Transport Research Laboratory
Creating the future of transport


CLIENT PROJECT REPORT CPR2151

Warrington Low Emission Strategy Feasibility Study

Kevin Turpin, Anna Savage & Tim Barlow

Prepared for: Warrington Borough Council, Environment Department

Project Ref:

Quality approved:

Anna Savage	Tim Barlow
(Project Manager)	(Technical Referee)

Disclaimer

Contents amendment record

This report has been amended and issued as follows:

Version	Date	Description	Editor	Technical Referee
1	29/05/15	First Draft (WP 1, 2 & 3a)	KT	TB
2	01/10/15	Second Draft (WP 1, 2, 3a & 3b)	KT	AS
3	02/10/15	Final draft with client comments	KT	AS
4	09/12/15	Final report with client comments	AS/KT	KT
5	04/01/16	Final Report (final client comments)	KT	KT

Contents

List of Figures

List of Tables

Executive summary

Warrington Borough Council (WBC) is at the centre of the North West region's transport network and as such road transport contributes significantly to pollutant emissions. There are three existing Air Quality Management Areas (AQMAs) designated in respect of exceedences of the nitrogen dioxide (NO_2) annual mean objective. As part of the local authority's continued local air quality management (LAQM) duties, they have concluded that there are other areas of concern outside of the AQMAs which need further investigation.

The purpose of this study was to consider a range of low emission options that could be implemented to reduce vehicle emissions and hence improve air quality concentrations in the AQMAs and across wider areas of concern. The study involved a scoping and screening assessment of a long list of low emission options and then a more detailed modelling assessment of a smaller number of options. The options considered in more detail were the re-routing of goods vehicles on key routes around the town centre and a number of changes to within the town centre such as one-way systems.

These two options were taken forward to a cost-effectiveness analysis and health impact assessment, which have been reported separately.

The option to re-route goods vehicles around the town centre considered sending vehicles in a clockwise or anti-clockwise direction. In the clockwise direction, the impact on NO_2 concentrations in the Parker Street AQMA was considered to be almost negligible. In the anti-clockwise direction, the improvements in air quality were more noticeable although the reductions in modelled annual mean NO_2 concentrations estimated within the Parker Street AQMA would be unlikely to meet the objective at all receptors. Neither re-routing schemes would improve the NO_2 annual mean objective exceedences at the Sankey Way roundabout AQMA. The analysis highlighted the potential of further adverse impacts on emissions across the wider study area for both schemes as vehicles were would tend to travel further distances around the town centre. Overall it was concluded that freight re-routing in the anti-clockwise direction appeared to offer positive opportunities to reduce pollution exposure and the scheme warrants further investigation.

With respect to the town centre one way gyratory options, the modelling showed that there was a direct reduction in estimated NO_2 concentrations on Parker Street and the inner road network owing to the redistribution of the traffic. The options resulted in a slight increase in concentrations at receptors on Winmarleigh Street although these properties were unlikely to exceed the air quality objective. Of the four variant options, the results showed that Option C would have the lowest impact on traffic flows and the least benefits to air quality and Option B would be most effective in terms of air quality improvements. This option includes plans for traffic to be one way northbound at the southern end of Bold Street, one way northbound on Barbauld Street from St. Austin's Lane to Friars Gate and Barbauld Street to be northbound only. Option B would therefore be the most favoured measure to consider further in terms of work to revoke the Parker Street AQMA.

1 Introduction

1.1 Background to the study

Warrington Borough Council (WBC) is at the centre of the North West region's transport network. As such, road transport contributes significantly to pollutant emissions. The Borough has three existing Air Quality Management Areas (AQMAs) designated in respect of exceedences of the nitrogen dioxide (NO_2) annual mean objective. These are at Parker Street in the town centre, Sankey Green and across the motorway network.

The local authority's 2015 Updating and Screening Assessment report (Warrington Borough Council, 2015) highlights that there are continued exceedences at locations outside the AQMAs around the town centre. A detailed assessment of the town centre is on hold following completion of the survey work for this low emission strategy.

A low emission zone (LEZ) is a measure that targets vehicle access into an area based on vehicle emissions criteria. A low emission strategy (LES) may involve other types of measures and is usually focused on specific locations and traffic modes (i.e. where traffic related emissions are a specific problem). The Transport Research Laboratory (TRL) has been commissioned to produce a detailed report assessing options and quantifying impact to improve air quality. In addition to the effect on NO_2, PM10 and carbon emissions are to be considered. Cost effective analysis will be carried out in addition to a Health Impact Assessment (HIA) of preferred options.

1.2 Air quality in Warrington

The local authority has three automatic monitoring sites, two at roadside sites (Parker Street and Chester Road) and one urban background site (Selby Street). Concentrations at Parker Street show continued exceedences in the annual mean objective with no clear decline in concentrations. An additional automatic monitoring site was installed on Chester Road in 2011 and along with diffusion tube date shows this area to be close to the objectives. The local authority also operates a targeted network of nitrogen dioxide diffusion tubes at roadside and urban background sites. NO_2 concentrations at the majority of roadside sites are currently above the annual mean objective.

1.3 Purpose of the study

The overarching purpose of the study is to scope out appropriate low emission options and then undertake a detailed air quality assessment of a preferred option or combination of options.

1.4 Report structure

In accordance with the brief provided by WBC, the structure of the report incorporates the following work packages:

WP1: Inception – a short consultation period with the client steering group, including a review of transport and air quality data.

WP2: Scoping of low emission options that could lead to reduced NO_2 levels using screening tools.

WP3: Detailed assessment phase – full analysis of a small number of preferred low emission options.

WP4: Cost-effectiveness analysis – a high level value-for-money assessment of the implementation of the preferred low emission options.

WP5: Environmental Impact Assessment (EIA) and Health Impact Assessment (HIA) – a basic assessment of the environmental impact of the preferred option(s), incorporating a health impact assessment.

2 Work Package 1: Inception phase

The study facilitated a stakeholder event at WBC offices on the 10th February 2012, with input from the client steering group. The aim of this event was to:

- Introduce air quality issues, including the local situation (aimed primarily at stakeholders less familiar with air quality);
- Describe a wide range of potential measures to reduce emissions, illustrate the outline cost, and explore possible impacts (on emissions and otherwise) via pre-prepared summaries of core and supporting groups of measures;
- Brainstorm alternative options and fine-tune according to Borough-specific circumstances;

Members of the study team engaged with stakeholders to reach a consensus on a package of measures to take forward to the scoping phase in Work Package Two.

As well as presenting a qualitative assessment of the environmental impacts of potential measures, the study undertook a STEP (social, technological, economic, and political) analysis with stakeholders at the meeting to understand external considerations, such as national and international issues.

Directly following the stakeholder inception event, the study team held a short review meeting with the WBC client steering group in order to reflect on the wider stakeholder feedback and elaboration of measures. Decisions on the next steps were agreed within the context of the methodological framework set out in the proposed scheme of works.

The Work Package 1 inception process was used to identify a priority list of core and supporting groups of measures. Core measures were those most likely to have significant air quality impacts. Supporting measures are those actions that are also helpful to this objective, or which will increase the chance of the success of core measures, but which do not individually achieve significant impact. This division into core and supporting groups of measures helped clarify the measures most likely to address poor air quality and assist future stakeholder decision-making with the aid of more detailed (quantitative) assessments.

3 Work Package 2: Scoping of options

3.1 Introduction

This work package involved the scoping of a number of low emission options that could potentially lead to reduced NO_2 concentrations in the town.

The study team engaged with WBC to agree the following:

- Clarification on boundary assumptions applied to assess potential measures
- A list of up to ten measures for consideration for scoping in Work Package 2;
- Data requirements and timescales for collection;

Three study areas were considered, which were relevant to different options. The extent of the study areas with the major link roads are indicated in Figure 1 to Figure 30.

Study Zone A

This incorporates the wider town centre to include Sankey Green AQMA, Parker Street AQMA. The area includes Mersey Street, Chester Road, Wilderspool Causeway and Knutsford Road as these areas are outside current AQMAs but show an objective exceedance or are close to the objective.

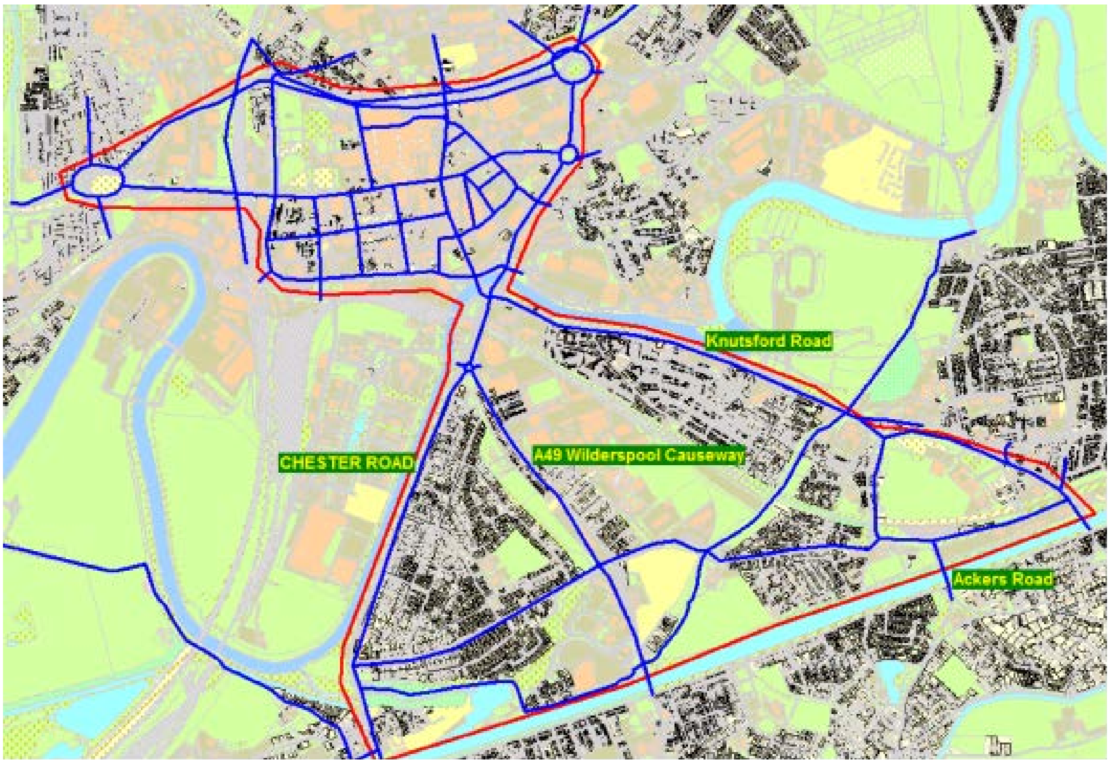


Figure 1: Study Zone A – Red. Road links intersecting the study area in blue

Study Zone B

This is the wider town centre area encompassing the Sankey Green and Parker Street AQMAs. This includes Mersey Street and Brick Street to the east which are of concern.

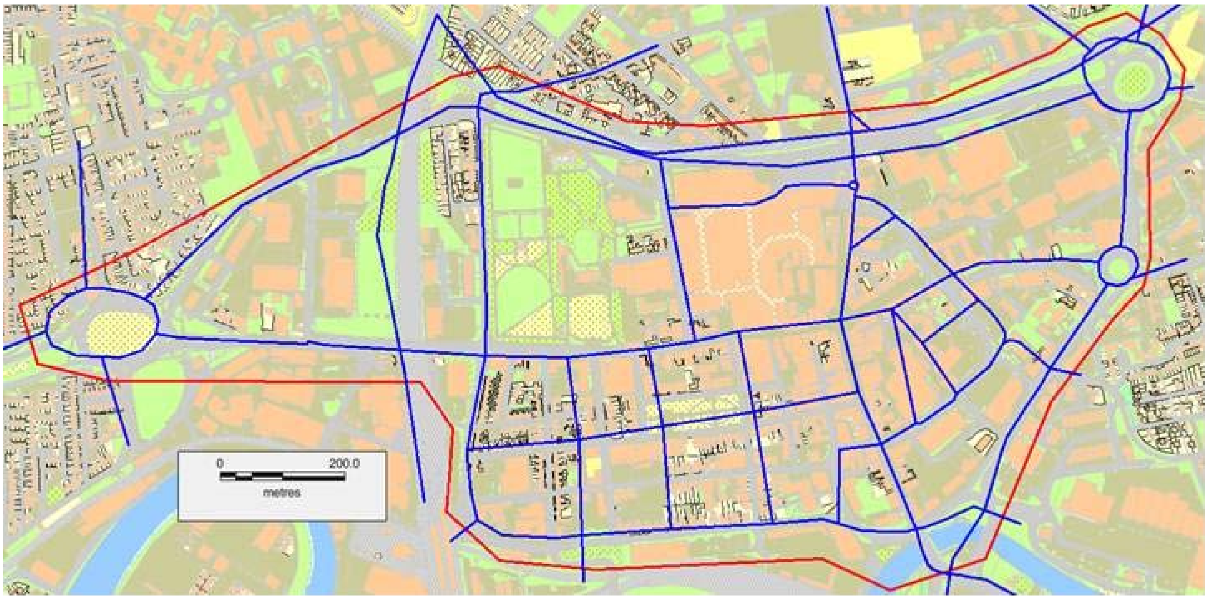


Figure 2: Study Zone B – Red. Road links intersecting the study area in blue

Study Zone C

This encompasses Parker Street AQMA and the town centre area within the ring road.

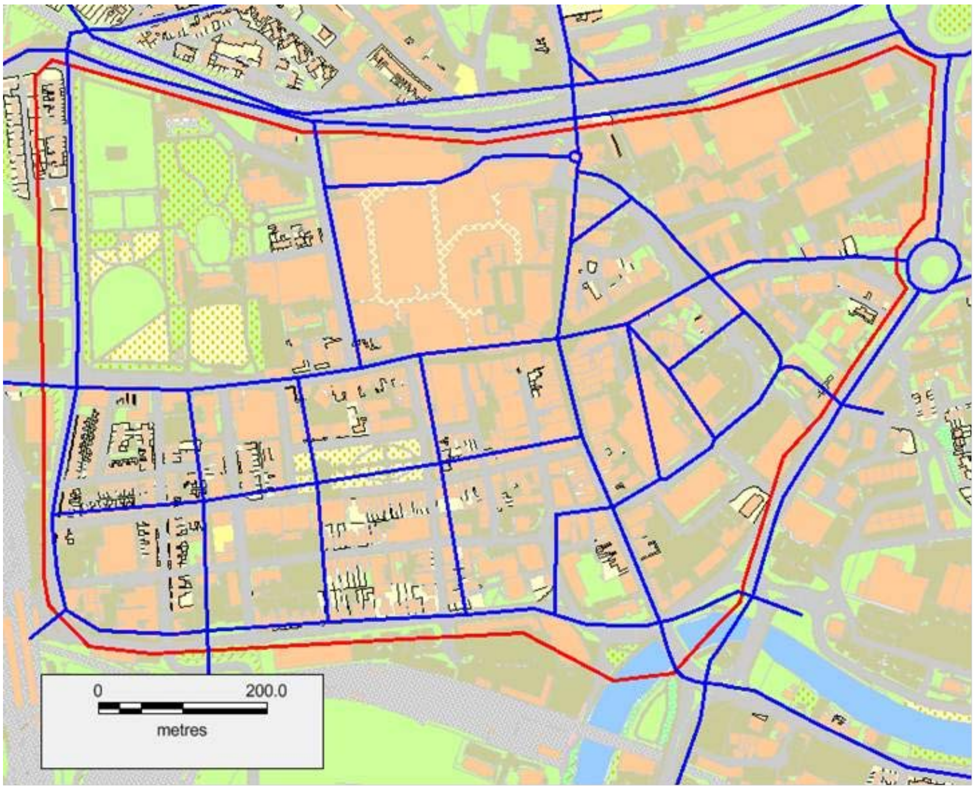


Figure 3: Study Zone C – Red. Road links intersecting the study area in blue

3.2 List of potential measures to be assessed

The bulleted list below describes the measures agreed by WBC that were assessed for the scoping exercise. Each measure was scoped in terms of the assessment approach applied. The measures agreed were as follows;

- Low Emission Zone
- Freight Consolidation Centre
- New road bridge and link road
- Route Management Plans
- Rapid take-up of low emission/alternative fuelled vehicles
- Bus fleet improvements
- Bio-methane refuelling station/ hub
- Active Travel campaign (e.g. walking, cycling, shift to bus)
- Park and Ride
- Compulsory Purchase

The air quality assessment (NO_2, PM_{10}), as part of the scoping phase, applied the state of the art pollution dispersion model ADMs Roads together with supporting air quality monitoring and background information for the year 2012.

A brief description of each option is given below, with further information and results of the tests are given in Appendix A.

BASELINE

The data requirements for the baseline were:
Traffic flows (ideally as Annual Average Daily Traffic (AADT) for as many traffic count sites in the study area as possible (focusing on major roads).

Traffic classification: the number of vehicles by vehicle class (e.g. car, taxi, Light Goods Vehicle (LGV), rigid Heavy Goods Vehicle (HGV), artic HGV, Public Service Vehicle (PSV including buses and coaches) and motorcycle) for as many count sites in the study area as possible (also focusing on major roads).

LOW EMISSION ZONE (LEZ)

A LEZ is a geographically defined area where the most polluting of vehicles are restricted, deterred or discouraged from access and use. The aim is to reduce the number of more polluting vehicles by setting specific exhaust emission standards or criteria as a condition of entry. For this test, the London LEZ criteria (PSV & HGV - Euro IV for PM) were applied and potential impacts on emissions and air quality were estimated. This test was applied to Study Zone A. Possible displacement around the zone boundary was *not* assessed at the scoping phase.

FREIGHT CONSOLIDATION CENTRE (FCC)

Freight Consolidation Centres are distribution centres situated close to a town centre, shopping centre or construction site. This test applied to all roads within Study Zone C and HGVs over 3.5 tonnes. The following two options were assessed:

Test 2a 20% uptake in participation.

Test 2b 100% update in participation

Both of these tests involved separately transferring goods onto 7.5 tonne and 9 tonne electric vehicles.

NEW ROAD BRIDGE AND LINK ROAD

The aim of this measure was to reduce through-traffic movements in the town centre and it applied to Spatial Zone B. The test assumed that a new link road was built from Chester Road to the Parker Street and Wilson Patten Street vicinity. The following two tests were conducted

Test 3a New Bridge and link road, with speed changed to 35 km/h

Test 3b New Bridge and link road, with speed changed to 25 km/h

ROUTE MANAGEMENT PLANS

A route management plan designed to prioritise traffic (or certain vehicle types) along defined routes. This test applied HGVs travelling in Spatial Zone B There was an increase in HGVs on the ring road with a subsequent decrease in interior roads.

RAPID TAKE-UP OF LOW EMISSION/ALTERNATIVELY FUELLED VEHICLES

A rapid take-up of private cars and smaller HGVs would be supported by WBC through provision of refuelling/charging points and incentives/rewards for users of these vehicles within the town centre. This test applied to Spatial Zone A and assumed a 1% uptake of electric fuelled cars and smaller HGVs.

BUS FLEET IMPROVEMENTS

This test assumed an improvement in the bus fleet to new dedicated compressed natural gas (CNG) vehicles able to run on natural gas and/or biomethane. The following tests were run in Spatial Zone A.

Test 6a 20% of buses converted to CNG

Test 6b 40% of buses converted to CNG

BIO-METHANE REFUELLING STATION/ HUB

This test considered that HGV fleets were cleaned-up through investment in dual fuel and dedicated gas vehicles. The tests assumed that 20% of HGVs in Study Zone A were switched to run on CNG or dual fuel (CNG/diesel) as below.

Test 7a 20% of HGVs converted to CNG

Test 7b 20% of HGVs converted to dual fuel

ACTIVE TRAVEL CAMPAIGN

An intensive active travel campaign could encourage a model shift from private cars to walking, cycling or bus. The test applied to Spatial Zone A and considered the following options:

Test 8a 5% reduction in cars

Test 8b 10% reduction in cars

Test 8c 20% reduction in cars

PARK AND RIDE

A park and ride scheme aims to reduce traffic travelling and parking within the town centre by establishing and out of town car park and using buses to travel into the centre. No specific test was undertaken in Warrington but indicative impacts were provided (see Appendix A).

