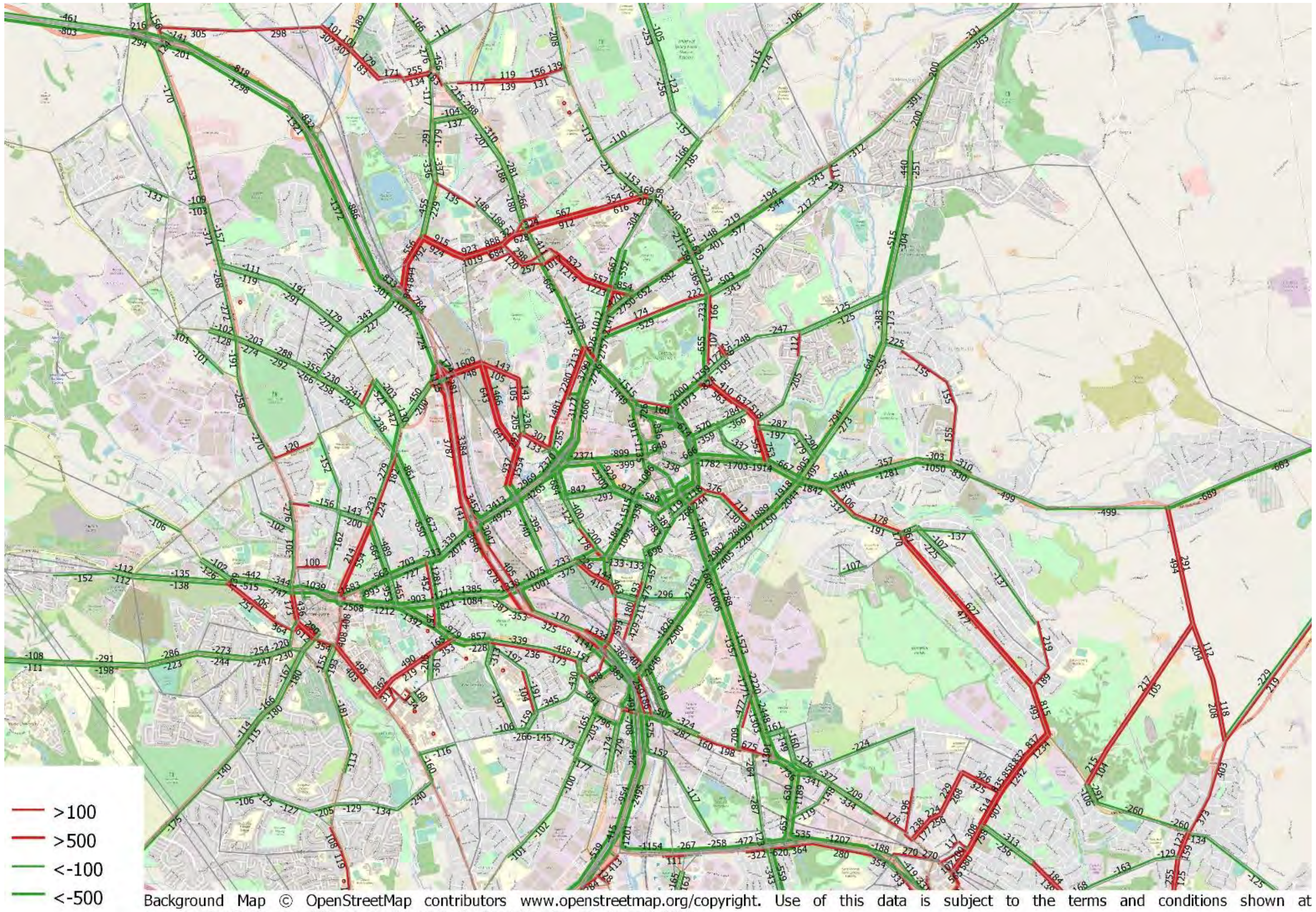


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Figure 9-2: Change in AM peak-hour traffic flows between 2022 Reference Case and 2022 Benchmark CAZ D – no-upgrade (vehicles)