COMPULSORY PURCHASE

Compulsory purchase orders (CPO) gives local authorities the power to take over land and/or housing. To remove existing AQMAs would involve compulsory purchase of a number of residential properties and changing use to non-residential and a total block on development to residential in these areas in the future. There would be no impact on emissions or pollution concentrations although there would no longer be relevant exposure at locations currently above the air quality objective for NO_2. No impact test was undertaken but details are provided in Appendix A.

3.3 Results

The full sets of results of each of the tests in terms of emissions and air quality impacts as well as cost assessment are provided in Appendix A. The section below provides an outline of the air quality impacts and indicative costs only.

LOW EMISSION ZONE

Air quality impacts

The LEZ scenario is estimated to reduce the annual mean NO_2 concentration in Spatial Zone area A at the test roadside receptor by 0.1 µg/m^3.

Indicative costs

A summary of the indicative costs for setting up and operating a LEZ in Warrington are given in Table 1.

Table 1: Low Emission Zone (LEZ) scheme set-up and operating costs

Cost Item	Scheme A Manual enforcement	Scheme B 10 x Fixed & 1 mobile ANPR camera
START-UP (CAPITAL) COSTS		
Roadside equipment	£30,000	£451,100
Central systems	£121,200	£167,400
Other set-up	£120,000	£182,500
Total start-up costs	£271,200	£801,000

Cost Item	Scheme A Manual enforcement	Scheme B 10 x Fixed & 1 mobile ANPR camera
ONGOING OPERATING COSTS		
Maintenance and replacement of equipment	£1,830	£36,539

FREIGHT CONSOLIDATION CENTRE (FCC)

Air quality impacts

The impact of test 2a (20% uptake) has been shown to reduce annual mean NO_2 concentration at the test roadside receptor by 0.2 µg/m^3. Test 2b (100% uptake) would reduce concentrations by 0.9 µg/m^3.

Indicative costs

A summary of the indicative costs for the two tests are given in Table 2 and Table 3 for a 7.5 tonne and 9 tonne vehicle.

Table 2: Summary of FCC using 7.5 tonne electric vehicles

	Mandatory participation		Voluntary participation	
	Shared centre	Dedicated centre	Shared centre	Dedicated centre
Total FCC annual cost	£4,065,690	£4,128,518	£500,647	£688,099
Cost per pallet	£7.87	£7.99	£10.36	£14.25
Total staff	101	104	12	19
Total vehicles	45		5	
Total vehicle runs per week	1243		117	
Total mileage per week	14916		1404	

Table 3: Summary of FCC using 9 tonne electric vehicles

	Mandatory participation		Voluntary participation	
	Shared centre	Dedicated centre	Shared centre	Dedicated centre
Total FCC annual cost	£4,624,948	£4,687,776	£546,001	£733,453
Cost per pallet	£8.95	£9.07	£11.30	£15.18
Total staff	94	96	12	19
Total vehicles	74		7	
Total vehicle runs per week	1243		117	
Total mileage per week	14916		1404	

NEW ROAD BRIDGE AND LINK ROAD

Air quality impacts

Test 3a which improves journey time (speeds of 35 km/h) was estimated to reduce annual mean NO_2 concentration by approx. 0.1 µg/m^3 within Spatial Zone B. The impact of reducing journey time (speeds of 25 km/h) was estimated to increase annual mean NO_2 at the test receptor by approx.0.4 µg/m^3.

Indicative costs

An elevated road (bridge) costs about 10 times that of a surface road, and tunnels probably cost more than 10 times more than bridges. For example, indicative costs are £78,000 per yard to build a bridge, £142,000 per yard for a tunnel and £17,045 per yard for an average three lane motorway[1].

ROUTE MANAGEMENT PLANS

Air quality impacts

A reduction of annual average NO_2 concentrations of approx. 0.7 µg/m^3 was modelled along Bridge Street/ Wilson Patten Street and Parker Street. An increase in annual mean NO_2 of approx. 1.2 µg/m^3 was modelled at a roadside receptor on the ring road to the north. Although an increase was estimated on the ring road in Spatial Zone B, there are far fewer relevant receptors compared to the town centre. Pollution dispersion may also be more favourable on the ring road.

Indicative costs

Indicative costs associated with installing infrastructure associated with route management plans are given in Table 5.

Table 4. Costs associated with route management plans

START-UP /CAPITAL COSTS	Technical basis	
Roadside equipment	Unit cost	Unit
Local route signage	1,300	per item
Strategic route signage	7,000	per item
Design and implementation	8,000	per item
Marketing and information campaign	5,000	per item
Traffic management/safety strategic roads	3,500	average per site
Traffic management/safety local roads	500	average per site
Traffic regulation order set-up costs	5,000	per item

RAPID TAKE-UP OF LOW EMISSION/ALTERNATIVELY FUELLED VEHICLES

Air quality impacts

Encouraging an uptake of 1% EVs cars and rigid goods vehicles <7.5 tonnes was estimated to reduce annual mean NO_2 at the test roadside receptor by approx. 0.05

[1] http://www.bbc.co.uk/news/magazine-13924687

μg/m³ within Spatial Zone A. It is therefore assumed that a 10% uptake would therefore be required to reduce NO_2 concentrations by 0.5 μg/m³.

Indicative costs

The indicative costs are provided for the cost of infrastructure, rather than costs to motorists as it is assumed that these would be in line with current motoring costs. As an example, the cost of installing new electric vehicle (EV) charging points is given in Table 5. In addition to these costs, it is assumed that 20x 22kW on-street charging points would be required for Warrington (i.e. cost of £200,000). There would also be running costs assumed to be at 15% per year (£30,000).

Table 5: Typical EV charging point equipment and installation costs

	Post Costs	Install Costs	Total Costs
7kW twin on-street (per unit)	£3,000	£3,000	**£6,000**
22kW twin on street (per unit)	£6,000	£4,000	**£10,000**
DC_50kW (per unit	**£15,000**	**£15,000**	**£30,000**

BUS FLEET IMPROVEMENTS

Air quality impacts

Test 6a (converting 20% of the bus fleet to CNG) was estimated to reduce annual mean NO_2 concentrations by approximately 0.08 μg/m³ at the test roadside receptor within Spatial Zone A. Test 6b (40% conversion) would reduce annual mean NO_2 concentrations at this receptor by approx. 0.1 μg/m³.

Indicative costs

The cost of a CNG refuelling station suitable for 40-50 buses is given in Table 6. A station payback is considered to be approximately 10 years. Further details of these costs are given in Appendix A.

Table 6: CNG refuelling station costs and fuel price

Station Size (kg/day)	Ave Capital Cost	Est. Civils etc.	Base NG delivered Price/kg	Capital payback (p/kg)	Fixed Opex[3] (p/kg)	Operator's Margin (p/kg)	Fuel Duty (p/kg)	Fuel Price (p/kg)
5,000	£350,000	£120,000	28	7	8	8	26.15	77.15

BIO-METHANE REFUELLING STATION/HUB

Air quality impacts

Test 7a (converting 20 percent of HGVs to CNG) was estimated to reduce annual mean NO_2 concentrations by around 0.3 μg/m³ at a test roadside receptor within Spatial Zone A. Test 7b (20% conversion to dual fuel) would reduce annual mean NO_2 concentrations at the receptor by around 0.2 μg/m³.

Indicative costs

The indicative costs given in Table 6 for buses would also apply to providing a bio-methane fuelling station for a similar number of HGVs running on gas. If they were running on dual fuel, it can be assumed that this size refuelling station would cover a fleet that was 30% larger, as the vehicles require less gas.

ACTIVE TRAVEL CAMPAIGN

Air quality impacts

Tests 8a (5% reduction in cars), Test 8b (10%), Test 8c (20%) were estimated to reduce annual average NO_2 concentrations at the test roadside receptor by approx. 0.2 $\mu g/m^3$, 0.4 $\mu g/m^3$ and 0.7 $\mu g/m^3$ within Spatial Zone A respectively.

Indicative costs

Active travel can be an extremely cost-effective measure and the health benefits of investing in cycling are estimated to be more than 2.5 times the cost. Benefit cost analysis of cycle training schemes have estimated that returns are of the order of 7:1. In dense urban areas such as London where there are gerater health, congestion and air qualty benefits, the cost-benefits impacts have been shown to be more beneficial (4:1). The health benefits from cycling outweigh any safety risks from increased cycling by more than 20 times[2].

PARK AND RIDE

Air quality impacts

Air quality impacts were not estimated at the scoping stage, since potential scenarios for the Park and Ride were not available

Indicative costs

To set up a new park and ride scheme, there will be set up costs associated with land purchase, facilities at the site (toilets etc.), signage, landscaping, fencing, CCTV cameras etc. There will also be operating costs which will depend on the number of bus services and revenue from the cost of the parking/bus fare.

3.4 Discussion of results

Table 7 shows the estimated change in annual mean NO_2 concentrations at the roadside receptor for each test undertaken. The table is designed to indicate which measures may have complementary potential. Clearly all the measures can be considered as standalone. However, those which have complimentary potential (i.e. can be combined with other measures to produce a cumulative impact) are indicated as group 1 or 2.

[2] http://www.corporatecitizen.nhs.uk/data/files/resources/269/Active-Travel-The-Miracle-Cure.pdf

Table 7: Summary of impacts

Test Description	Approximate change in annual mean NO_2 ($\mu g/m^3$) at receptor	Proposed Spatial Zone	Complementary group
LEZ	-0.1	A	n/a
Freight consolidation centre (FCC) with 100% uptake	-0.9	C	1
FCC with 20% uptake	-0.2	C	1
New bridge and link road, speed changed to 35 km/h	-0.1	B	n/a
New bridge and link road, speed changed to 25 km/h	-0.5	B	n/a
Routing of HGVs around the town centre	0.5	BC	1
1% uptake of EV cars and light HGVs	-0.1	A	n/a
20% of buses converted to CNG	-0.1	A	2
40% of buses converted to CNG	-0.2	A	2
20% of HGVs converted to CNG	-0.3	A	1
20% of HGVs converted to dual fuel	-0.2	A	1
5% reduction in cars	-0.2	A	n/a
10% reduction in cars	-0.4	A	n/a
20% reduction in cars	-0.7	A	n/a
Park and Ride	n/a	A	2
Compulsory purchase	n/a	A	n/a

The impacts of all measures at test receptors appear low (i.e. +/- ~1 $\mu g/m^3$ annual mean NO_2). Exposure at any one location is unlikely to greater or less than this. However, a low impact over a wide area (such as in Spatial Zone A) has a net benefit in terms of reducing overall exposure. There is also the potential cumulative benefit of implementing complementary measures as described in Table 7.

The most encouraging results for NO_2 in the town centre (zone C) are associated with re-routing of HGVs (~-0.7 $\mu g/m^3$). However this does cause an increase in NO_2 on the ring road (overall effect being ~+0.5 $\mu g/m^3$). One might consider that rerouting heavy traffic onto the ring road is reasonable proposition given the density of residential properties are far fewer adjacent to the ring road compared with for example the Parker Street area. Also air dispersion would be increased particularly on the elevated section of the ring road.

The most encouraging results for NO_2 across the largest area (A) are associated with mode shift from car at high (20%) levels (~-0.7 $\mu g/m^3$) based on active travel measures applied to achieve levels of walking and cycling seen in best-practice areas of Europe. Mode shift of 10% produces lower, but comparably strong, impacts (~-0.4 $\mu g/m^3$).

The impact of the LEZ appears quite low, and are similar to a 5% modal shift in cars, in terms of NO_2 reduction. However, for the LEZ there are also PM10 benefits including wider exposure reduction potential as the entry standard of London LEZ prioritises PM reduction for pragmatic and health purposes.

In terms of encouraging complementary measures in a themed package then implementing a FCC (with 100% compliance) and converting 20% of HGVs to CNG could potentially lead to a 1 µg/m^3 annual mean NO_2 reduction. However, a 20% HGV CNG fleet will require national measures outside WBC direct control. A more feasible package would be to pursue HGV rerouting combined with a FCC.

A package of options that spans various modes might be considered as: Active Travel (aiming for 10% mode shift from car); 40% of bus fleet converted to CNG and freight measures (FCC with 20% + take up). These could be applicable to a urban area the size and nature of Warrington, generate other benefits (to economy, efficiency and health) while providing a sum impact of much greater benefit than more punitive measures (such as LEZ).

3.5 Options selected for detailed assessment

The results to the steering group were presented on the 19th July 2012 at a scoping workshop. A vote was held to see which of the measures they considered had the most potential to move forward to the detailed phase of the study. The results of the voting are shown in Figure 4. A clear favourite appeared to be introducing a form of FCC. The least favoured option being compulsory purchasing of houses in areas with poor air quality. Other measures were fairly equally distributed such as route management with seven votes. Promoting the uptake of electric vehicles had no response registered. Figure 4 also provides an indication of the complementary effects between measures such as the association between a LEZ and FCC in terms of managing emissions from specific goods vehicles within a controlled zone.

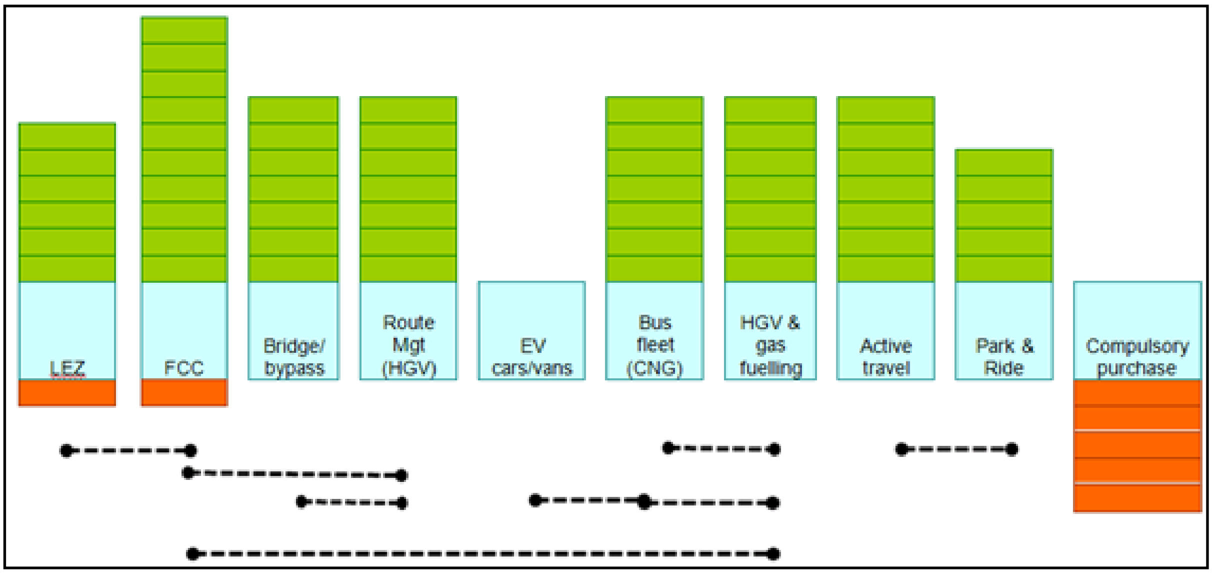


Figure 4: Results of voting to select measure for detailed assessment

A scoping review follow up meeting was held on 12th September 2012 between the study team and WBC. The objectives set for that meeting were as follows:

- To review the scoping workshop outcomes and measures, identify/agree a short list of options to take into detailed phase;
- To review the detailed phase approach (emissions method, AQ method, cost method and input data constraints) and
- Agree on the boundary assumptions for the preferred options.

The study team reviewed the Scoping Workshop outcomes and presented a summary paper to WBC. This upgraded the scoping phase work, with workshop voting included the study team's recommendations on what measures to take to detailed assessment and which would probably not benefit from further investigation. In some cases this was because the input data could not be improved upon.

The decision on which options were recommended for detailed assessment was based on two main questions:

1. Which options are most effective (in terms of reducing NO_2 concentrations within the AQMA), and likely to be cost effective, well-supported and feasible?
2. Which options will benefit most from detailed investigations (and which will not)?

The final conclusions of the meeting are summarised in Table 8

Table 8: Discussion of options to take forward to detailed assessment

Option	**Discussion**	**Take forward to detailed assessment**
LEZ	There was deemed to be sufficient information from the scoping phase on emission impacts. It was considered unlikely to be improved upon for a detailed assessment. There continued to be uncertainty about implementation methods (regulatory and infrastructure) which might be applied at that point in time. The likely need to make the LEZ cover a large area to be effective was a concern for political acceptance. Costs for set-up and operation were quite high in relation to the AQ benefits. It was acknowledged that very small incremental improvements in air quality would occur across a fairly large population. LEZ are never economically cost-effective (e.g. London). FCC plus HGV re-routing would require some level of access control and management into town centre which was thought to replicate many of the aspects of an LEZ in practice.	No
FCC with 20% uptake	This was considered a more likely scenario compared to compulsory uptake. WBC highlighted three possible locations and agreed that the Omega site at Burtonwood was a preferred option.	Yes (initially)
New bridge and link road	This is a long term aspirational goal for WBC. If brought forward would require a full Environmental Impact Assessment under planning requirements and air quality would be further assessed under this, whether part of this study or not. WBC also considered the plans associated with a new Bridge Street relief road. At that stage plans were considered premature and hence it was decided not to include an alteration to the road traffic network and or	No

	the traffic flows on this basis.	
Routing of HGVs	This is potentially a highways action and due to the level of air quality impact and potential displacement of impacts it was considered worthwhile to select for further detailed assessment. The route was confirmed as the same as for the scoping phase.	Yes
1% uptake of EV cars and light HGVs	At the time, this option was largely considered to be out of the control of WBC as it was more reliant on national uptake and new technology. The scoping phase was sufficient to show its potential impact.	No
Buses converted to CNG	This was considered but it was concluded that to funding would not be able to significantly affect uptake. It was concluded that updating of the bus fleet over and above current plans would be unlikely.	No
HGVs converted to CNG	This was also considered, but it was decided that creating of a biomethane hub would currently not be practical and the scoping phase was sufficient.	No
Active travel campaigns	The scoping phase was considered sufficient and further information would not drive forward any change in current policy.	No
Park and Ride.	The scoping phase was considered to be sufficient given the lack of knowledge or information that could feed into a more detailed design and therefore detailed testing.	No
Compulsory purchase	This option was rejected as being inappropriate and politically unacceptable in face of other Council policies and priorities.	No

At the end of the session a final short list of options for detailed assessment was confirmed these included the following;

- FCC 20% uptake
- HGV rerouting
- 1 and 2 combined to consider increase in effect.

These measures would benefit from more careful designation of geographical extent, year of introduction and implementation profile to adjust the emission modelling and achieve more accurate understanding of impacts. It should be appreciated that because some measures that can be modelled further it does not necessarily make them more valid in terms of overall impact or effectiveness. However, in these cases these measures were also strongly supported by the stakeholders.

The scoping meeting in July 2012 highlighted concerns over the limited traffic data and the ability therefore to effectively test options. For example, in order to manage the re-routing of HGVs there needed to be an understanding of the current situation. For this reason, WBC conducted a comprehensive automatic number plate recognition (ANPR) and Automatic Traffic Count (ATC) survey across the town centre in May 2013. Details of the surveys and data analysis are provided in Appendix D.

Further consideration was given to the final options owing to proposed highway changes to the town centre. It was decided in 2014 not to pursue the FCC option as this was less likely in practice to be taken forward. In addition to the HGV re-routing option it was decided that a general traffic rerouting proposal around the Parker Street area should be assessed. Therefore it was decided to amend the detailed assessment proposals to cover:

- HGV re-routing strategy around the town centre, clockwise and anticlockwise directions.
- Parker Street one-way system with four options

4 Work Package Three - Detailed Assessment

4.1 Introduction

Work Package Three involved conducting a full analysis of the following preferred low emission options;

- HGV re-routing strategy around the town centre, clockwise and anticlockwise directions.
- Parker Street one-way system with four options

The following sections describe the methodology and key results for the baseline and detailed assessment of the two scenario options. Further details of this detailed work are given in the following appendices.

- ANPR and ATC survey (Appendices D and E)
- Emissions Modelling (Appendices G, H and I)
- Air Quality Dispersion Modelling (Appendix J)
- HGV re-routing traffic data (Appendix K)
- Parker street one way system traffic data (Appendix L).