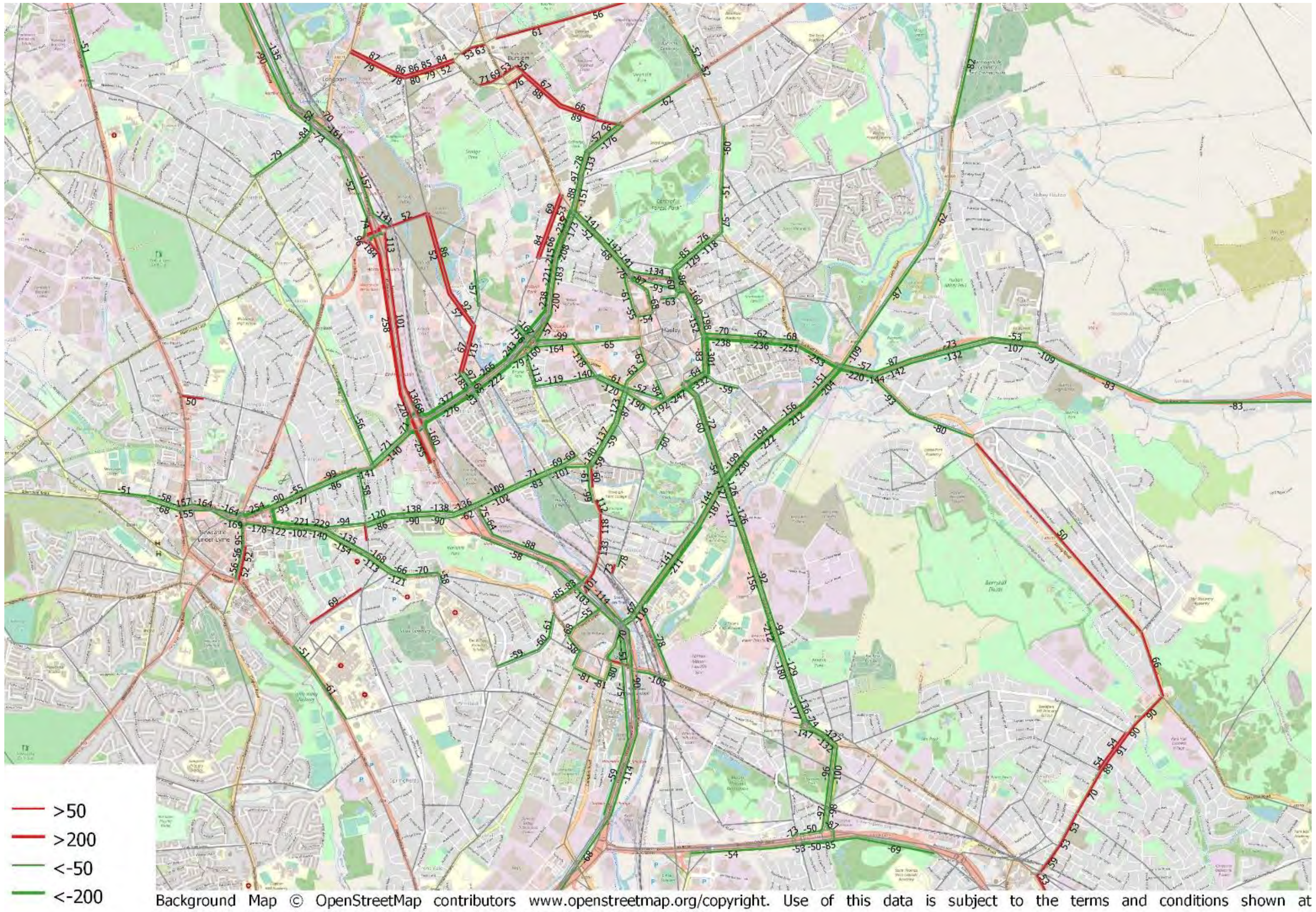

Figure 9-3: Change in Inter-Peak hour traffic flows between 2022 Reference Case and 2022 Benchmark CAZ D – no-upgrade (vehicles)