4.2 Methodology

The following describe the tasks that were conducted as part of the methodology;

- Mark up and anonymise the ANPR data to compare with the DVLA database.
- Identify understand travel patterns around Warrington.
- Produce travel pattern summary statistics
- From Task (3) produce GIS map of the most common travel pattern and the total distance of each.
- Produce a fleet model in accordance with the UK standard emission factor database.
- Using ANPR data define a coarse composition and relate this to an appropriate ATC site.
- Define the modelled road network in line with the scoping exercise and by the confines of the traffic collection survey.
- Compile ATC data into the emissions model in accordance with (7) (i.e. assumed ADT and average speed).
- Run emissions for the base year 2013
- Compile ADMS Roads emissions inventory using (9)
- Run ADMS Roads using address points buffered up to 200m and across a grid.
- Conduct model verification for road NO_X against 2013 monitoring data and a 2013 meteorological file.
- Report the baseline evidence (emissions and concentrations)
- Scenario testing: Consider how the two options affect the baseline. (steps 9-13 conducted for the scenarios)

4.3 Summary of traffic situation

A summary of the key findings of the ANPR and ATC survey is given below (see also Table 10 and Table 11), in terms of the current traffic situation in the town centre. Further details of the ANPR survey are given in Appendix D.

Key routes

- Only a small fraction of vehicles entered and exited the town within 15 minutes (0.02%).
- There was a tendency for vehicles to enter and leave using the same route.
- The most popular routes are “From and To Winwick Road” and “From and To Sankey Way/Lovely Lane”.

Trips by time of day

- As expected, the highest vehicle activity occurred during the 7 – 9am rush hour period. The routes with the highest increase in variation at this time are Old Liverpool Road to Farrell Street, Sankey Way to Farrell Street and on Chester Road.
- Traffic activity on Winwick Road, Lovely Lane and Wharf Street show the least variation over the day.

Vehicle fleet

- The vehicle fleet composition on all routes surveyed in Warrington was similar in terms of the Euro emission standards.
- The fleet was compared to national predictions in the National Atmospheric Emissions Inventory (NAEI). The Warrington fleet tended to be older than the national predictions, and comparisons are shown below by vehicle type below. If the NAEI was used instead of information from the ANPR survey, then it is likely that this study would have underestimated vehicle emissions in Warrington.

Cars

- The dominant vehicle on all roads was cars (typically more than 80%).
- Through traffic across the town centre is associated with trips from Old Liverpool Road, trips from Knutsford Road, River Road, Chester Road, and Sankey Way towards Lovely Lane and to a lesser extent towards Bewsey Road to Knutsford Road, Wilderspool Causeway and Chester Road.
- Car drivers heading towards Winwick Road and From Sankey Way were most likely to have included an element of business in the town.
- Over a 24 hour period, the percentage of through traffic was around 37%.
- The local car fleet is slightly older than the national fleet predictions. For example, there are fewer Euro 5 petrol cars (12-15%) and diesel cars (29-34%) in the local fleet on surveyed routes than the national fleet predictions of 28% and 43% respectively and a higher number of Euro 4 diesel cars (45-48%) compared to 36% in the national fleet.

LGVs

- Routes with a higher than national average proportion of LGVs included Farrell Street to Lovely Lane (31%) and Wharf Street (20%). This may be expected as Wharf Street leads to a retail and industrial area;
- The greatest number of LGV trips occur between 9am-4pm, with numbers tailing off between 4-6pm and very few after 6pm. This patter coincides with working times of retail and light industry in Warrington.
- Outbound routes with higher mean percentage of LGVs between 4-6pm are Farrell Street, Chester Road and Sankey Way.
- Routes with the highest LGV traffic in the morning out of Warrington are Knutsford Road, Wilderspool Causeway, Chester Road, Old Liverpool Road, Sankey Way and Lovely lane.
- Most LGVs enter and leave town via Sankey Way or Winwick Road. LGVs that enter Warrington using Knutsford Road appear to be conducting business before leaving (duration of around 40 minutes)
- The proportion of through traffic was difficult to estimate as the patterns of LGVs are much less prescribed than that of HGV movements. Further information would be needed on the location of retail servicing and light industrial activity to be able to understand LGV movements in more detail.
- The LGV fleet in Warrington was older than national fleet predictions, although the fleet on Winwick Road was more similar to the national fleet.

Rigid HGVs

- The most popular rigid HGV route of was recorded to and from Sankey Way (i.e. 53 across the 24 survey period) and between Sankey Way and Lovely Lane (45). Sevent eight percent of rigids from Sankey Way were observed as having business in the town cetre.
- The lowest rigid activity (7 vehicles per day) was observed operating to and from Bewsey Road.
- Over 65% of vehicles traveling to Wharf Street do so without participating in business in the town centre.
- Over a 24 hour period, the percentage of through traffic was around 48%.
- There were higher proportions of Euro III and IV rigid HGVs but lower proportions of Euro V vehicles compared to national fleet predictions.

Articulated HGVs

- The most popular single route for artic HGVs was observed between Winwick Road and the Chester Road (36 over the survey period). Chester road was also the most popular combined destination from all other destinations.
- Other roads with high number of artics along their route over the 24 hour period included, Manchester Road, Knutsford, Wilderspool Causeway and Sankey Way.
- Battersby Lane had the lowest artic activity (i.e. 1 vehicle trip observed).
- Most vehicles leave Warrington on Winwick Road, Manchester Road, Chester and Sankey Way and approach on Winwick Road and Sankey Way.

- Routes with highest trip durations were Winwick Road (return), Manchester Road to Chester Road, Old Liverpool Road and Sankey Way (~43, 60, and 55 minutes respectively). These type of durations suggest retail type drop offs.
- Over a 24 hour period, the percentage of through traffic was around 17%.
- The articulated HGV fleet in Warrington was older than national fleet predictions, although the fleet on Winwick Road was newer than the national fleet.

Buses

- The highest proportion of the traffic which were buses (within the study area) operated along key routes ranged from 0% to 3.7% (in Old Liverpool Road via the Sankey Green AQMA).
- The most popular bus trips were as follows,
    - Old Liverpool Road to Old Liverpool Road (119 observations)
    - Sankey Way to Sankey Way (110 observations)
    - Winwick Road to Orford Lane (60 observatios)
    - Wilderspool Causway to Wilderspool Causway (64)
    - Clearly, many buses were observed passing single camera locations having started and completing their routes.
- Establishing the proportion of bus through traffic is clearly not relevant for this study.
- Bus traffic appears to be on a par with HGVs although buses operate over shorter diurnal time periods. According to the fleet composition shown Table 9, 60% of the smaller buses are Euro IV or better.

Table 9: Bus fleet emission characteristics 2013

Weight	Euro Class	%
<=15t	Euro 0	1%
<=15t	Euro I	0%
<=15t	Euro II	13%
<=15t	Euro III	26%
<=15t	Euro IV	40%
<=15t	Euro V EGR	0%
<=15t	Euro V SCR	20%
<=15t	Euro VI	0%

The following tables provide a summary of the traffic flows and route directions (through traffic or traffic using the town centres) on key routes from the ANPR data across the 24 hour survey period. The results show that:

- The pattern of through trips varies by origin/destination pairing.
- With the exception of Knutsford Road, the higher proportion of trips would be categorised as being through traffic.

Table 10: Summary of traffic flow and fleet on key routes.

Road	Direction	AADT	% car (AADT)	% LGV (AADT)	% Rigid HGV (AADT)	% Artic HGV (AADT)	% Bus (AADT)
1 Wilderspool Causeway	To Bridgefoot	7389	89.7% (7032)	6.7% (525)	1.4% (110)	0.5% (39)	1.7% (133)
2 Wilderspool Causeway	From Bridgefoot	7780	89.3% (6948)	7.3% (568)	1.5% (117)	0.5% (39)	1.4% (109)
3 Chester Road	To Bridgefoot	9189	89.8% (8252)	7.1% (652)	1.5% (138)	0.8% (74)	0.8% (74)
4 Chester Road	From Bridgefoot	9884	90.2% (9006)	7.1% (709)	1.3% (130)	0.9% (90)	0.6% (60)
5 Old Liverpool Road	To Sankey Green AQMA	4107	81.4% (3327)	11.5% (470)	2.7% (110)	0.7% (29)	3.7% (151)
6 Old Liverpool Road	From Sankey Green AQMA	4087	82.3% (3380)	10.9% (448)	2.4% (99)	0.7% (29)	3.7% (152)
7 Sankey Way	To Sankey Green AQMA	18674	91.7% (17124)	5.9% (1102)	1.3% (243)	0.3% (56)	0.8% (149)
8 Sankey Way	From Sankey Green AQMA	18711	92.1% (17232)	5.4% (1010)	1.3% (243)	0.4% (75)	0.9% (168)
9 Lovely Lane	From Sankey Green AQMA	7370	89.0% (6559)	8.4% (619)	1.1% (81)	0.3% (22)	1.1% (81)
10 Lovely Lane	To Sankey Green AQMA	7746	89.4% (6925)	7.5% (581)	1.2% (93)	0.3% (23)	1.5% (116)
11 Bewsey Road	Away from town centre	2519	90.4% (2277)	7.8% (196)	1.0% (25)	0.2% (5)	0.7% (18)
12 Bewsey Road	Towards town centre	2284	89.5% (2044)	8.5% (194)	1.1% (25)	0.3% (7)	0.6% (14)
13 Winwick Road	Away from town centre	10956	87.7% (9608)	7.4% (811)	2.3% (252)	1.2% (131)	1.4% (153)
14 Winwick Road	Towards town centre	12167	88.0% (10707)	7.4% (900)	2.0% (243)	1.3% (158)	1.3% (158)
15 Orford Lane	Away from Winwick Road	3704	91.7% (3397)	5.3% (196)	0.5% (19)	0.1% (4)	2.4% (89)
16 Orford Lane	Towards Winwick Road	3438	91.9% (3160)	4.9% (168)	0.8% (27)	0.1% (3)	2.2% (76)
17 Battersby Lane	Away from town centre	7120	92.9% (6614)	5.4% (384)	0.4% (28)	0.1% (7)	1.1% (78)
18 Battersby Lane	Towards town centre	6440	92.6% (5209)	5.5% (309)	0.4% (22)	0.0% (0)	1.5% (84)

Road	Direction	AADT	% car (AADT)	% LGV (AADT)	% Rigid HGV (AADT)	% Artic HGV (AADT)	% Bus (AADT)
19 Manchester Road	Away from town centre	9766	89.2% (6534)	6.9% (505)	1.8% (132)	0.8% (56)	1.4% (103)
20 Manchester Road	Towards town centre	9936	89.3% (7325)	7.0% (522)	1.4% (104)	1.1% (82)	1.3% (97)
21 Farrell Street	Away from town centre	5589	90.6% (5064)	7.8% (436)	1.2% (67)	0.4% (22)	0.1% (6)
22 Farrell Street	Towards town centre	4908	89.9% (4412)	8.3% (407)	1.2% (59)	0.3% (15)	0.2% (10)
23 Wharf Street	Away from Bridgefoot	4341	90.8% (3941)	6.7% (291)	1.7% (74)	0.5% (22)	0.3% (13)
24 Wharf Street	Towards Bridgefoot	4110	91.4% (3757)	6.1% (251)	1.6% (66)	0.5% (21)	0.3% (12)
25 Mersey Street	Away from Bridgefoot	14342	88.9% (12750)	7.3% (1047)	1.3% (186)	0.9% (129)	1.6% (229)
26 Mersey Street	Towards Bridgefoot	14283	88.9% (12698)	7.3% (1043)	1.3% (186)	0.9% (129)	1.6% (229)
27 Wilson Patten Street	Towards Bridgefoot	10771	95.9% (11163)	0.0% (0)	2.8% (326)	1.3% (151)	0.0% (0)
28 Wilson Patten Street	Away from Bridgefoot	14112	89.4% (15074)	0.0% (0)	7.1% (1197)	3.4% (573)	0.0% (0)
29 Midland Way	East bound	7913	89.7% (7098)	7.1% (562)	1.4% (111)	0.6% (47)	1.3% (104)
30 Midland Way	West bound	7260	89.7% (6512)	7.1% (515)	1.4% (102)	0.6% (44)	1.3% (94)
31 Knutsford Road	Away from Bridgefoot	8889	90.4% (8036)	6.7% (596)	1.3% (116)	0.5% (44)	1.1% (98)
32 Knutsford Road	Towards Bridgefoot	9817	89.8% (8816)	7.0% (687)	1.3% (127)	0.7% (69)	1.1% (108)

Table 11 shows the proportion of traffic by mode for specific origin destination pairs. The table indicates the proportion and representative number of vehicles categorised as through traffic and having business in the town centre over the survey period. Just for clarity the highlighted value of 27% indicates that 27% of cars observed between Wilderspool Causeway and Chester Road had journeys of less than 20 minutes and hence categorised as through traffic.

Table 11: Proportion of traffic by mode for specific origin destination pairs

			Direction to													
		Mode	**W'pool Causeway**		**Chester Road**		**Sankey Way**		**Winwick Road**		**M'chester Road**		**Wharf Street**		**Knutsford Road**	
Dir. from	**W'pool Causeway**		%	#	%	#	%	#	%	#	%	#	%	#	%	#
	Through Traffic	Cars	14%	137	**27%**	102	87%	1046	80%	627	64%	165	76%	252	21%	176
		Car/van*	29%	4	44%	7	78%	51	76%	50	60%	12	100%	8	33%	1
		Buses	5%	3	0%	0	80%	4	0%	0	0%	0	0%	0	0%	0
		LGV	18%	7	100%	26	81%	56	86%	86	79%	26	91%	21	17%	1
		Rigid HGV	0%	0	17%	0	80%	20	71%	22	71%	5	50%	1	100%	3
		Artic HGV	25%	1	100%	4	75%	3	57%	8	100%	1	100%	1	0%	0
	Town Centre	Cars	86%	875	73%	279	13%	153	20%	156	36%	91	24%	79	79%	645
		Car/van	71%	10	56%	9	22%	14	24%	16	40%	8	0%	0	67%	2
		Buses	95%	62	0%	0	20%	1	100%	4	100%	3	0%	0	100%	2
		LGV	82%	32	0%	0	19%	13	14%	14	21%	7	9%	2	83%	5
		Rigid HGV	100%	3	83%	2	20%	5	29%	9	29%	2	50%	1	0%	0
		Artic HGV	75%	3	0%	0	25%	1	43%	6	0%	0	0%	0	100%	1
	Chester Road															
	Through Traffic	Cars	16%	44	8%	128	83%	1014	82%	913	85%	441	77%	268	36%	47
		Car/van	50%	6	11%	4	77%	57	85%	68	67%	26	64%	9	56%	5
		Buses	50%	1	12%	3	100%	6	8%	1	50%	1	0%	0	100%	1
		LGV	56%	10	17%	10	88%	70	89%	107	77%	46	85%	17	50%	6
		Rigid HGV	33%	1	18%	2	67%	14	76%	35	62%	8	100%	6	0%	0
		Artic HGV	100%	2	0%	0	50%	2	89%	12	0%	0	100%	3	25%	1
	Town Centre	Cars	84%	239	92%	1469	17%	209	18%	204	15%	80	23%	78	64%	83
		Car/van	50%	6	89%	31	23%	17	15%	12	33%	13	36%	5	44%	4
		Buses	50%	1	88%	22	0%	0	92%	11	50%	1	0%	0	0%	0
		LGV	44%	8	83%	49	13%	10	11%	13	23%	14	15%	3	50%	6

			Direction to													
		Mode	**W'pool Causeway**		**Chester Road**		**Sankey Way**		**Winwick Road**		**M'chester Road**		**Wharf Street**		**Knutsford Road**	
		Rigid HGV	67%	2	82%	9	33%	7	24%	11	38%	5	0%	0	0%	0
		Artic HGV	0%	0	100%	13	50%	2	11%	1	100%	0	0%	0	75%	3
	Sankey Way															
	Through Traffic	Cars	87%	941	87%	1065	15%	639	26%	159	87%	1072	80%	355	90%	1339
		Car/van	83%	45	84%	47	25%	23	46%	18	79%	61	76%	13	81%	63
		Buses	100%	3	100%	4	16%	18	100%	1	0%	0	100%	2	50%	2
		LGV	82%	72	75%	56	14%	15	28%	15	79%	84	76%	19	81%	114
		Rigid HGV	85%	17	78%	7	22%	10	31%	4	74%	32	88%	7	81%	13
		Artic HGV	67%	2	100%	1	0%	0	40%	2	86%	6	0%	0	100%	7
	Town Centre	Cars	13%	142	13%	161	85%	3599	74%	464	13%	164	20%	89	10%	143
		Car/van	17%	9	16%	9	75%	70	54%	21	21%	16	24%	4	19%	15
		Buses	0%	0	0%	0	84%	92	0%	0	100%	3	0%	0	50%	2
		LGV	18%	16	25%	19	86%	94	72%	39	21%	23	24%	6	19%	27
		Rigid HGV	15%	3	22%	2	78%	35	69%	9	26%	11	13%	1	19%	3
		Artic HGV	33%	1	0%	0	100%	11	60%	3	14%	1	0%	0	0%	0
	Winwick Road															
	Through Traffic	Cars	80%	753	81%	1170	22%	139	17%	563	55%	364	74%	289	66%	384
		Car/van	76%	65	82%	85	21%	6	24%	36	68%	42	86%	18	54%	22
		Buses	33%	1	31%	4	33%	1	33%	12	40%	4	100%	2	78%	7
		LGV	85%	109	84%	136	33%	20	22%	41	59%	44	79%	31	69%	31
		Rigid HGV	91%	30	68%	28	29%	4	14%	9	70%	14	76%	13	75%	9
		Artic HGV	83%	10	58%	21	56%	5	13%	6	58%	7	100%	9	80%	4
	Town Centre	Cars	20%	188	19%	277	78%	483	83%	2804	45%	302	26%	103	34%	196
		Car/van	24%	20	18%	19	79%	23	76%	111	32%	20	14%	3	46%	19
		Buses	67%	2	69%	9	67%	2	67%	24	60%	6	0%	0	22%	2
		LGV	15%	19	16%	26	67%	41	78%	144	41%	31	21%	8	31%	14

			Direction to													
		Mode	**W'pool Causeway**		**Chester Road**		**Sankey Way**		**Winwick Road**		**M'chester Road**		**Wharf Street**		**Knutsford Road**	
		Rigid HGV	9%	3	32%	13	71%	10	86%	57	30%	6	24%	4	25%	3
		Artic HGV	17%	2	42%	15	44%	4	88%	42	42%	5	0%	0	20%	1
	M'chester Road															
	Through Traffic	Cars	70%	249	85%	599	83%	898	53%	294	17%	322	84%	336	29%	51
		Car/van	64%	16	82%	36	84%	49	71%	32	30%	15	85%	22	29%	4
		Buses	54%	7	87%	20	95%	221	29%	2	67%	6	100%	1	78%	14
		LGV	78%	28	82%	68	87%	92	64%	42	25%	17	76%	26	45%	9
		Rigid HGV	55%	6	91%	10	72%	26	56%	5	18%	2	67%	6	40%	2
		Artic HGV	0%	0	36%	4	36%	2	67%	6	5%	1	100%	2	0%	0
	Town Centre	Cars	30%	107	15%	106	17%	189	47%	262	83%	1606	16%	65	71%	127
		Car/van	36%	9	18%	8	16%	9	29%	13	70%	35	15%	4	71%	10
		Buses	46%	6	13%	3	5%	12	71%	5	33%	3	0%	0	22%	4
		LGV	22%	8	18%	15	13%	14	36%	24	75%	51	24%	8	55%	11
		Rigid HGV	45%	5	9%	1	28%	10	44%	4	82%	9	33%	3	60%	3
		Artic HGV	100%	3	64%	7	64%	4	33%	3	95%	19	0%	0	100%	3
	Wharf Street															
	Through Traffic	Cars	90%	355	90%	327	77%	331	70%	217	72%	182	43%	23	93%	821
		Car/van	94%	15	84%	16	83%	10	96%	24	100%	13	40%	2	91%	32
		Buses	0%	0	0%	0	4%	0	1%	0	2%	0	0%	0	13%	0
		LGV	88%	21	94%	31	90%	28	86%	30	71%	17	27%	4	100%	50
		Rigid HGV	100%	5	83%	5	100%	8	94%	7.5	100%	0	0%	0	100%	15
		Artic HGV	0%	0	100%	0	100%	0	91%	0	100%	0	0%	0	100%	0
	Town Centre	Cars	10%	39	10%	37	23%	100	30%	94	28%	72	57%	31	7%	64
		Car/van	6%	1	16%	3	17%	2	4%	1	0%	0	60%	3	9%	3
		Buses	0%	0	0%	0	96%	0	99%	0	98%	0	100%	0	87%	0
		LGV	13%	3	6%	2	10%	3	14%	5	29%	7	73%	11	0%	0

		Direction to													
	Mode	W'pool Causeway		Chester Road		Sankey Way		Winwick Road		M'chester Road		Wharf Street		Knutsford Road	
	Rigid HGV	0%	0	17%	1	0%	0	6%	0.5	0%	0	0%	0	0%	0
	Artic HGV	0%	0	0%	0	0%	0	9%	0	0%	0	100%	0	0%	0
Knutsford Road															
Through Traffic	Cars	30%	114	41%	114	88%	1390	66%	360	26%	41	79%	430	22%	376
	Car/van	35%	8	70%	14	86%	66	67%	39	15%	2	82%	14	29%	21
	Buses	33%	1	50%	1	0%	0	53%	8	0%	0	0%	0	0%	0
	LGV	57%	20	55%	18	81%	100	68%	42	47%	7	68%	17	37%	37
	Rigid HGV	67%	4	92%	11	94%	17	62%	8	0%	0	100%	7	0%	0
	Artic HGV	29%	2	75%	3	71%	5	33%	4	0%	0	100%	3	0%	0
Town Centre	Cars	70%	271	59%	161	12%	186	34%	183	74%	119	21%	117	78%	1369
	Car/van	65%	15	30%	6	14%	11	33%	19	85%	11	18%	3	71%	51
	Buses	67%	2	50%	1	100%	2	47%	7	100%	7	100%	0	100%	39
	LGV	43%	15	45%	15	19%	23	32%	20	53%	8	32%	8	63%	64
	Rigid HGV	33%	2	8%	1	6%	1	38%	5	100%	3	0%	0	100%	4
	Artic HGV	71%	5	25%	1	29%	2	67%	8	100%	2	0%	0	100%	10

*Car/van refers to car derived vans

4.4 Emissions modelling

The detailed traffic and fleet data was utilised with TRL's Transport and Enhanced Emissions Model (TEEM) to calculate emissions totals from each mode for the main roads links. The output from TEEM is used within the ADMS dispersion model to calculate pollutant concentrations at relevant receptors and across the study domain. Full details of the TEEM modelling conducted is given in Appendix G. TEEM was set up with all the necessary input data to provide a baseline emissions profile for the Warrington assessment Study Zone A assessment area (181 road links).

4.5 Air quality modelling

Atmospheric dispersion modelling for the base year of 2013 was undertaken using the ADMS-Roads (Extra) model (version 3.2) The ADMS-Roads model uses a number of input parameters to simulate the dispersion of pollutant emissions, predicting pollutant concentrations at specified receptors and across a user-defined area. The input parameters include emission source activity data from TEEM, local meteorological conditions and site specific characteristics including latitude, boundary layer height and surface roughness. Full details of the modelling and verification process are included in Appendix J.

For the purpose of this assessment, pollutant concentrations have been modelled at the monitoring sites and at address points within 200 metres of modelled roads (as indicated in Figure 42 in Appendix J). All receptors were modelled at 1.5 metres in height unless otherwise stated. Concentrations were also modelled across a grid that covered the entire study area.

The modelling focused on annual mean NO_2 concentrations as these were of an issue in terms of not meeting the air quality objective. However, the modelling was also conducted to predict annual mean PM_{10} concentrations even though this pollutant is not an issue in Warrington in terms of the air quality objectives, but is an issue in terms of health effects.

4.6 Results

4.6.1 Baseline

The total emissions per annum are shown in Table 12 for NO_x, PM and CO_2 and the contribution from different vehicle types are shown in Table 14. For NOx and exhaust PM, the key contributor appears to be diesel passenger cars and rigid HGVs are the second contributor for NO_x. In contrast the proportion of kilometres driven by vehicle category is shown in Table 13 where cars dominate. Approximately 10% of annual PM emissions and 20% of NOx emissions come from 3% of HDV activity. Note that the proportion of vehicle kilometres in Table 13 can be compared in with a similar set of results obtained in the scoping phase using 2012 data (see Appendix B, Table 49).

Table 12: Baseline emissions 2013

Pollutant	Sum of Light Duty Vehilces – cars and LGVs (kg/yr)	Sum of Heavy Duty Vehicles – HGVs and buses (kg/yr)	Total (kg/yr)
NOx	115,670	62,397	178,067
PM10 exhaust	3,254	760	4,014
PM25 exhaust	3,092	722	3,813
CO_2	77,887,130	8,824,638	86,711,767

Table 13: Proportion of vehicle kilometres driven by vehicle category

Vehicle kilometres per year				
Cars	LGVs	Rigid HGVs	Articulated HGVs	Bus & Coaches
90%	6%	1%	2%	1%

Table 14: Contribution of vehicle types to emissions (source apportionment), 2013

Pollutant	Car Petrol (%)	Car Diesel (%)	LGV Petrol (%)	LGV Diesel (%)	HGV Rigid (%)	HGV Articulated (%)	Buses (%)
NOx	11.3%	50.0%	<0.0%	7.9%	12.2%	7.5%	11.1%
PM10 exhaust	18.9%	52.1%	<0.0%	12.7%	7.5%	3.1%	5.7%
PM25 exhaust	18.9%	52.1%	<0.0%	12.7%	7.5%	3.1%	5.7%
CO_2	53.4%	32.4%	<0.0%	5.4%	3.3%	2.6%	2.7%

The estimated dispersion of NO_2, as an annual mean, representing the baseline across the entire study area is presented in Figure 5. A similar gridded plot for the inner ring road area is presented in Figure 6. Note that in Figure 5 the outer boundary of the contour plot is white. Given that this area was not included by the modelled road network the assumption here is that as a minimum the pollution level is equivalent to the background concentration. It is also worth noting that the detail of modelled dispersion differs markedly depending on the application of the standard number of grid points applied at different spatial scales. For example, see Figure 5 compared to Figure 6 where pollution dispersion is better defined from the road centre line.

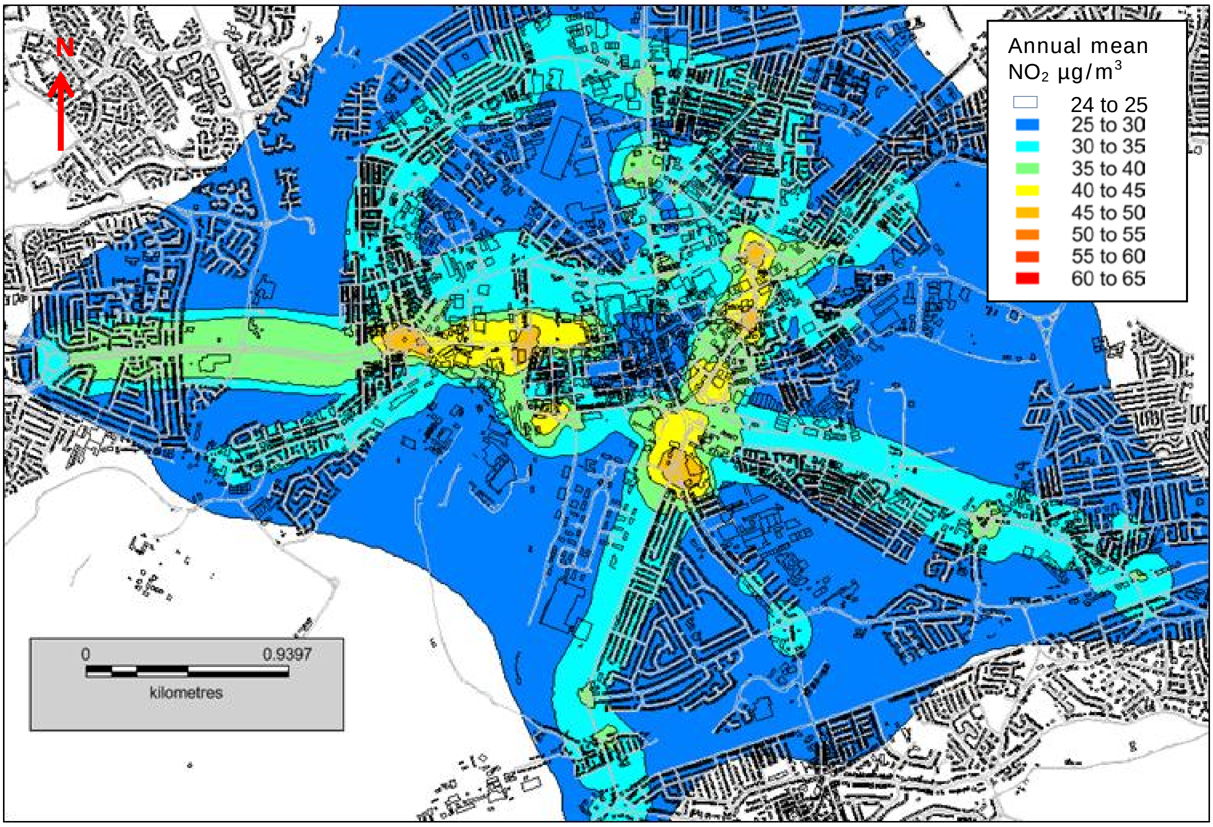


Figure 5: Baseline 2013 - Annual mean NO_2 concentrations using a gridded output

In all plots the annual mean objective for NO_2 (i.e. 40 µg/m^3) is delineated by the yellow contour. The baseline plot indicates that residential properties alongside Parker and Wilson Patton Streets are exceeding the NO_2 annual mean objective. Closer inspection of Figure 7 suggests other properties around Sankey roundabout may also be subject to exceedances. This would appear to concur with previous modelling work upon which the declaration of the AQMA was based. There is some justification to consider extending the boundary of the AQMA to include properties to the north east of Sankey Way roundabout but this would require further consideration of the results in terms of modelling uncertainty. For this work the modelling uncertainty is approximately +-5 µg/m^3 (see model validation in Appendix J). Hence, a receptor with an annual mean NO_2 estimate of 45 µg/m^3 is likely to exceed the objective; likewise an estimate of 35 µg/m^3 is likely to comply.

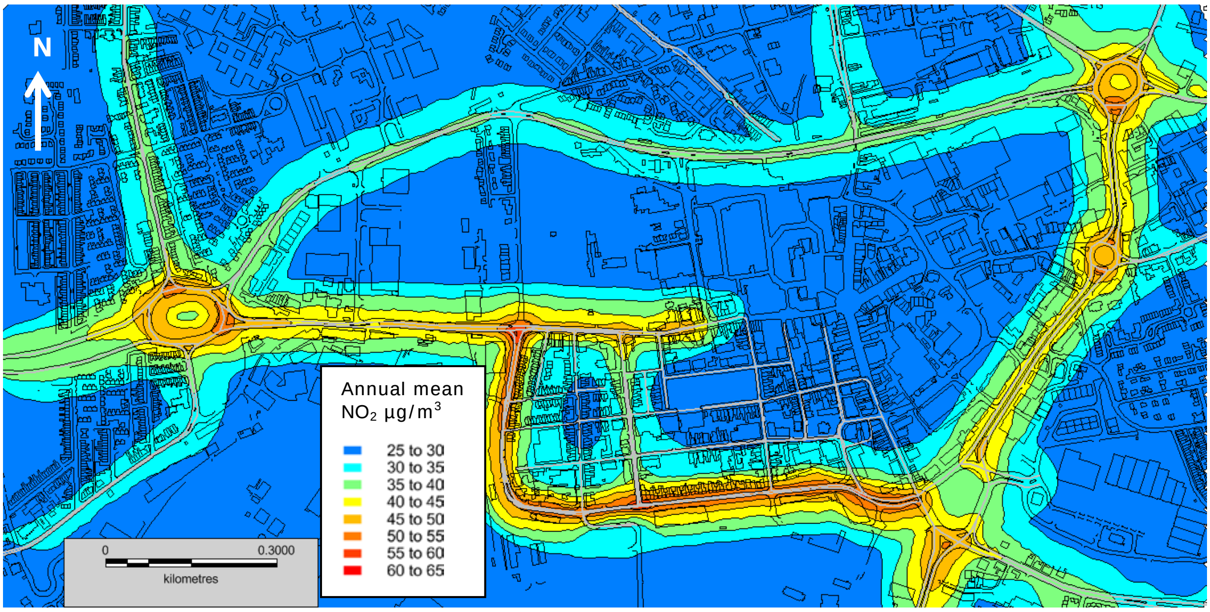


Figure 6: Baseline 2013 - Annual mean NO_2 concentrations using a gridded output (inner ring road)

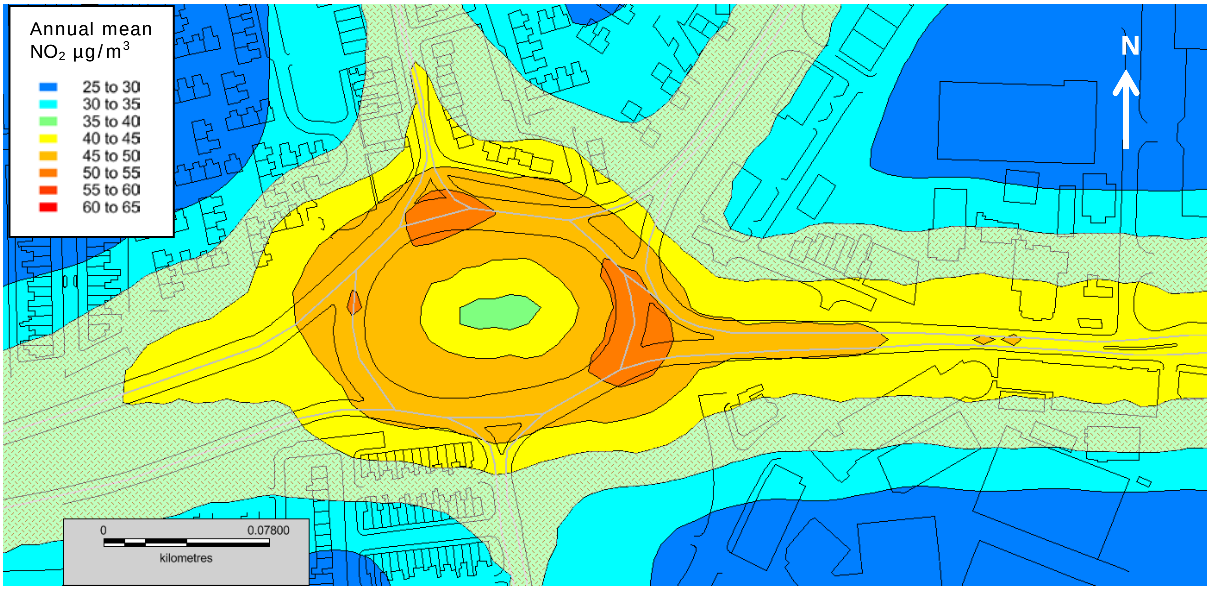


Figure 7: Baseline 2013 - Annual mean NO2 concentrations using a gridded output (Sankey Way Roundabout)

Figure 8 shows in more detail the baseline annual mean concentration of NO_2 for the Parker Street AQMA. The modelling suggests that the exceedance limit (yellow contour) extends onto properties to the east of Parker Street and to the north and Wilson Patton Street. The roadside real-time automatic monitoring site (CM2) would appear to be within the banding of 45 to 50 µg/m^3. The monitored annual mean concentration in 2013 was 49.4 µg/m^3. Hence, estimates appear to be agreeable with the current declaration of the AQMA boundary. As a caveat, contour plots are very much an artefact of the interpolation method applied across a defined grid of points. In other words different interpolation and grid spacing can produce different results.

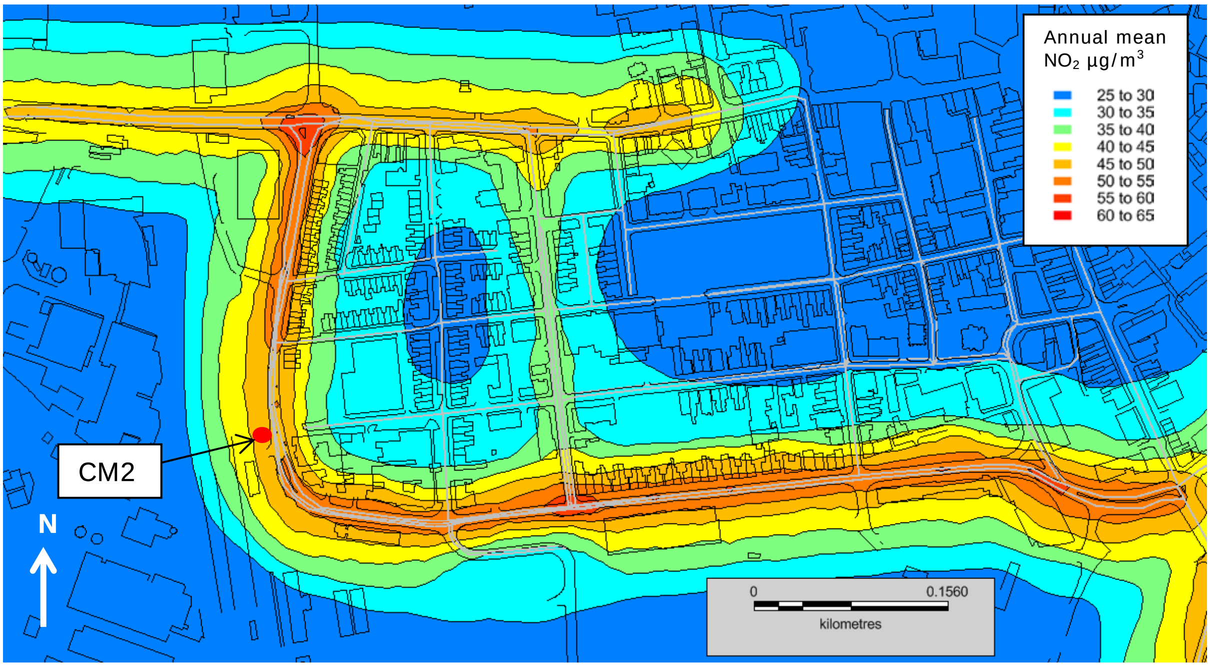


Figure 8: Baseline 2013 - Annual mean NO2 concentrations using a gridded output (Parker Street area)

Figure 9 shows the estimated baseline PM_{10} annual mean concentration. With a background level of 17.5 µg/m³ the maximum value estimated was 19 µg/m³ and hence well below the objective of 40 µg/m³.