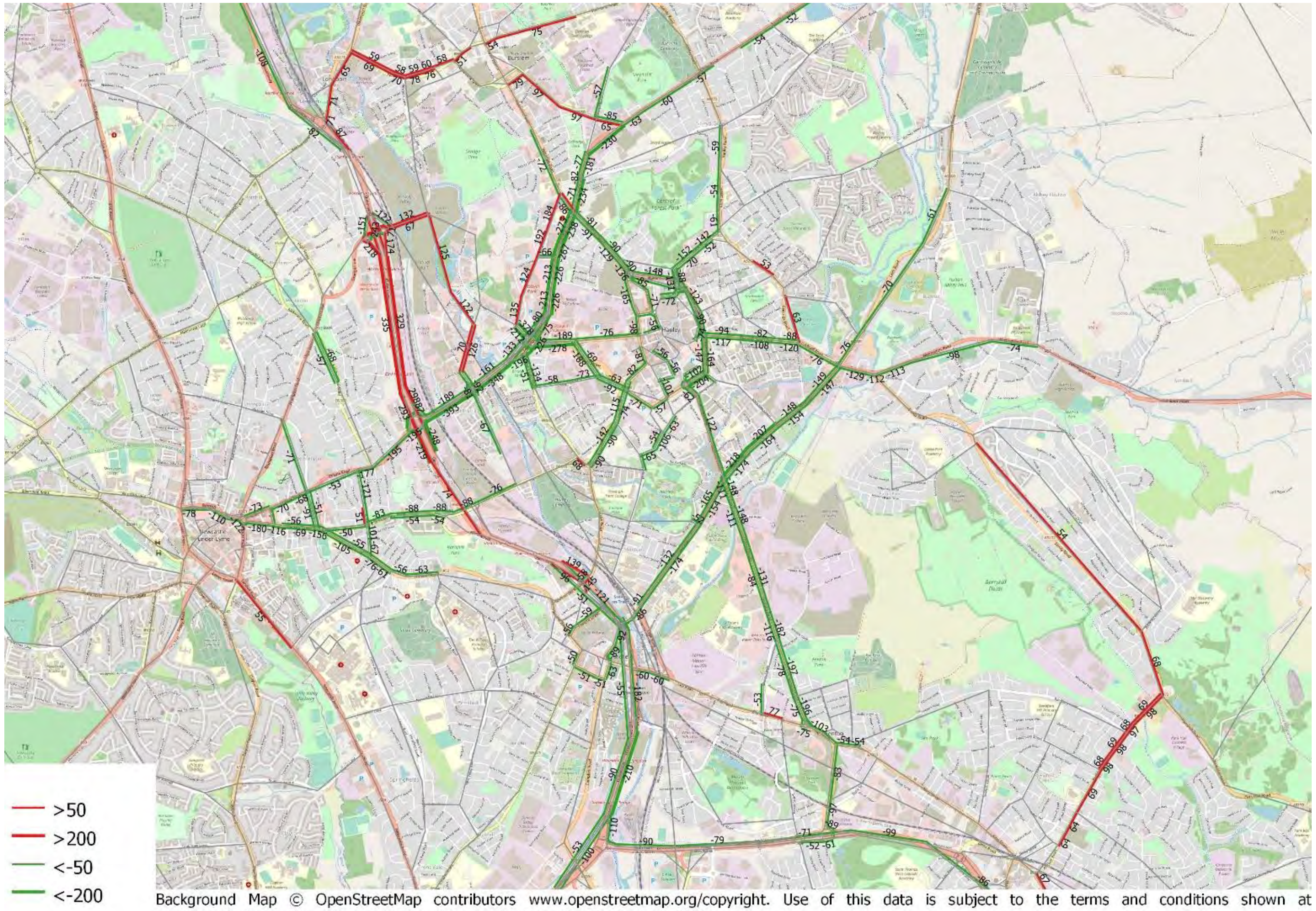

Figure 9-4: Change in PM peak-hour traffic flows between 2022 Reference Case and 2022 Benchmark CAZ D – no-upgrade (vehicles)