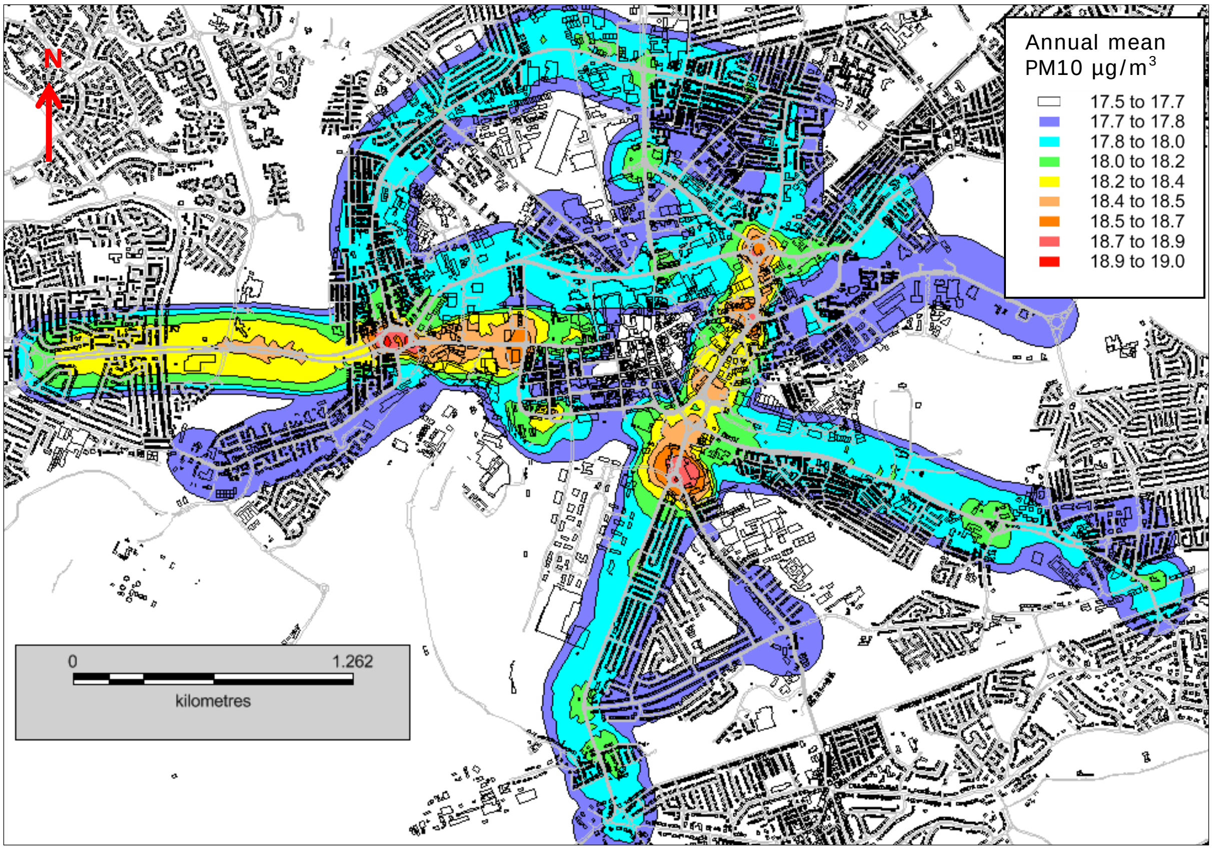


Figure 9: Baseline 2013 - Annual mean PM_{10} concentrations using a gridded output

In terms of receptor modelling, in total, 52 out of 2,898 modelled relevant receptors modelled exceeded the NO_2 annual mean objective in the baseline (see Appendix J). These receptors were located in the Parker/Wilson Patten Street vicinity. There were some borderline cases (18) on Liverpool Road, Chester Road, Sankey Way (and roundabout) and Lythgoes Lane. For the inner road network the study estimates NO_2 annual mean concentrations to be below 34µg/m^3. The concentrations are elevated slightly towards the west, influenced by the high emissions on Parker Street.

4.6.2 HGV re-routing around the town centre

4.6.2.1 Introduction to option

This test involved estimating the impact on emissions by unilaterally applying either a clockwise or anticlockwise HGV (>3.5 tonnes gross vehicle weight) rerouting strategy around the ring road system. This would essentially make Parker Street/Wilson Patten Street one-way for HGVs – also Mersey Street/Brick St and Midland Way one-way. This detailed assessment included the entire Study Zone A.

The redistribution of vehicle flows were derived based on existing ANPR data. To estimate emissiond as accurately as possible all road links included in the study area have a 24 hour speed and flow profile attached. Each link is typified by the number of cars, LGVs and HGVs per day and every vehicle type is subject to a very detailed fleet breakdown (i.e. the Warrington Fleet Model).

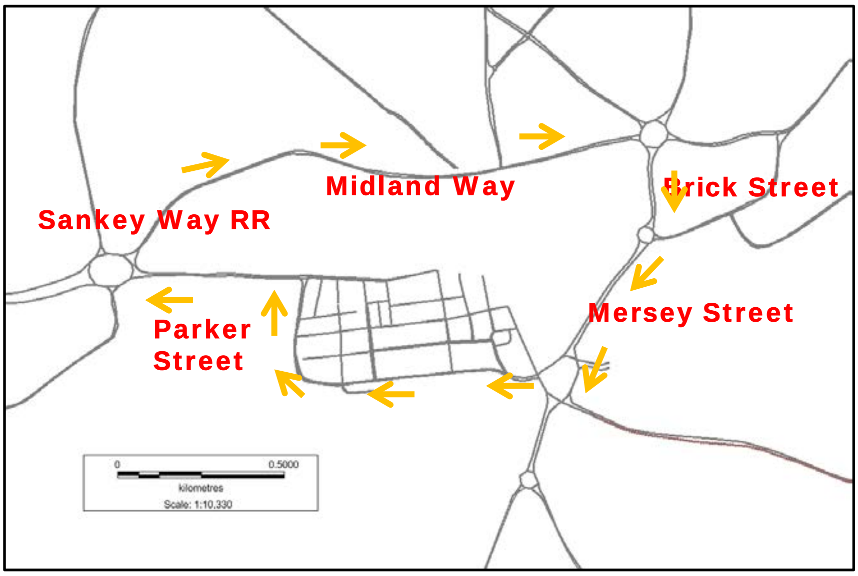


Figure 10: Spatial representation of the HGV re-route clockwise

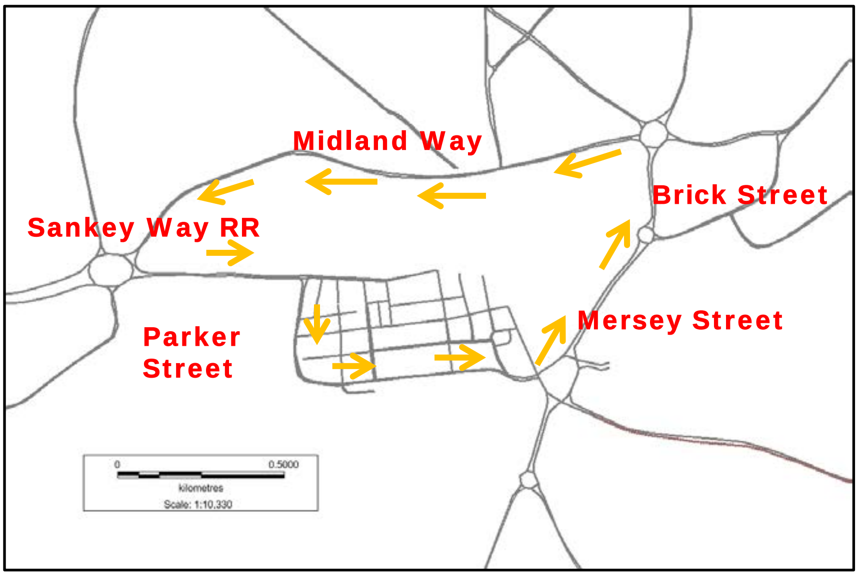


Figure 11: Spatial representation of the HGV re-route anti-clockwise

4.6.2.2 Route changes

For this test, rigid and articulated HGV flows (cars, LGVs and buses are not affected) were redistributed according to the following assumptions;

In the **clockwise direction**

- One way clockwise direction for HGVs. From Bridgefoot to Wilson Patten Street, Parker Street, Sankey Island, Midland Way, Cockhedge roundabout, Brick Street to Mersey Street back to Bridgefoot (see Figure 11)
- HGVs travelling on the Cockhedge Green roundabout; 48% travel southbound on Brick Street (this also accounts for vehicles travelling westbound on the A57 approaching the Cockhedge Green roundabout).
- HGVs travelling on the Cockhedge Green roundabout; 52% travel in other directions
- HGVs travelling southbound on Winwick Road continue in the southbound direction

In the **anticlockwise** direction

- One way anti-clockwise direction for HGVs. From Bridgefoot to Mersey Street, Brick Street to Cockhedge roundabout to Midland Way to Sankey Green Island to Parker Street to Wilson Patten Street (see Figure 12)
- HGVS intending to travel northbound on Froghall Lane are assumed to travel northbound on the Bridgefoot roundabout.
- 30% of HGVs travelling northbound exit east on the Bridgefoot roundabout to access Vernon Street on the Wharf Street development.
- 70% of HGVs travelling northbound on the Bridgefoot roundabout continue northbound on Mersey Street.

Schematic representations of the changes made to traffic flows are shown in Figure 12 and Figure 13 for the clockwise (CW) and anti-clockwise (ACW) scenarios. The full set of traffic data applied in the tests are provided in Appendix J.

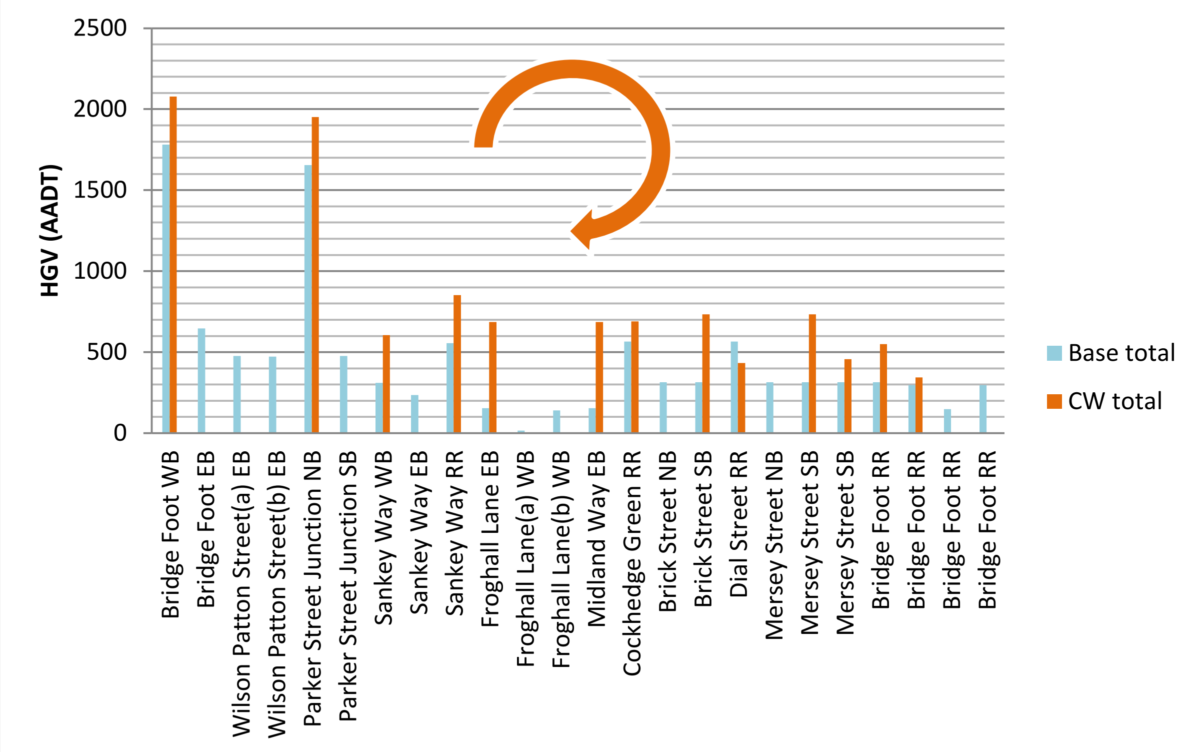


Figure 12: The redistribution of goods vehicle traffic travelling in the clockwise direction compared to the baseline.

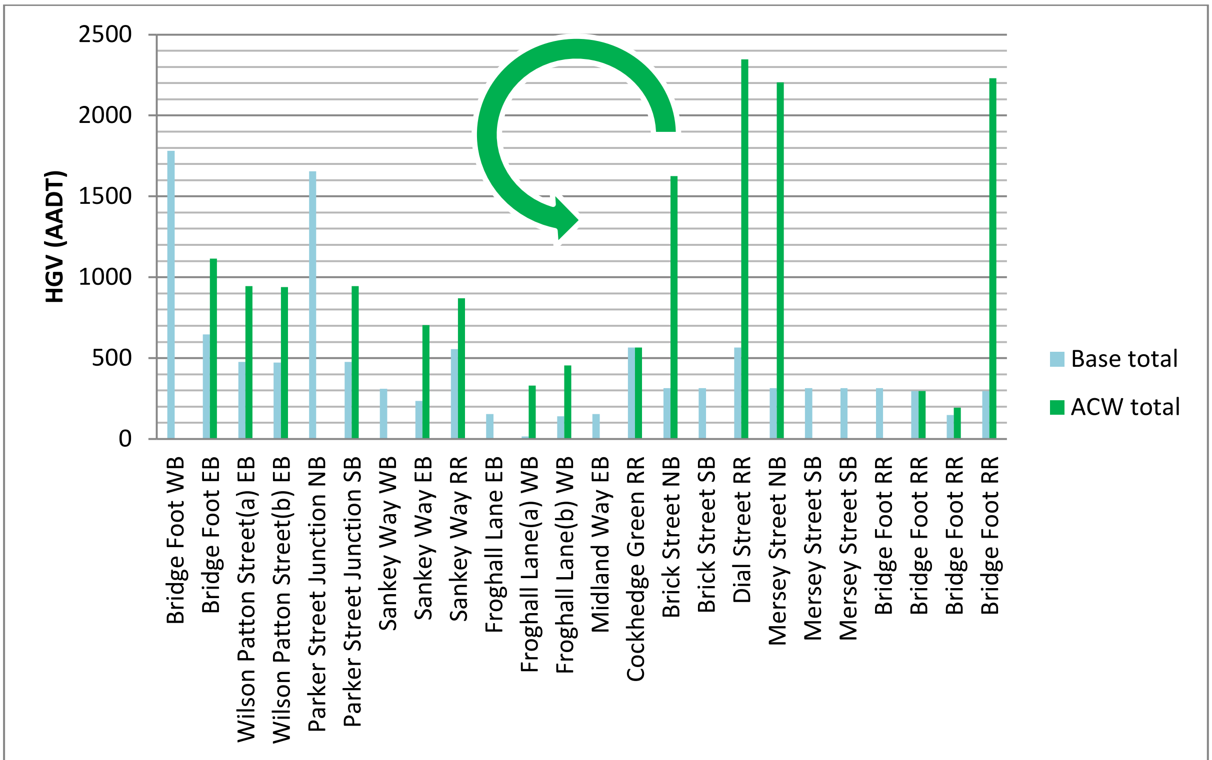


Figure 13: The redistribution of goods vehicle traffic travelling in the anticlockwise direction compared to the baseline.

4.6.2.3 Emissions

Emissions were estimated applying the same methodology as for the one way gyratory system. Annualised NOx, PM_{10} and CO_2 emissions are shown in Table 15 to Table 17. Note that light duty vehicles are unaffected by the measure and as such emissions remain the same as per the baseline. The redistribution of the goods vehicle traffic has caused NOx and PM_{10} emissions to increase from the base in the clockwise direction and decrease slightly in the anticlockwise direction. This is owing to an increase in the kilometres driven by goods vehicles that now have to alter preferred route choices in order to reach desired destinations about the town centre. Essentially in the clockwise direction all traffic intending to travel northbound from Bridgefoot roundabout onto Mersey Street, or wishing to gain access to the Wharf Street area need to travel around the whole town centre. The impact of the traffic circulating in the anti-clockwise direction is relatively marginal compared to the baseline. This is possibly because traffic intending to the travel northbound from the Bridgefoot roundabout are unimpeded as are the traffic wishing to travel from Sankey way to the Bridgefoot roundabout via Parker Street.

Table 15: Annual NOx emissions: Freight re-route strategy

	Sum of Light Duty Vehicles – cars and LGVs (kg/yr)	Sum of Heavy Duty Vehicles – HGVs and buses (kg/yr)	Total (kg/yr)	LDV	HDV
Baseline	115,670	62,397	178,067	65%	35%
Clockwise	115,670	65,438	181,108		
Anti-clockwise	115,670	61,937	177,607		

Table 16: Annual PM_{10} emissions: Freight re-route strategy

	Sum of Light Duty Vehicles – cars and LGVs (kg/yr)	Sum of Heavy Duty Vehicles – HGVs and buses (kg/yr)	Total (kg/yr)	LDV	HDV
Baseline	3,254	760	4,014	80%	20%
Clockwise	3,254	795	4,040		
Anti-clockwise	3,254	752	3,997		

Table 17: Annual CO_2 emissions: Freight re-route strategy

	Sum of Light Duty Vehicles – cars and LGVs (kg/yr)	Sum of Heavy Duty Vehicles – HGVs and buses (kg/yr)	Total (kg/yr)	LDV	HDV
Baseline	77,887,130	8,824,638	86,711,768	90%	10%
Clockwise	77,887,130	9,275,252	87,162,382		
Anti-clockwise	77,887,130	8,880,080	86,767,210		

4.6.2.4 Air quality

Both the clockwise and anti-clockwise HGV re-routing options were modelled for the impact on air quality at receptors. The resultant statistics are shown in Table 18. The values in brackets represent the number of receptors exceeding the relevant UK AQ objective standards. In the clockwise direction, minimum and maximum is very similar to the baseline. The anti-clockwise direction appears to substantially reduce the maximum concentration with only two exceedances within the study area.

Table 18: Goods vehicle re-route option appraisal statistics

Statistic	Base case	CW	ACW
Max annual mean NO_2 (µg/m^3)	53.3 (52)	53.9 (51)	41.6 (2)
Max annual mean PM10 (µg/m^3)	18.7 (0)	18.7 (0)	18.3 (0)
Max change NO_2 (µg/m^3)	na	+ 1.8 - 1.0	+4.8 -11.7
Max change PM10 (µg/m^3)	na	+0.03 -0.1	+0.1 -0.4
Population weighted net change in NO_2 (µg/m^3)	na	908.7	643.4
Population weighted net change in PM10 (µg/m^3)	na	-30.2	-37.3

4.6.2.5 Discussion

Anti-clockwise routing provided the greatest variance of maximum change. In terms of human exposure the net weighted results showed that the population in the study area would benefit in terms of PM_{10} compared to the baseline situation but not it would appear in terms of NO_2. In terms of NO_2 this situation is explained further in Figure 14 to Figure 19. Figure 14 and Figure 17 show the changes expected owing to each scenario at relevant receptors and monitoring sites whereas the other figures show the absolute concentration using contour maps.

In the **clockwise direction** the following observations are noted;

- The reduction in annual mean NO_2 concentrations on Parker and Wilson Patton Street are within 2 µg/m^3.
- The Parker Street monitoring site is showing very slight adverse impact.
- Owing to dispersion effects there are some marginal gains at properties on White Street, Thynne Street and Arpley Street.
- Very minor adverse effects are observed in the vicinity of Manley Gardens (off Sankey Green Island) in particular owing to goods traffic being redirected onto the A57 from the Sankey Way roundabout.
- Very minor adverse impacts are observed at many properties across the receptor map and in particular outside of the ring road.

In the **anticlockwise** direction;

- The reduction in annual mean NO_2 concentration on Parker and Wilson Patton Street could be as high as 8 µg/m^3.
- The estimated annual mean NO_2 concentration for the monitoring site CM2 was 41.6 µg/m^3.
- Redirecting traffic north on Mersey Street has caused adverse effects on Hall Napier and Smith Streets as well as at properties close to the road. Some of these were within 2-3 µg/m^3 of the objective.
- Similar to the clockwise direction there were very minor adverse impacts at many properties across the receptor map outside of the ring road.

From a purely visual stand point the contour maps show a slightly conflicting picture to the conclusions drawn above. In the clockwise direction the NO_2 air quality receptor and contour mapping tell a similar story (i.e. small reductions at receptors on Parker and Wilson Patton Street). However by examining the contour plot in Figure 19 (anti-clockwise direction) the number of receptors within the 40 µg/m^3 to 45 µg/m^3 banding appear to be greater than 2 (see Table 18). This is why the interpretation of contour and receptor mapping needs close attention. It's reasonable to suggest that owing to the modelling uncertainty of +/- 5 µg/m^3 relevant receptors which are in the green contour but close to the light blue are likely to comply with the annual mean. Thus receptors in the in the yellow but very close to the orange are likely to exceed.