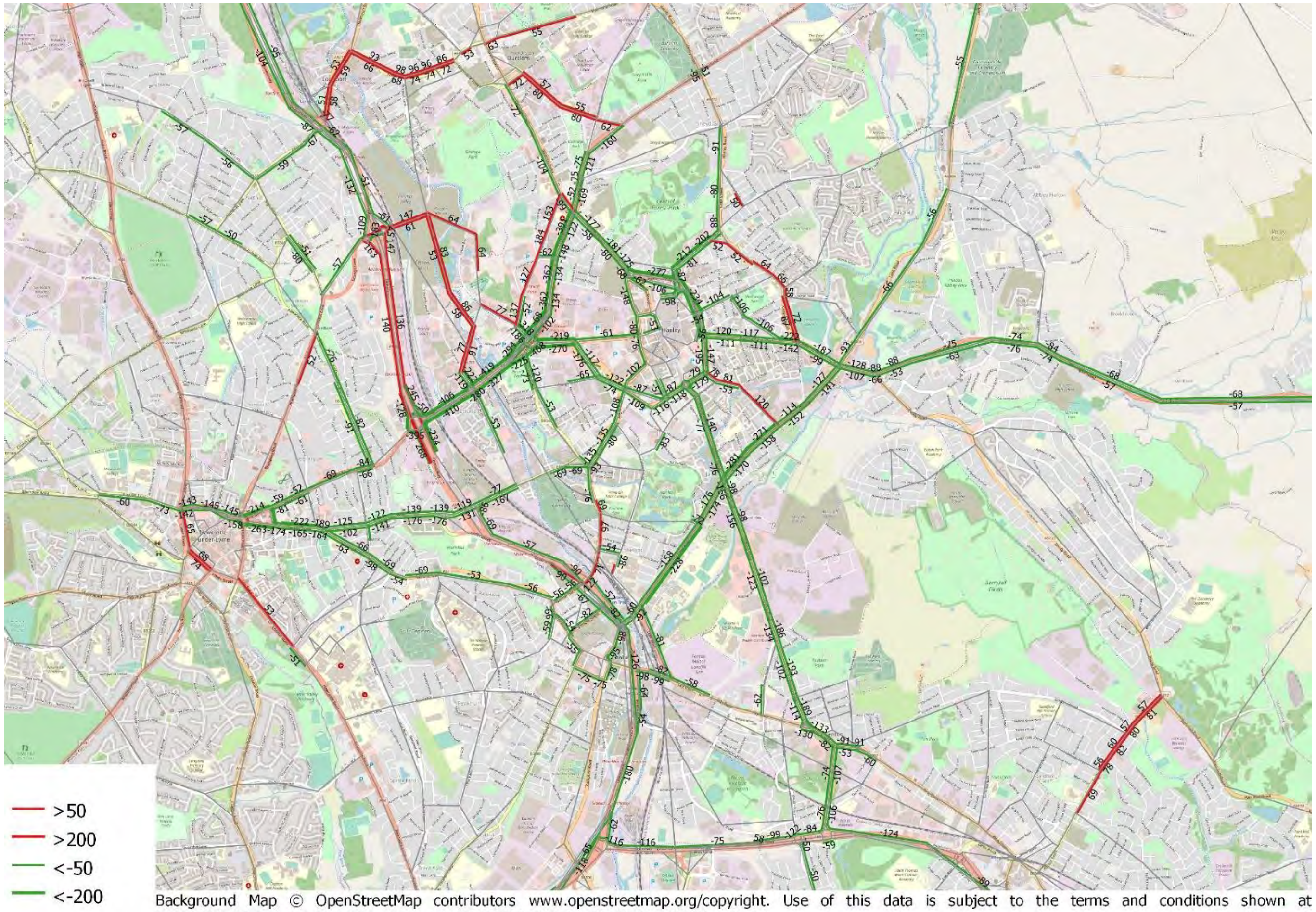

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Figure 9-5: Change in AADT traffic flows between 2025 Reference Case and 2025 Benchmark CAZ D – no-upgrade (vehicles)

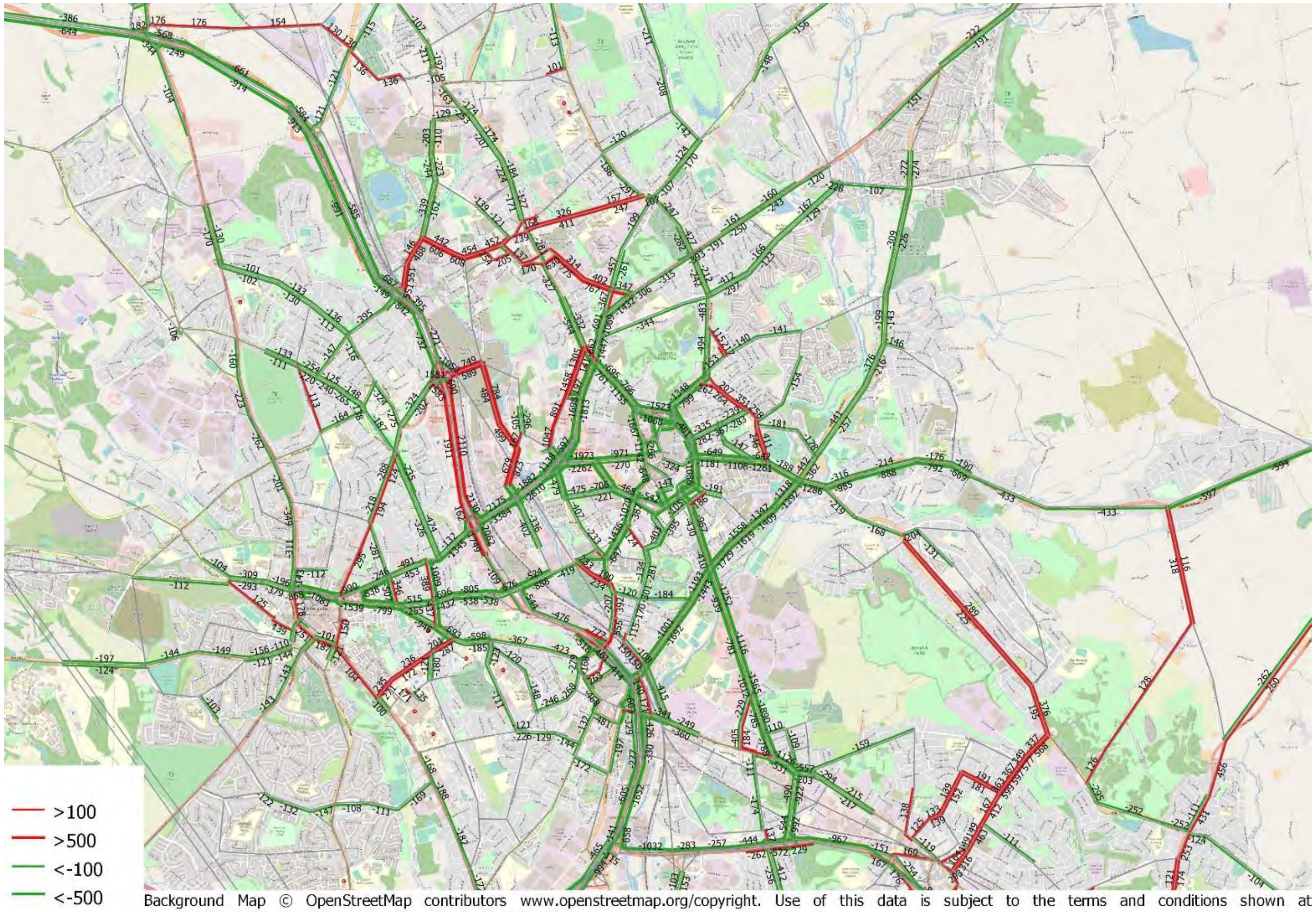

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Figure 9-6: Change in AM peak-hour traffic flows between 2025 Reference Case and 2025 Benchmark CAZ D – no-upgrade (vehicles)