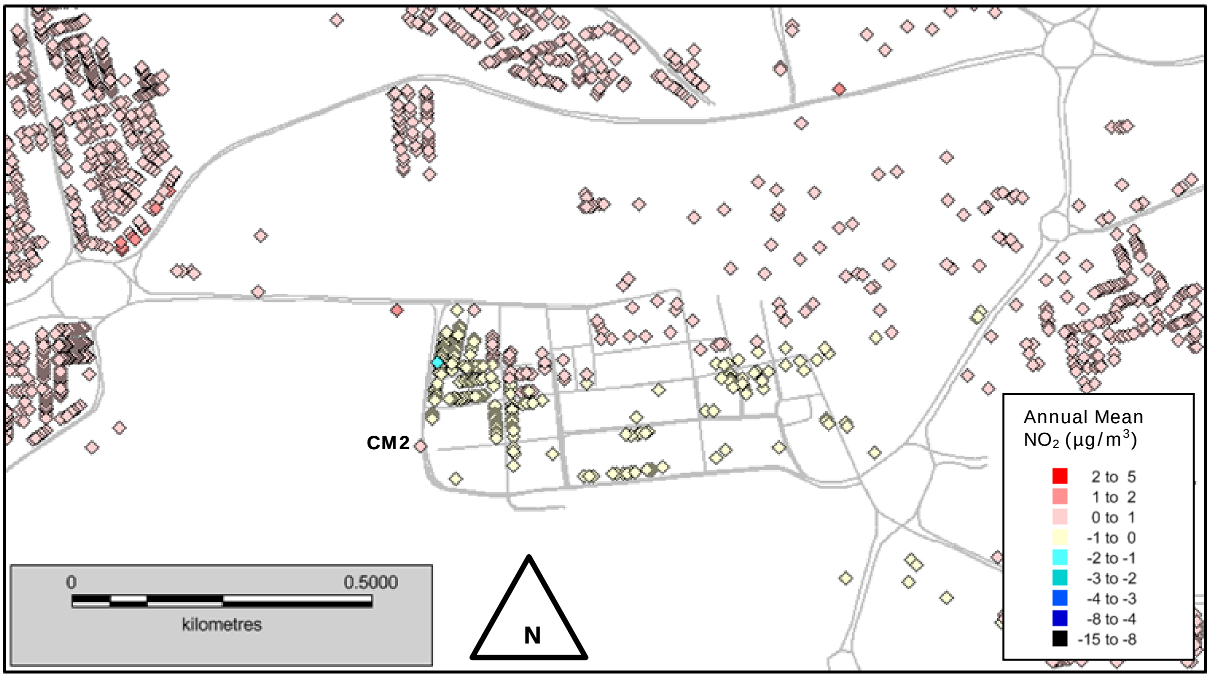


Figure 14: Change in annual mean NO_2 concentrations with heavy goods vehicle rerouting in the **clockwise** direction compared to the baseline

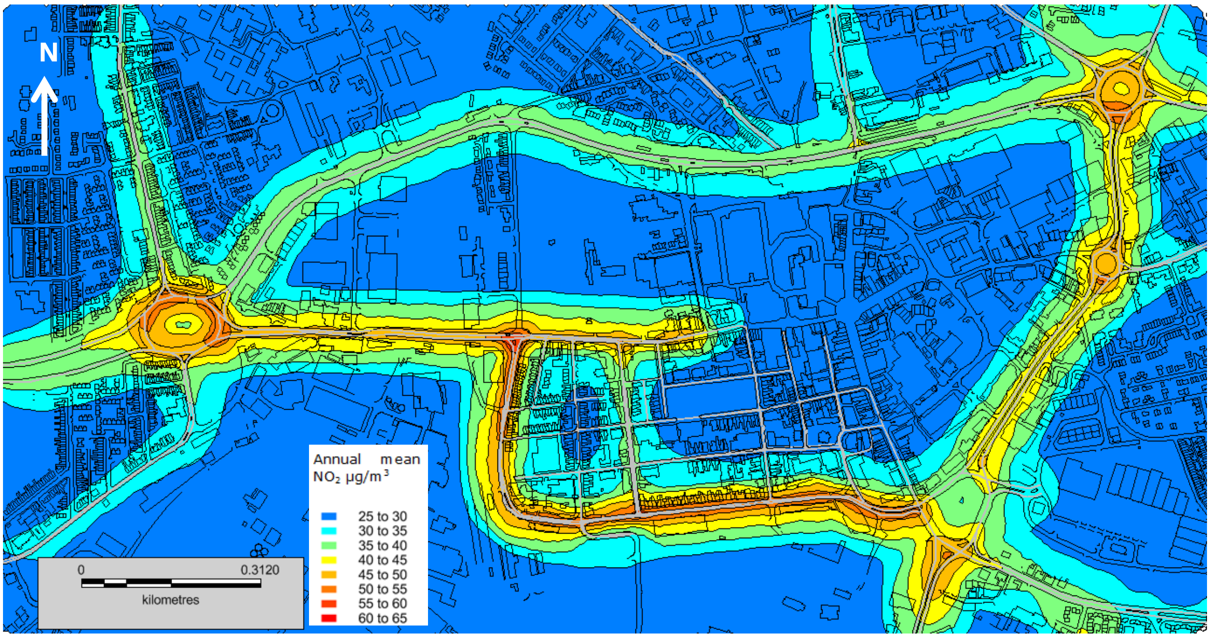


Figure 15: Annual mean NO_2 concentration 2013 with heavy goods vehicle rerouting in the **clockwise** direction

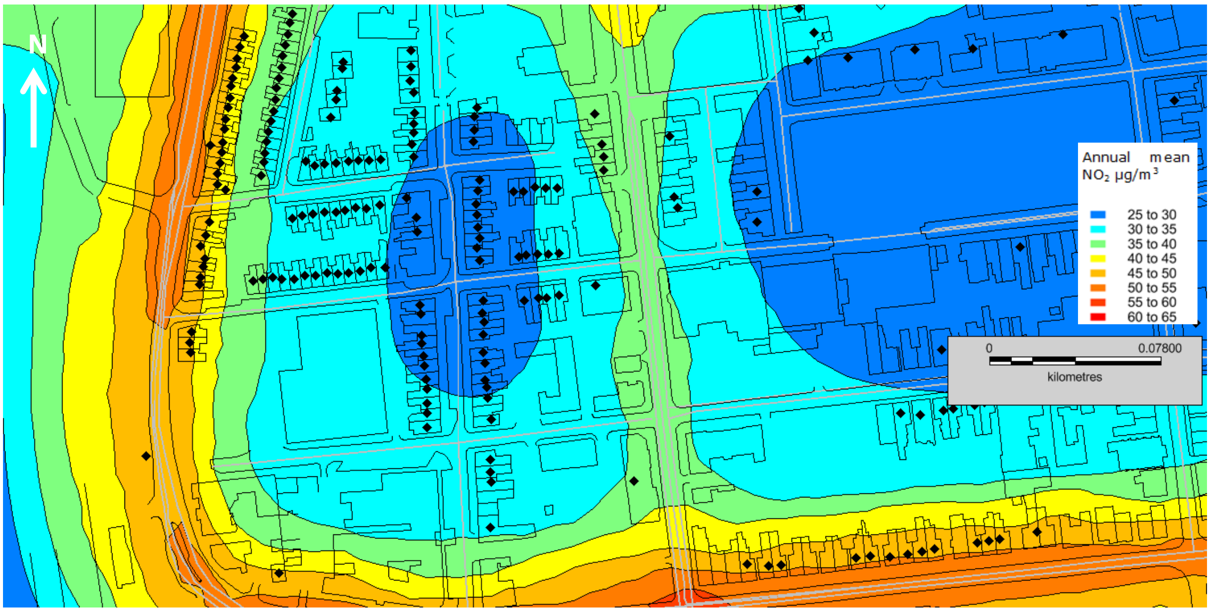


Figure 16. Annual mean NO_2 concentration 2013 with heavy goods vehicle rerouting in the **clockwise** direction. Modelled receptors are also shown.

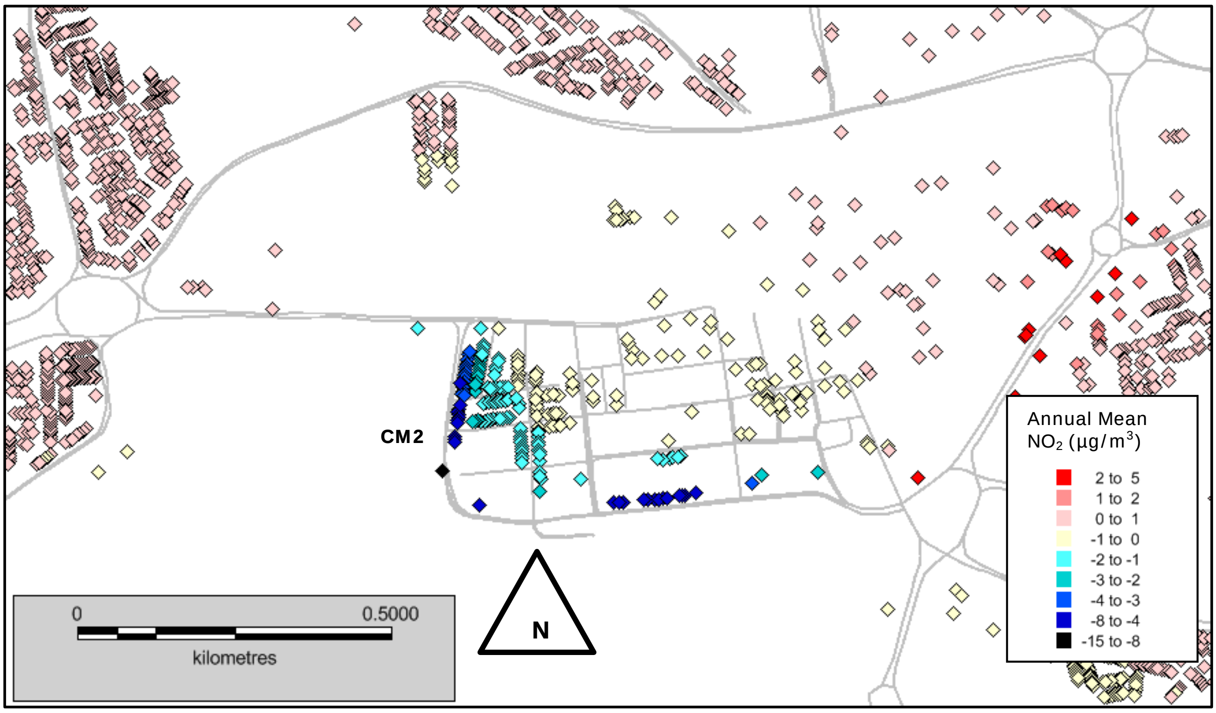


Figure 17: Change in annual mean NO_2 concentrations with heavy goods vehicle rerouting in the **anti-clockwise** direction compared to the baseline

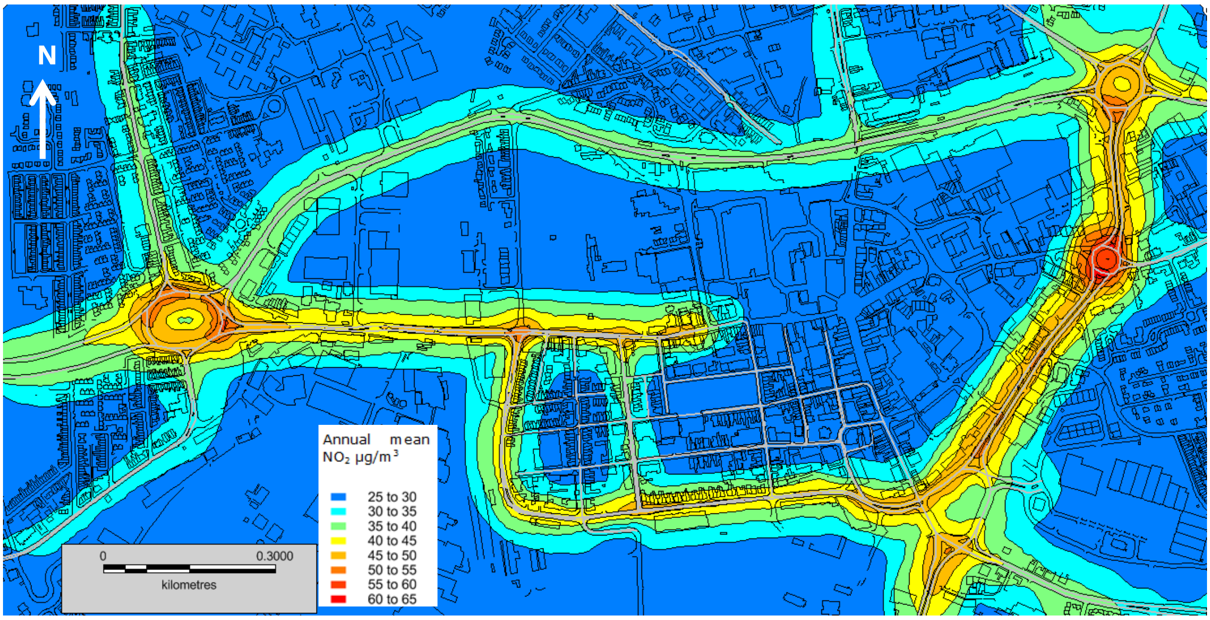


Figure 18: Annual mean NO_2 concentration 2013 with heavy goods vehicle rerouting in the **anti-clockwise** direction

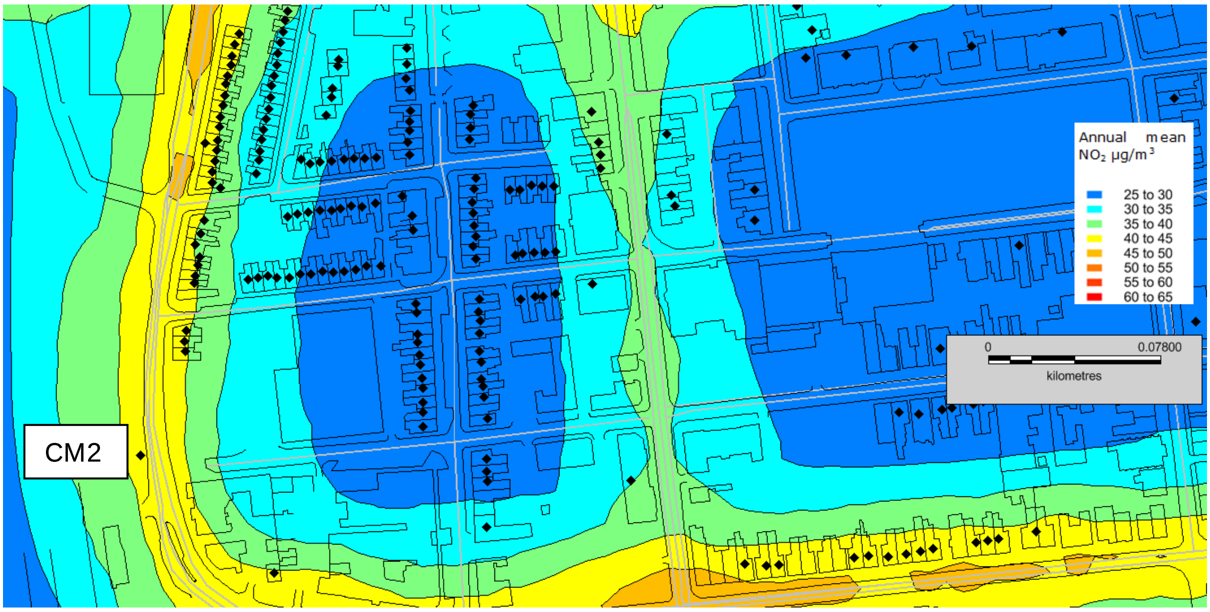


Figure 19. Annual mean NO_2 concentration 2013 with heavy goods vehicle rerouting in the **anti-clockwise** direction. Modelled receptors are also shown.

4.6.3 Parker Street town centre one way system

4.6.3.1 Introduction

The following four traffic management options were considered in terms of re-routing around the town centre;

Option A

- One way southbound at southern end of Bold Street
- One way southbound on Barbauld Street from Suez Street to Friars Gate
- Barbauld Street northbound only

Option B

- One way northbound at southern end of Bold Street
- One way northbound on Barbauld Street from St. Austin's Lane to Friars Gate
- Barbauld Street northbound only

Option C

- One way eastbound on Museum Street
- One way westbound on Palmyra Square South
- Bus lane eastbound on St. Austin's Lane
- Two way movement on Academy Way
- Two way on Barbauld Street

Option D

- One way westbound on Museum Street
- One way eastbound on Palmyra Square South
- One way westbound on St. Austin's Lane
- Two way on Barbauld Street

It is worth noting that the study was informed by WBC that Option C would be the preferred option if plans were to be realised.

The ANPR survey did not include the additional roads within the ring road (red links shown in Figure 20) which were required for these tests. Therefore additional traffic data were provided to the study team by WBC Highways Department. These values were extracted from the most recent strategic traffic model. The flows were provided as peak hour which were then factored to daily values using existing ATC data. Vehicle categories included cars, HGVs and buses only. Vehicle speed was assumed to be the average of the traffic model peak periods. Hence, if anything the average speed may be on the low side with respect to the daily traffic flow. However, the speeds in the town centre are somewhat restricted and not likely to be that much higher, in real terms, than at peak periods. Note that speed and flow are still subject to diurnal variation in terms of calculating emission in the TEEM. For all additional inner road links (i.e. 70 links) generic Warrington based speed and flow profiles were applied. In addition, all links were subject to the generic Warrington fleet composition. All traffic activity data applied in the analysis is shown in Appendix L.

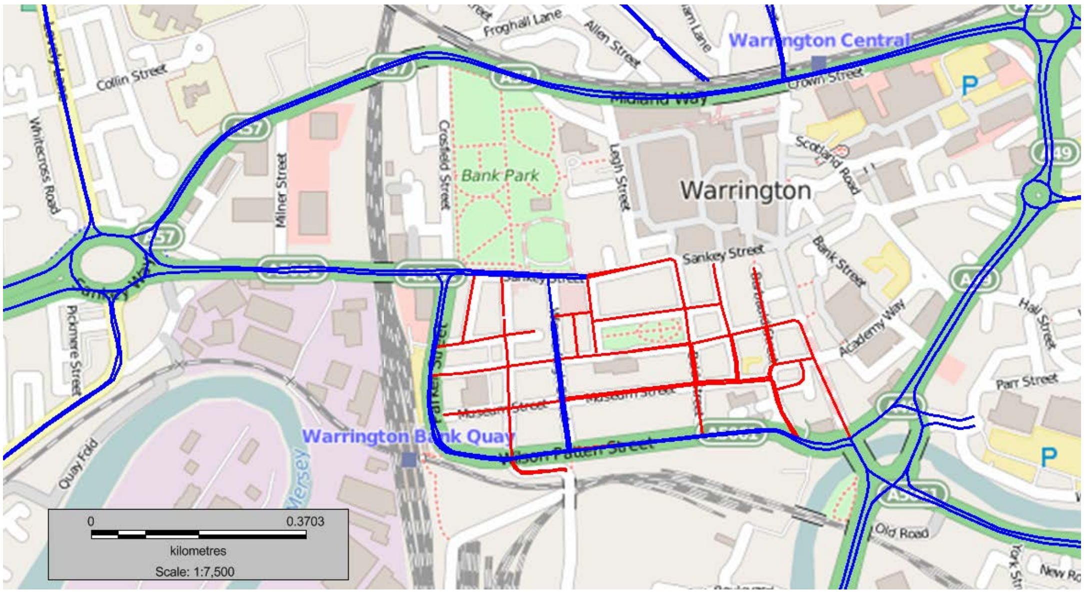


Figure 20: The additional inner road network for option testing shown in red

4.6.3.2 Emissions

In the first instance the annualised NOx, PM_{10} and CO_2 emissions were estimated for the four options to compare against the 2013 baseline. The results are shown in Table 19 to Table 21. The emissions from all options are lower than the baseline, with Option B being the lowest. The percentage split across all options remains similar to the baseline.