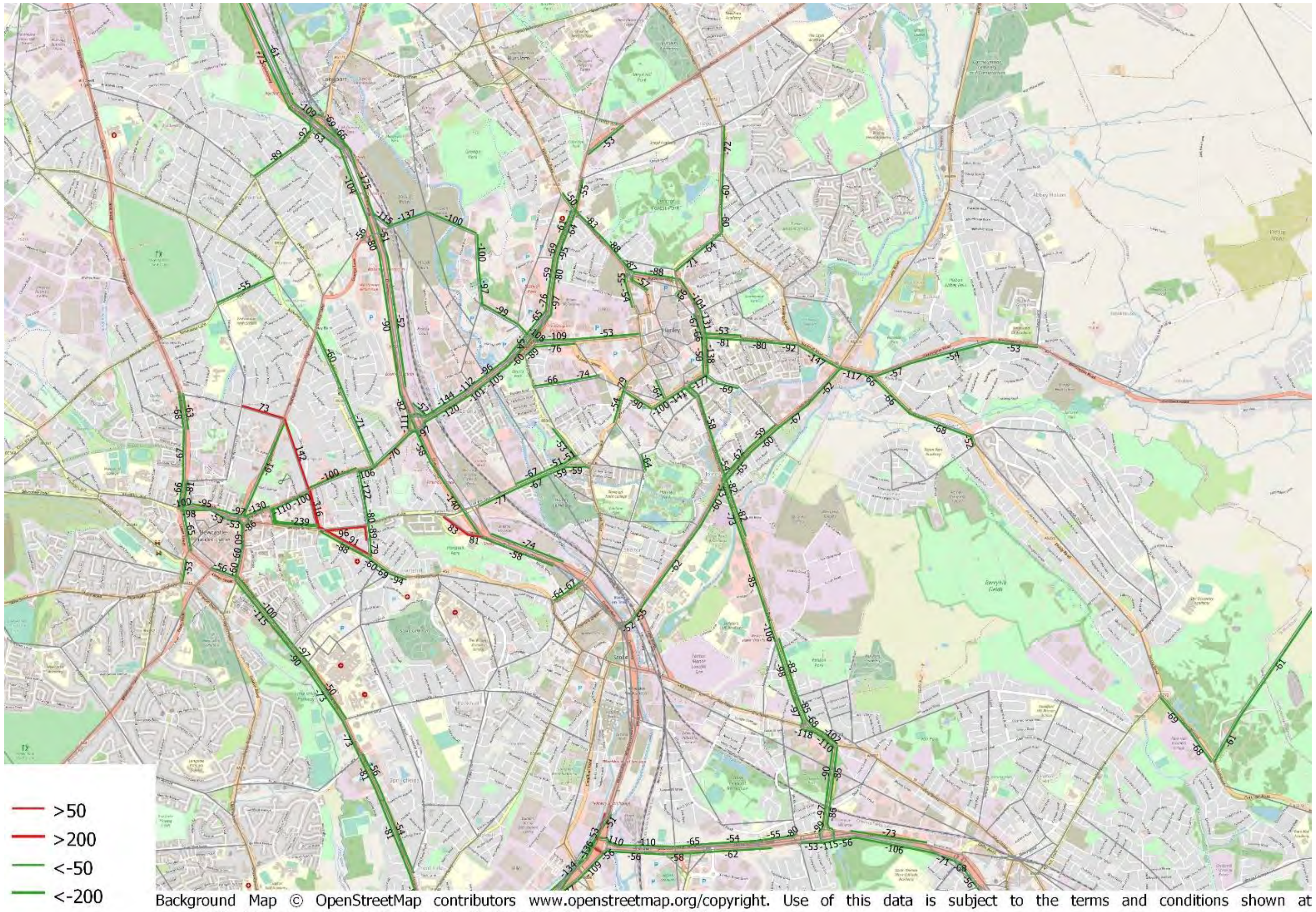

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Figure 9-7: Change in Inter-Peak hour traffic flows between 2025 Reference Case and 2025 Benchmark CAZ D – no-upgrade (vehicles)

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Figure 9-8: Change in PM peak-hour traffic flows between 2025 Reference Case and 2025 Benchmark CAZ D – no-upgrade (vehicles)

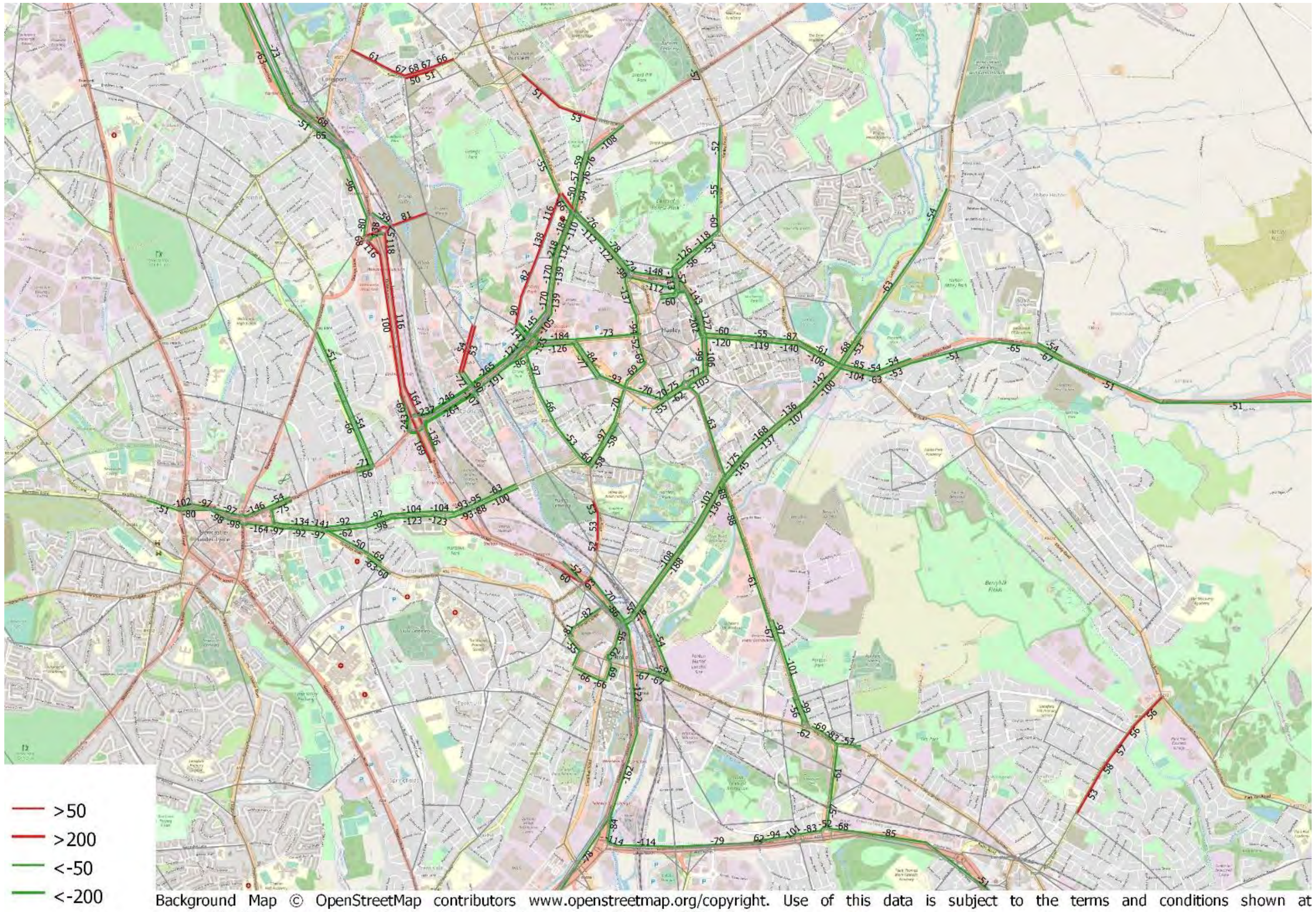

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Figure 9-9: 2022 Benchmark CAZ D No-Upgrade AM peak-hour overcapacity links and significant junction delays