Table 19: Annual NO_X emissions (181 links)

	Sum of LDV (cars and LGVs) in kg/yr	**Sum of HDV (HGVs and buses), kg/yr**	**Total (kg/yr)**	**LDV**	**HDV**
Baseline	115,670	62,397	178,067	65%	35%
Option A	111,444	56,761	168,205		
Option B	110,769	55,808	166,577		
Option C	111,840	58,012	169,852		
Option D	111,798	56,983	168,780		

Table 20: Annual PM_{10} emissions (181 links)

	Sum of LDV (cars and LGVs), kg/yr)	Sum of HDV (HGVs and buses), kg/yr	Total (kg/yr)	LDV	HDV
Baseline	3,254	760	4,014	81%	19%
Option A	3,144	690	3,834		
Option B	3,127	678	3,805		
Option C	3,155	705	3,860		
Option D	3,153	693	3,847		

Table 21: Annual CO_2 emissions (181 links)

	Sum of LDV (cars and LGVs), kg/yr)	Sum of HDV (HGVs and buses), kg/yr	Total (kg/yr)	LDV	HDV
Baseline	77,887,130	8,824,638	86,711,767	90%	10%
Option A	74,959,229	8,025,324	82,984,554		
Option B	74,494,848	7,890,397	82,385,245		
Option C	75,231,056	8,182,308	83,413,364		
Option D	75,202,129	8,053,987	83,256,116		

4.6.3.3 Air quality

Receptor modelling statistics for all four option variants and the baseline are shown in Table 22. The value in brackets represents the number of relevant receptors exceeding the objective.

Table 22: Summary of relevant receptor modelling statistics for one way system

Statistic	Base case	Opt. A	Opt. B	Opt. C	Opt. D
Max annual mean NO_2 ($\mu g/m^3$) with number of exceedences in brackets.	53.3(52)	40.5 (1)	39.0 (0)	43.7 (1)	41.9 (1)
Max annual mean PM10 ($\mu g/m^3$)	18.7(0)	18.2 (0)	18.2 (0)	18.3 (0)	18.2 (0)
Max change NO_2 ($\mu g/m^3$)	na	+0.2 to -2.9	+0.4 to -14.6	+0.7 to -9.6	+0.3 to -11.5
Max change PM_{10} ($\mu g/m^3$)	na	0.0 to -0.6	0.0 to -0.7	0.0 to -0.5	0.0 to -0.5
Population weighted net change in NO_2 ($\mu g/m^3$)*	na	-3724	-4049	-3253	-3502
Population weighted net change in PM_{10} ($\mu g/m^3$)*	na	-161	-173	-143	-151

*It was assumed that the average household size for Warrington was 2.3[3].

[3] 2011 Census results for housing profiles in Warrington

4.6.3.4 Discussion

The result show that all options led to an improvement in modelled pollutant concentrations over and above the baseline at the relevant receptors. Discussions on each option compared to the baseline are given below:

Option A

- This option resulted in a reduction in the number of sites exceeding the objective. The only site above the objective was the Parker Street monitoring site (CM2). It is noted that this site is not a relevant location in terms of AQMA declaration but is indicative of roadside exposure.
- The change in the maximum annual mean PM_{10} is negligible, but declines.

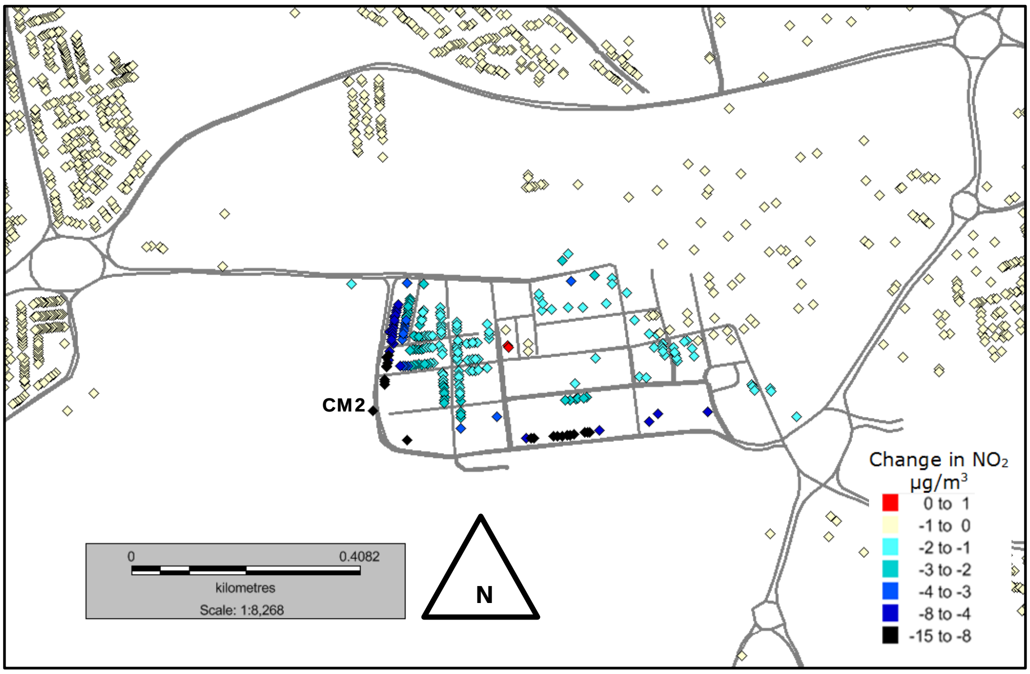


Figure 21: Change in annual mean NO_2 concentrations with Option A compared to baseline

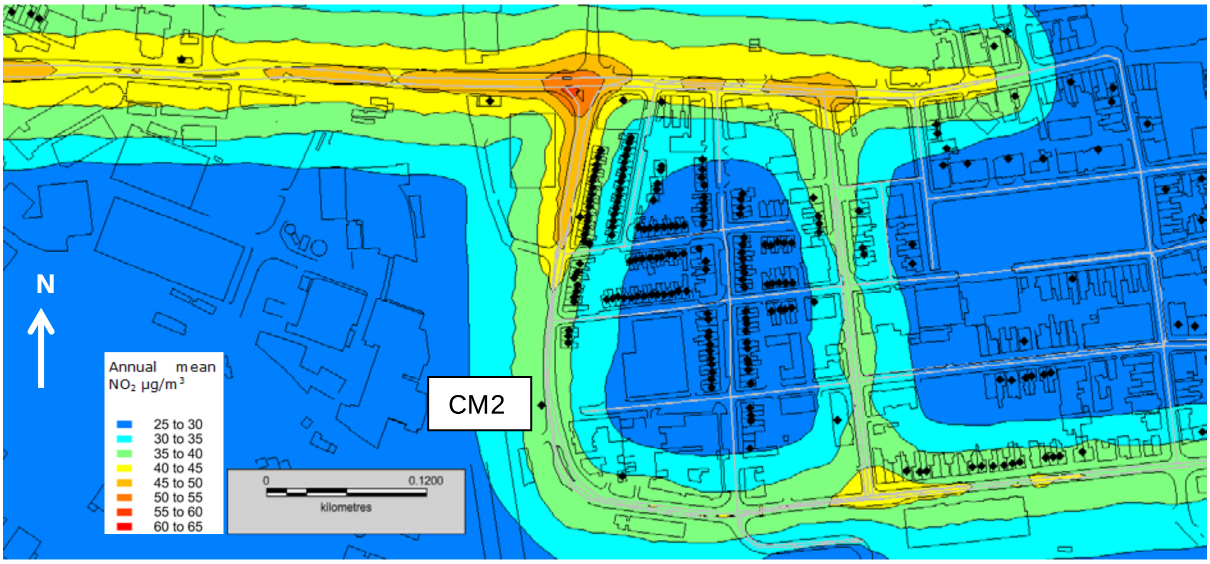


Figure 22: Annual mean NO_2 concentration 2013 for Option A

- The reduction indicated by the receptor modelling is contrasted with the contour profile shown in Figure 22. The 40 µg/m³ contour touches the facades of properties to east of Parker Street. Using address point data the geographic location of receptors are positioned in the centre of the polygon representing the property border extents. It could be argued that this location is more relevant for exposure than placing a receptor on the façade although the LAQM guidance applies to the nearest façade. Irrespective of the yellow contour these properties and others along Parker and Wilson Patton Street reside within the green 35-40 µg/m³. Accounting for modelling uncertainty, properties which are closer to the light blue contour are likely to comply.

Option B

- The annual average daily traffic flow (AADT) on Wilston Patten Street/Parker Street showed the highest reduction for this option compared to the baseline (27,676 vehicles per day for the baseline compared to 18,215 for Option B).
- This option has the greatest maximum reduction in NO_2 and PM_{10} concentrations. All modelled receptors were predicted to meet the annual mean NO_2 objective as the highest (maximum) annual mean NO_2 concentration modelled at the Parker Street monitoring site (CM2) was reduced from 53.3 to 39 µg/m³.
- The change in the maximum annual mean PM_{10} is negligible, but declines.
- This option produces the greatest variance in terms of performance, i.e. with some receptors increasing (by up to 0.4 µg/m³ and some declining by up to 14.6 µg/m³.
- This option would be the most effective when considering the net impact on the local population.

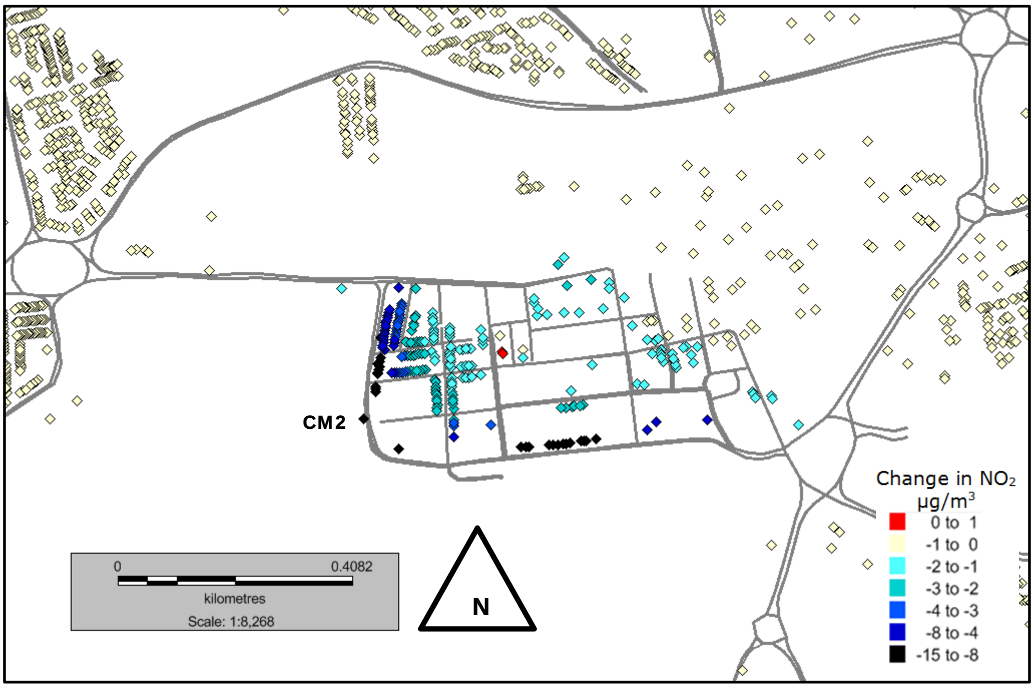


Figure 23: Change in annual mean NO_2 concentrations with Option B compared to baseline.

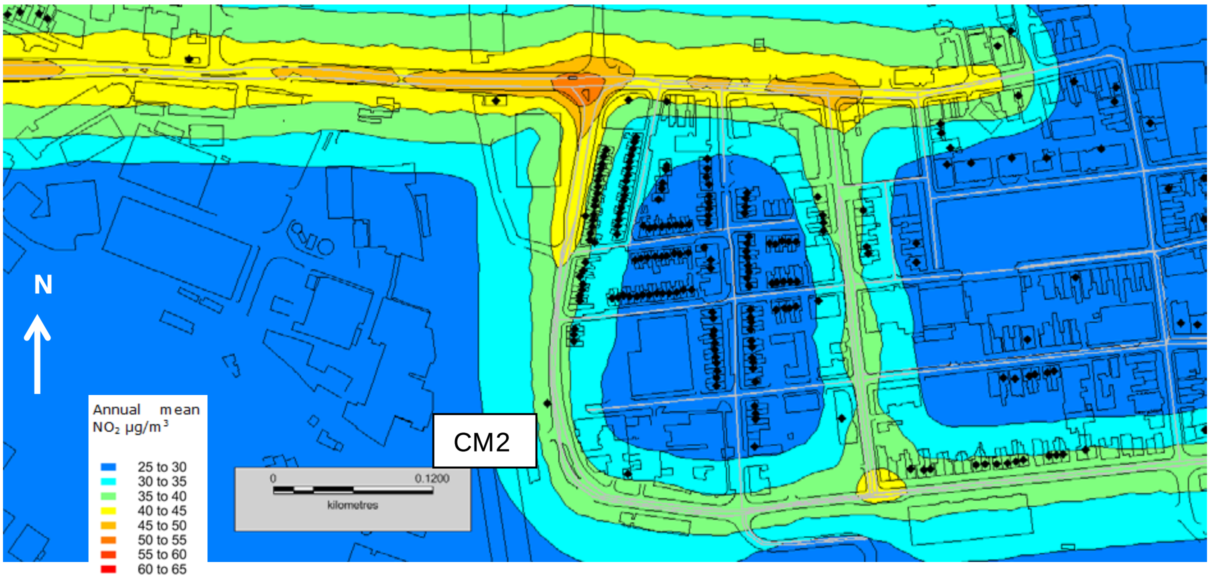


Figure 24: Annual mean NO_2 concentration 2013 for Option B

- Figure 24 shows that the NO_2 annual mean objective (yellow contour) has retreated towards the road centreline along Parker Street. The other exceedance is shown at the junction of Winmarleigh Street and Wilson Patton Street. It is thought that even with the modelling uncertainty it is very likely that relevant exposure can be managed below the objective. In other words, locations that are likely to exceed are not relevant in terms of air quality management. Option B would be the most favoured in terms of working to revoke the Parker Street AQMA.

Option C

- This option had the lowest impact on traffic flows (21,950 vehicles per day) and therefore the lowest impact on pollutant concentrations. The maximum reduction in NO_2 concentrations of 9.6 $\mu g/m^3$ was predicted at Parker Street monitoring site. This was the only modelled site that was predicted to exceed.
- The change in the maximum annual mean PM_{10} is negligible, but declines.
- This option would be the least effective when considering the net impact on the local population.

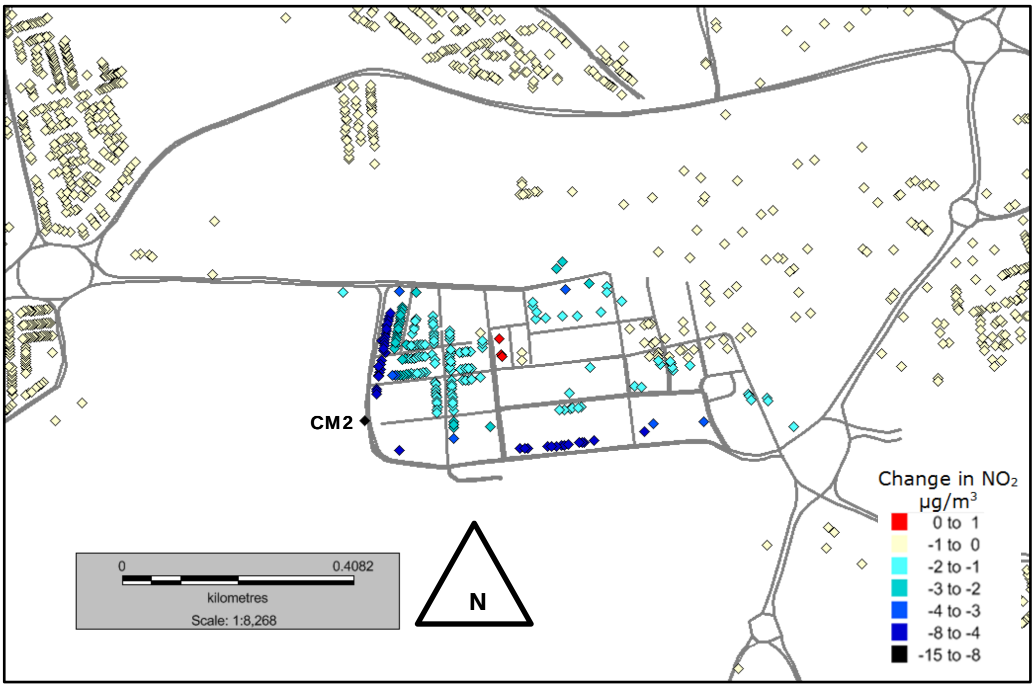


Figure 25: Change in annual mean NO_2 concentrations with Option C compared to baseline

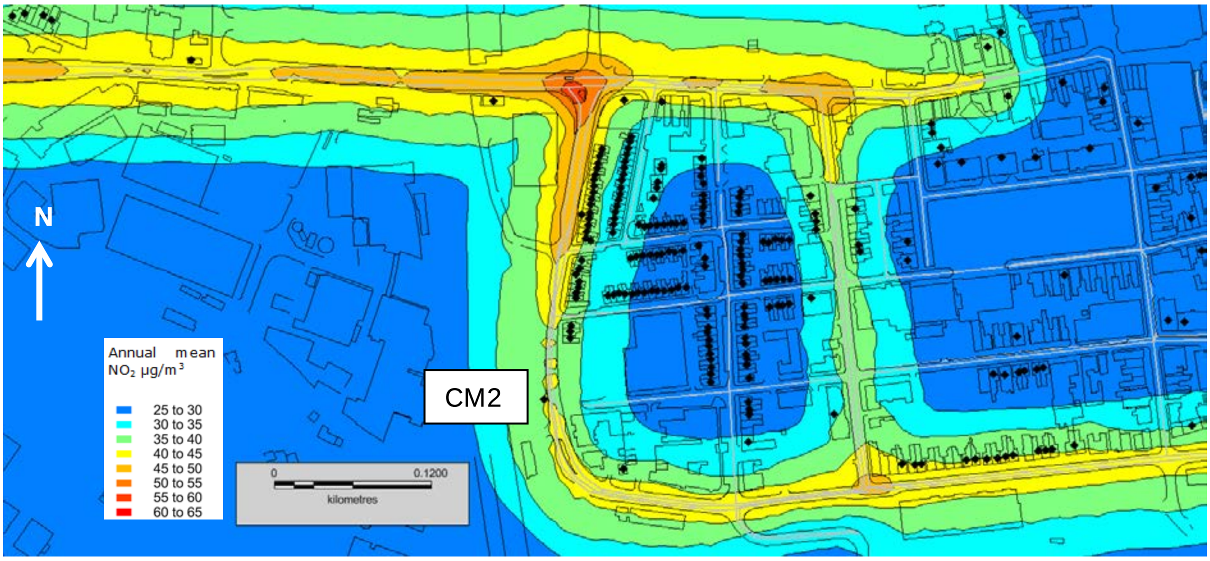


Figure 26: Annual mean NO2 concentration 2013 for Option C

- Figure 26 indicates that Option C would cause an exceedance at relevant locations to the east of Parker Street and the north of Wilson Patton Street. As discussed above for Option A receptor and contour results provide conflicting messages. On the evidence provided by the contour mapping taking into account the uncertainty of the modelling, Option C would appear to be the least effective measure of the four.

Option D

- This option resulted in a reduction in the number of sites exceeding the objective. The only site above the objective was the Parker Street monitoring site (CM2).
- The change in the maximum annual mean PM_{10} is negligible, but declines.