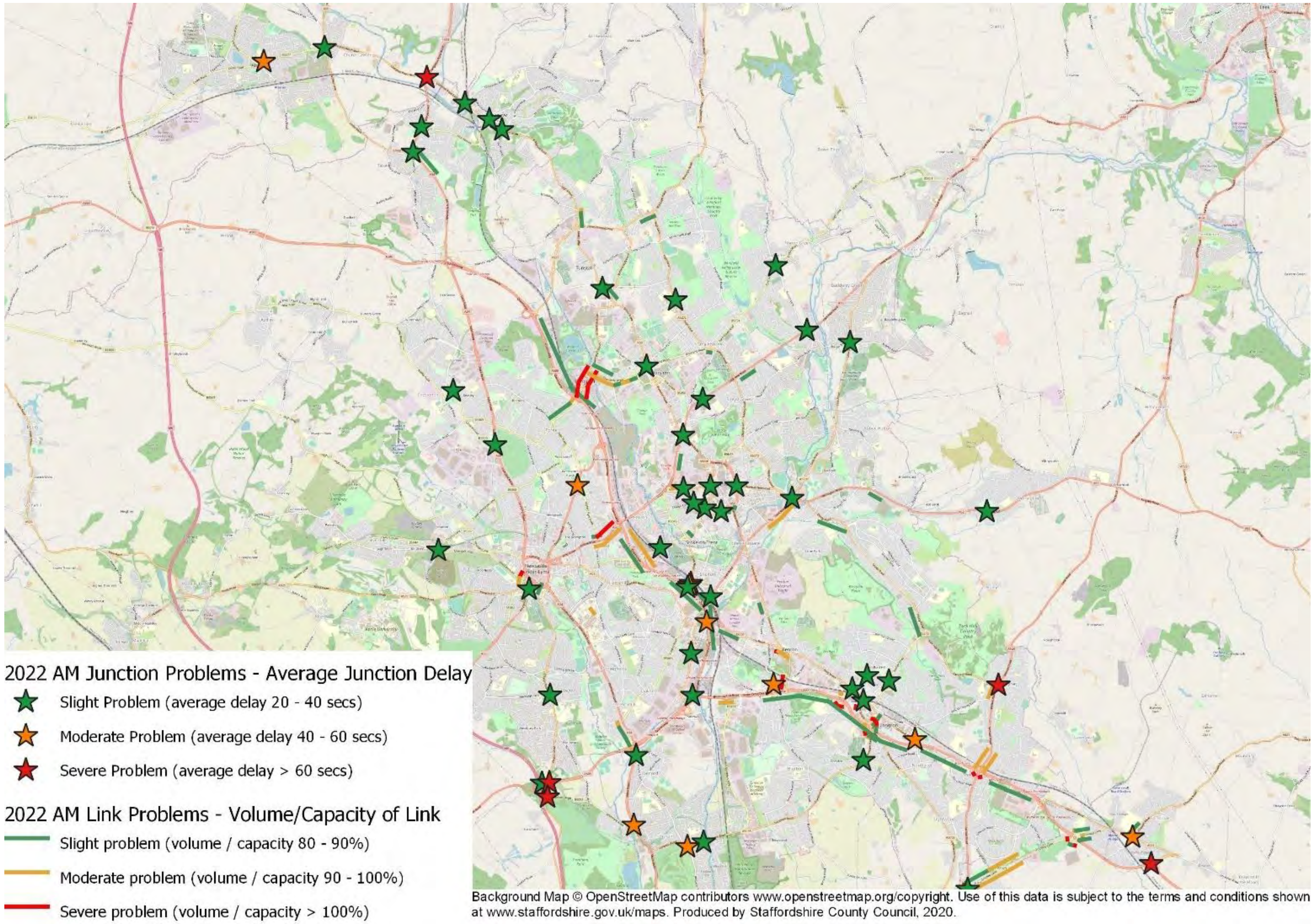
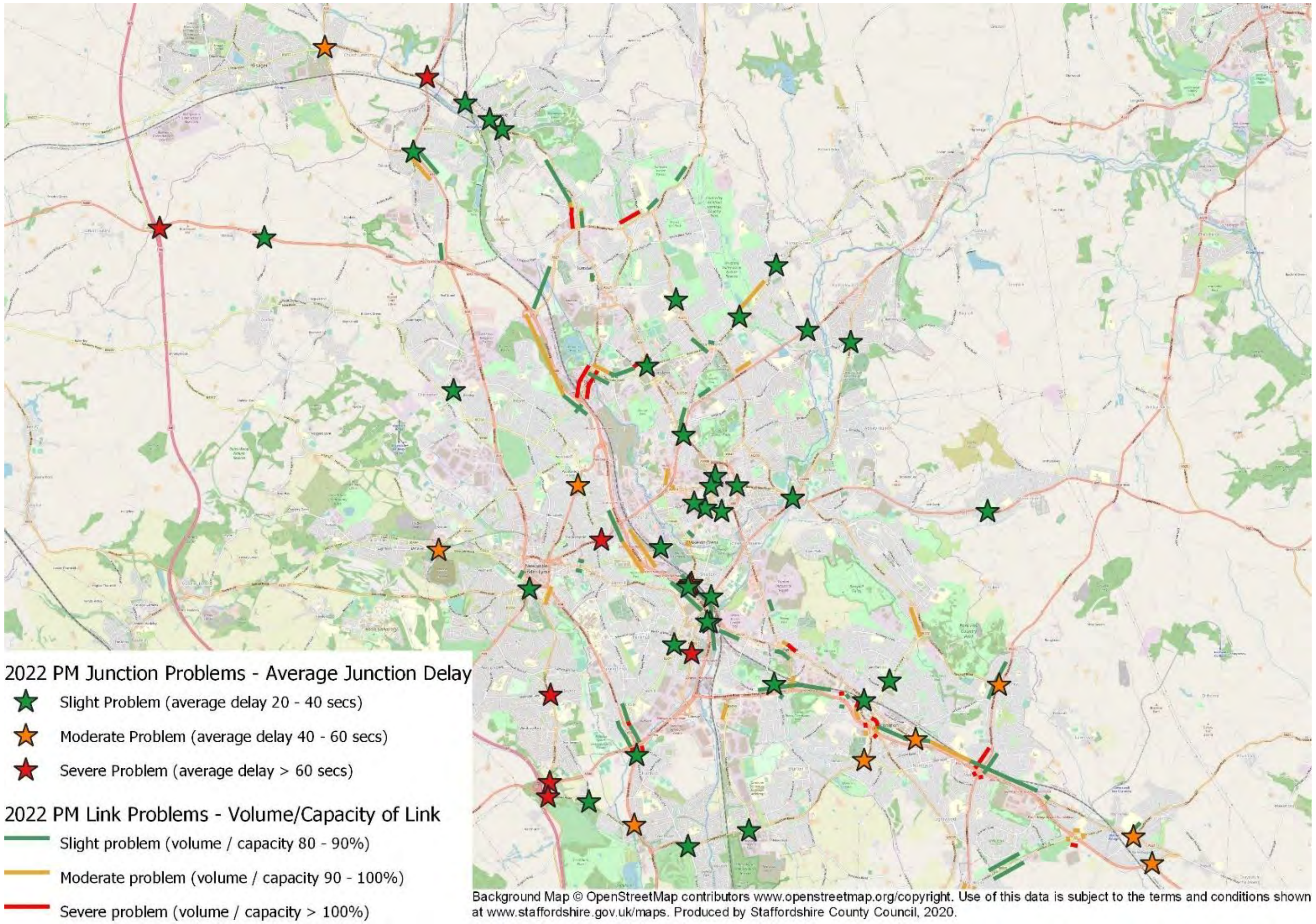


Figure 9-10: 2022 Benchmark CAZ D No-Upgrade PM peak-hour overcapacity links and significant junction delays



10 Conclusion

The NSMM transport model has been updated and refined to provide an appropriate analytical tool that will aid NuLBC, SoTCC and SCC in the development and implementation of an Air Quality Local Plan. The NSMM transport model has been used to derive appropriate Reference Case forecast traffic information and to inform the development of an air quality model, identify appropriate air quality initiatives and the subsequent appraisal of the Local Plan. These traffic forecasts have been used to inform the benchmarking of the Local Plan against a charging CAZ. The development and application of the NSMM transport model has been carried out in accordance with the DfT TAG guidance and additional guidance issued by the JAQU.

The NSMM transport model has been used to derive traffic forecasts for a 2022 forecast year, the year by which compliance with air quality targets is expected to be achieved. The traffic forecasts take account of all committed transport schemes and land-uses developments which are expected to be implemented by 2022. In addition, a 2025 forecast year has been produced too.

From the traffic forecasting work undertaken, total traffic is predicted to grow by approximately 5% between the 2015 base-year and the forecast year of 2022. Furthermore, the number of non-compliant car trips is predicted to reduce by approximately 6% with an even greater percentage shift to compliant vehicles for taxis, HGVs and buses. The implementation of the EVLR Project is also predicted to significantly reduce traffic flows on the A53 Etruria Road to the east of the A500.

Following testing of several mitigation measures, the identified Preferred Option removes the forecast NO_2 exceedances within North Staffordshire without resulting in additional exceedance locations and without the implementation of a charge scheme. Three exceedance locations were identified from the 2022 Reference Case transport model and air quality modelling. The exceedance locations are: A53 Etruria Road, A50 Victoria Road and Bucknall New Road. The Preferred Option includes the following measures:

- A53 Etruria Road westbound peak restrictions (bus gate) extending from the A500 roundabout to the Basford Park Road junction (except bus, cyclists and taxi)
- Pedestrian phases at both Albert Street and Basford Park traffic lights
- 75% bus retrofit along Bucknall New Road
- Victoria Road northbound peak restrictions (bus gate) on Victoria Road extending from the southern end of Victoria Road up to the Manor Street junction (except bus, cyclists and taxi)
- 100% bus retrofit along Victoria Road
- Traffic management measures to the east and west of Victoria Road in order to ensure that the adjacent local communities are not adversely impacted by traffic re-routeing through these areas when the bus gates are in operation

The Preferred Option reduces forecast daily traffic flows along both the A53 and A50 corridors due to the peak restrictions which therefore delivers compliance at these locations. The bus retro-fitting on Bucknall New Road addresses the exceedance at that location. The Preferred

Option reduces NO_2 and achieves air quality compliance at all exceedance areas without causing NO_2 exceedances in other locations.

The Benchmark CAZ D successfully reduces the number of non-compliant vehicles and is also effective in reducing flows at the exceedance locations.