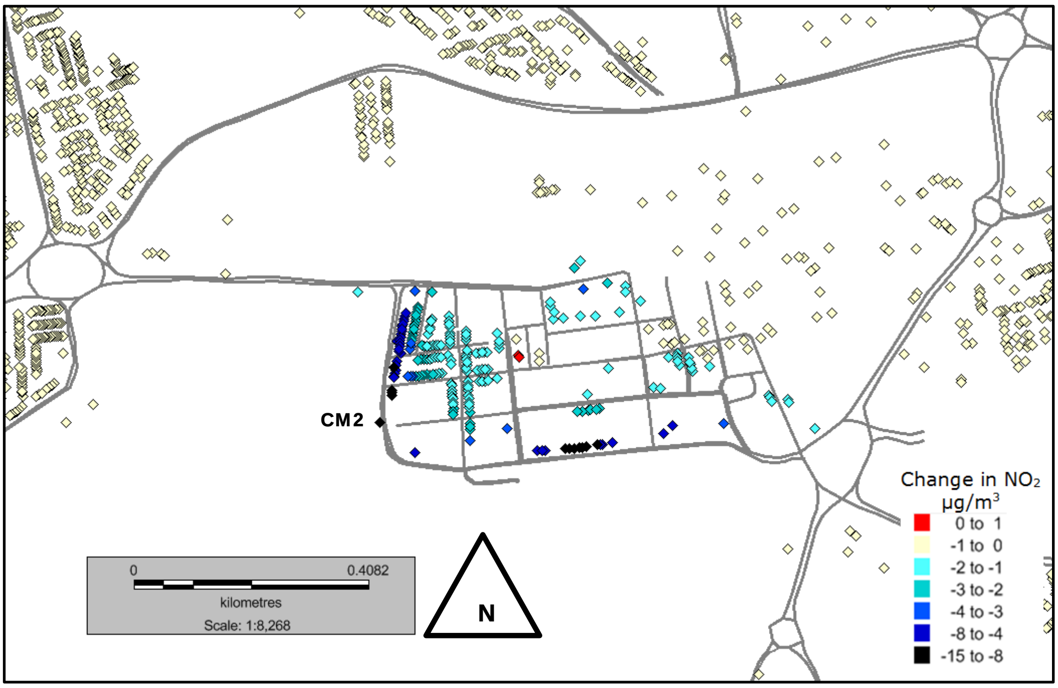


Figure 27: Change in annual mean NO_2 concentrations with Option D compared to baseline

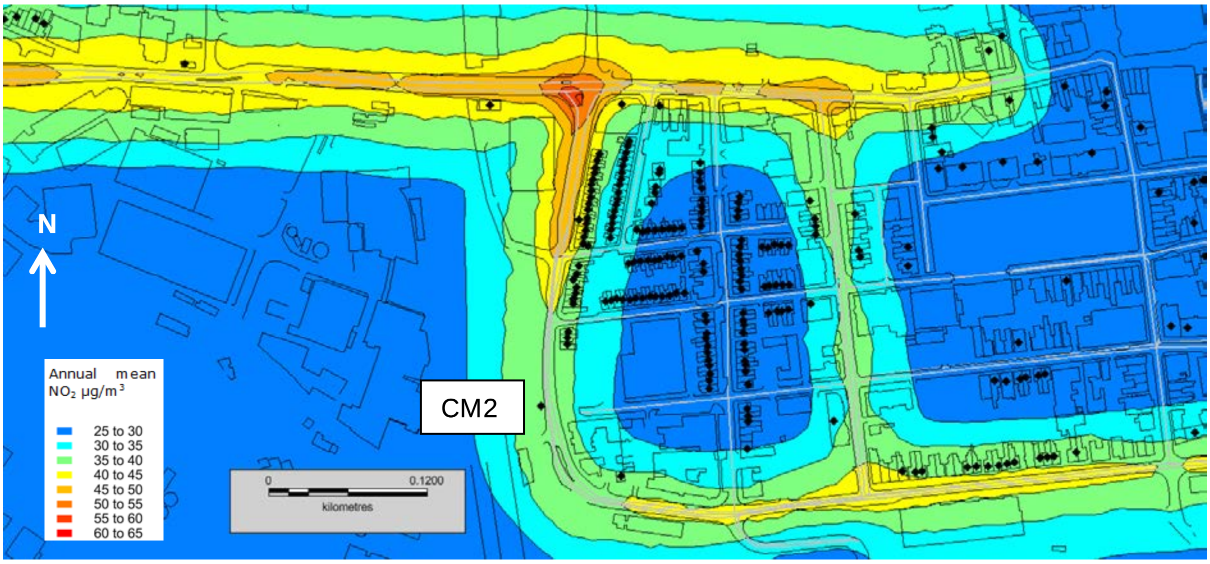


Figure 28: Annual mean NO_2 concentration 2013 for Option D

- Figure 28 suggest that Option D is perhaps the third least favourite of the four variants. Monitoring site CM2 does in fact exceed the NO_2 annual mean objective but the single point exceedance is not visibly representative by the colour mapping process.

4.7 Conclusions

The re-routing of goods vehicles about the town centre has a very mixed outcome. In the clockwise direction, the impact on the Parker Street AQMA is considered to be almost negligible. In this direction many properties around the ring road are very slightly adversely impacted. In the anti-clockwise direction, the improvements in air quality are more noticeable. The reductions estimated within the Parker Street AQMA would not be sufficient to remove the Parker Street AQMA status. It must also be acknowledged that modelling uncertainty would need to be considered and a judgement formed as to what extent relevant receptors would in fact benefit from this intervention. However, it is possible that additional measures could be introduced alongside the re-routing scheme to produce the desired outcome. For example, it may well be possible to tweak the scheme in terms of adjusting operating hours or apply restrictions to certain weight classes. A further sensitivity analysis would be required to test for the optimum strategy. It is worth noting that whilst restrictions can be developed, it is important to understand that hauliers may change the way they operate and hence emissions reductions may not be in line with those estimated. Again, modelling uncertainty and sensitivity analysis could be applied to account for these issues.

Both re-routing schemes do not appear to improve the NO_2 annual mean objective exceedences at the Sankey Way roundabout AQMA.

There are some anomalies with a reroute strategy such as effective access to the Wharf Street area. In the clockwise direction vehicles would have to traverse the entire ring road for vehicles approaching the town centre via Bridgefoot. This would need to be addressed with sensible traffic management.

Overall a rerouting measure directed at goods vehicles appears to modify air quality pollutants in the Parker Street AQMA. In accordance with the results of receptor modelling this needs to be weighed against the incremental adverse impact across the wider study area. Contour plots paint a slightly different picture but by accepting modelling uncertainties could be useful when developing the preferred option. Freight re-routing in the anti-clockwise direction appears to manage local and wider exposure better and so with a few adjustments may prove the more successful of the two measures.

With respect to the town centre one way gyratory (all four variants) the mapping exercise shows that there is a direct reduction in NO_2 concentrations on Parker Street owing to the reduction in the traffic. This reduces emissions not only on Parker Street but the effects are seen on the inner road network to the east as a result of the predominant wind direction being from the west. Across the wider network the impact is shown to be negligible. Another feature is the reduction in the concentration along the north side of Wilson Patten Street. The more significant characteristic perhaps is the slight increase in concentration at receptors on Winmarleigh Street. Further examination of the traffic data at the specific location where the increase has been recorded verifies that, as expected, this indeed would be the likely outcome. However, the absolute concentration is still well below the annual mean objective and when accounting modelling uncertainty of +/-5 $\mu g/m^3$ concentrations at these receptors are unlikely to exceed the objective.

One of the least expected outcomes is a reduction in the concentration at receptors to the north side of Wilson Patten Street. At this point in the road network, traffic flow is two-way. At the junction of Winmarleigh Street, westbound traffic proceeds onto Parker Street and then to the junction with Liverpool Road. The traffic adjacent to these receptors, travelling in the eastbound direction emanate from Winmarleigh Street (having travelled in the southbound direction). On this basis, the traffic level adjacent to these receptors might have been expected to be similar to that of the baseline.

However, the data from the traffic model showed that traffic flow reduced compared to the baseline for each option. This is perhaps a likely scenario as traffic may well find alternative routes owing to journey time penalties observed within the options in accordance with the origin destination matrix configured for the traffic model.

Overall, the results of this option showed that of the four variant options, Option C would have the lowest impact on traffic flows and the least benefits to air quality. Option B would be most effective in terms of air quality improvements and even with the modelling uncertainty, it is likely that relevant exposure can be managed to below the objective. This makes Option B be the most favoured measure to consider further in terms of work to revoke the Parker Street AQMA.

Acknowledgements

The work described in this report was carried out in Air Quality Team of the Transport Research Laboratory. The authors are grateful to Tim Barlow who carried out the technical review and auditing of this report.

Glossary of terms and abbreviations

AADT	Annual Average Daily Traffic
ADMS	Atmospheric Dispersion Modelling System
AQEG	Air Quality Expert Group
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emission Factor Toolkit
HDV	Heavy Duty Vehicle (includes buses and HGVs)
HGV	Heavy Goods Vehicle (over 7.5 tonnes)
GIS	Geographic Information System
LAQM	Local Air Quality Management
LDV	Light Duty Vehicle (includes cars and LGVs)
LGV	Light Goods Vehicle (between 3.5 tonnes and 7.5 tonnes)
LTP	Local Transport Plan
NAEI	National Atmospheric Emissions Inventory
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_X	Total Oxides of Nitrogen
O_3	Ozone
PHEM	Passenger car and Heavy-duty Emission Model
PM_{10}	Particulate matter less than 10 microns in diameter
PSV	Public Service Vehicle
RMSE	Root Mean Square Error
TEEM	Transport and Enhanced Emissions Model
TEA	Triethanolamine
TEMPRO	Trip End Model Presentation Program
TRL	Transport Research Laboratory
WBC	Warrington Borough Council

Appendices

A. Description of Scoping Measures

MEASURE DESCRIPTION

1. Low Emission Zone

Summary description

A Low Emission Zone is a geographically defined area where the most polluting of vehicles are restricted, deterred or discouraged from access and use. The aim is to reduce the number of more polluting vehicles being used in a particular area by setting specific exhaust emission standards or criteria as a condition of entry, with the aim of reducing overall emissions from traffic and improving the resulting the air quality. Generally this means the removal of older, more polluting, vehicles unless the can retrofit their exhaust systems. The London LEZ is the largest example which covers the greatest ranges of vehicles, but smaller examples aimed at bus / coach exist in Norwich and Oxford. LEZs are more prevalent in some EU countries, particularly Germany and Italy.

Implementation method

A defined area needs setting within which specified emission criteria are in place.

As described in Defra's Practice Guidance (2009), Low Emission Zones tend to be focussed on city and town centres, where land-use is dense, traffic is heavy and population exposure is high. There is the highest value in such areas from restricting, discouraging or deterring the use of more polluting vehicles. Previous studies have demonstrated that the most common vehicles to target in a scheme with enforceable restrictions are diesel powered Heavy Duty Vehicles due to their cost-effectiveness relative to schemes that would restrict other vehicle types.

The two main legal options for implementing Low Emission Zones in the UK are Traffic Regulation Orders under the Road Traffic Regulations Act 1984 (commonly introduced to manage traffic flow at specific locations, to define on-street parking conditions, or as part of a broader traffic management scheme) and Section 106 agreements as planning obligations[4] for site usage when new or re-development takes place.

Part 6 of the TMA 2004 provides for the civil enforcement of most types of parking contravention, so enforcement of parked vehicles is possible. Powers under Traffic Management Act 2004 enable definition of permitted vehicles, which sets the basis for enforcement. One

[4] **Planning obligation:** A legally enforceable obligation entered into under section 106 of the Town and Country Planning Act 1990 to mitigate the impacts of a development proposal.

MEASURE DESCRIPTION

current barrier to implementing an LEZ via this potential route is that enforcement of moving vehicles cannot yet be done through civil by Local Transport Authorities because DfT has not yet drawn up the necessary regulations. These would be done under Schedule 7 to the TMA 2004 to allow local traffic authority-appointed Civil Enforcement Officers the powers to monitor and penalise a range of moving traffic offences such as stopping in boxed junctions, making banned turns and entry to an area by a non-permitted vehicle, the latter process being the one that we believe offers the method for enabling an LEZ that applies to general traffic (outside of London, where the relevant authorities can already access different and available powers).

Various local authorities and the LGA are lobbying DfT to draw up regulations for enabling them to enforce moving vehicle offences, as provided for in the TMA 2004. Defra has issued Practice Guidance that provides advice on Authorities considering LEZ (2009). On the other hand, a Government Transport Minister in late 2011 cautioned against Authorities rushing to introduce LEZ.

In principal, an LEZ scheme design should aim to regulate emissions to a sufficiently high standard and early enough to produce benefits over and above the business as usual trajectory of vehicle fleet improvements. At this point a Euro III standard should be considered as the minimum standard for Low Emission Zone schemes, and ideally Euro IV (as per London LEZ, for PM emissions). Applying this recommendation was reported in the Defra LEZ Practice Guidance (2000) to produce three to four years of benefits, albeit diminishing. Raising the minimum standard again in future years, to keep the scheme effective, should be planned and flagged with vehicle owners well in advance, which is the approach taken for the London LEZ as it has now gone through a second phase that tightens emissions controls further.

A significant number of Low Emission Zones are now in place or under development in Europe. The most effective methods of managing permitted vehicles (for traffic, parking or development control schemes) will be to use existing systems and sources of information as far as possible. Examples of Low Emission Zones from mainland Europe include manual and low-tech (manual) observation and enforcement methods as well as sophisticated automatic camera based systems. Given constraints on revenue budgets, a scheme which has low operating costs will tend to be more attractive from a whole-life cost viewpoint. However, this needs to be carefully balanced against the resulting level of compliance by users with the scheme emission standards, or the purpose and value of the scheme is undermined.

Boundary assumptions

- ***Spatial extent:*** urban area of Warrington, inside Motorway network to capture most benefits and to include main through routes (on A-roads). Boundary to be put city-side of any outlying industrial estates.
- ***Vehicles*****:** HGV, Bus, larger Van (over 1.3 tonnes), as per London LEZ. The London LEZ criteria are (a) for Bus, Coach and Heavy

MEASURE DESCRIPTION

Goods Vehicles Euro IV for PM[5], (b) for Larger Vans and Minibuses - Euro III for PM[6]

- ***Emissions criteria*****:** as per London LEZ, which is focussed on removing oldest vehicles or having them retrofitting for PM reduction.
- ***Year of introduction*****:** assumed 2012 (for comparison purposes with other measures).

The above suggests modelling Study Zone A (for comparative purposes in the scoping stage) and potentially a wider area for the future detailed assessment. Study Zone A includes within it major roads into and surrounding the core urban area and therefore is suitable area to subject to a first assessment, at this stage of this study which is considering relevant sources and impacts of potential measures.

In terms of practicability, then a urban area with an outer ring-road may be a more suitable candidate for an LEZ that a town without such a ring-road because of the option for diversionary routes. In the case of Warrington the motorway network may fulfil some, but not all of this function. Any future detailed design study can be expected to consider again the exact area covered by a LEZ and suitability of one of more roads for inclusion. It should be noted that removing too many roads from the LEZ area will reduce its effectiveness. Also that the positive impact on emissions by an LEZ may be much wider than the formal enforced area as cleaner vehicles travel towards the Zone from elsewhere in Warrington. The latter will have an offsetting influence on any negative impact of diversionary affects that might arise on or outside the LEZ boundary.

Indicative costs

Cost estimates to be developed for Warrington scenario by TTR prior to the workshop, (based on previous studies for Oxford CC, Defra, Bristol, Edinburgh etc.). Costs will best estimated for a low-cost manually enforced scheme and a high-cost automatic (camera based) scheme.

Costs will depend heavily on the following factors:

- Types of vehicles included (more = higher costs);
- Emission criteria/year of introduction (the greater stretch to meet the standard then greater potential for cost)
- Geographical extent (a larger area could mean more vehicles are affected, so higher costs on operators and for

---

5 http://www.tfl.gov.uk/roadusers/lez/17700.aspx#tkt-tab-panel-1
6 http://www.tfl.gov.uk/roadusers/lez/17700.aspx#tkt-tab-panel-1

MEASURE DESCRIPTION

operating/enforcing the scheme).

Costs will fall onto:

- Scheme operator (values provided in a range between £x and y);
- Vehicle owners (values in a range between £x and y);

Costs for scheme operator will be formed from:

- set up costs (staff, equipment, software, office, support companies etc.);
- running costs (equipment maintenance and replacement, staff costs, dealing with appeals and admin of penalties etc.)
- income (from penalties)

Summary costs are contained in the Table 23 below.

Table 23: Low Emission Zone (LEZ) scheme set-up and operating costs

COST ITEMS	**Scheme A**	**Scheme B**
	Manual enforcement	Fixed & mobile ANPR camera
	0 HDV, Coach, Bus, LGV,	10 camera sites plus 1 mobile HDV, Coach, Bus, LGV,
START-UP (capital) COSTS		
Roadside equipment	£30,000	£451,100
Central systems	£121,200	£167,400
Other set-up	£120,000	£182,500
Total start-up costs	**£271,200**	**£801,000**
ONGOING OPERATING COSTS		
Maintenance & replacement of equipment	£1,830	£36,539
Central system, premises and supplies	£221,493	£196,417

MEASURE DESCRIPTION

Staff costs	£866,264	£511,570
Total operating costs p.a.	**£1,089,587**	**£744,526**
Total costs - end of Year 1	**£1,360,787**	**£1,545,526**
REVENUES		
Total capital & 10 year operating costs	£11,167,065	£8,611,647

The two options are based on:

A) manual enforcement, on-street, by officers observing and recording vehicles not permitted to enter the LEZ, and taking evidence back to the control room for processing and checking against scheme and DVLA records;

B) camera based enforcement, with on Automatic Number Plate Recognition (ANPR) cameras at 10 sites on main routes into Warrington, plus 1 mobile ANPR unit (van based).

It can be seen that manual scheme has higher operating costs than a camera based scheme due to the greater number of persons needed to be on-street each day, and in the medium to long term this means a manual scheme might cost more to implement overall.

Air quality impacts and other benefits

The scenario modelled was for a LEZ in 2012 with no changes to traffic flows.

Emissions impacts

The impacts are summarised in Table 24 below.

Table 24: Emissions impacts for test 1 (LEZ)

Area	**NOx % of baseline**	**Total NOx (t/a)**	**NOX Petrol Cars**	**NOX Diesel Cars**	**NOX Rigid HGV**	**NOX Artic HGV**	**NOX Buses**
AREA A	97.9%	34.4	16.4%	29.1%	37.1%	7.1%	10.3%
	PM % of baseline	**Total PM (t/a)**	**PM Petrol Cars**	**PM Diesel Cars**	**PM Rigid HGV**	**PM Artic HGV**	**PM Buses**

MEASURE DESCRIPTION

	C % of baseline	Total C (t/a)	C Petrol Cars	C Diesel Cars	C Rigid HGV	C Artic HGV	C Buses
AREA A	94.4%	2.99	46.2%	36.0%	12.4%	1.8%	3.6%
AREA A	99.8%	5,256	56.6%	46.2%	12.4%	1.8%	3.6%

Air quality impacts

The LEZ scenario is estimated to reduce the annual mean NO_2 concentration in area A by approximately **0.1 µg/m^3**. This may be inaccurate due to use of the NOx emission factors in EFT v4.2.2. The detailed study will apply the recent dataset published in the EFT v5.1. More detail could be achieved if automatic number plate recognition cameras were deployed to assess current fleet emissions standards. A full list of all air quality impacts is shown in Appendix A.

The applied LEZ criteria for compliant vehicle emission standards have a greater impact on reducing PM (i.e. ~5.6% reduction on base emissions). This largely due to step changes in emission controls between Euro standards which appear greater for PM than for NOx. It worth noting however that whilst these reductions appear relatively low the impact must be considered in terms of public exposure across a wider area (i.e. small incremental reductions in NOx and PM on potentially thousands of residents).

Assumptions

LEZ scenario for 2012 with no changes to traffic model flows.

Retrofit effects assumed were

- 25 percent of pre-Euro III rigid HGVs are retro-fitter with diesel particulate filters (DPF)
- 25 percent of pre-Euro IV artic HGVs are retro-fitted with DPF

Fleet redistribution effects assumed were:

- 45 percent of pre-Euro III rigids are now Euro IV
- 30 percent of pre-Euro III rigids are now Euro V
- 70% of Euro III rigids are Euro IV
- 30% of Euro III are Euro V
- 45 percent of pre-Euro IV artics are now Euro IV
- 30 percent of pre-Euro IV artics are now Euro V

MEASURE DESCRIPTION

The baseline situation assumed a fleet consistent with year 2012 according the National Atmospheric Emissions Inventory. For the LEZ the entry criteria assumes that 25% pre Euro III rigid HGVs and pre Euro IV articulated HGVs are retro fitted with a diesel particulate filter (DPF) to meet the required particulate standards. The remaining 75% in each case are subject to an upgrade (replacement vehicles) to emission standards split between Euro IV and Euro V. Euro III rigid HGVs are subject to an upgrade to Euro IV and Euro V.

The air quality impact assessment of the LEZ scenario was undertaken using road traffic emission rates estimated for Priestley Street. This location had relatively high traffic flow and a nearby relevant receptor at Manley Gardens. The air pollution model was setup to characterise Warrington urban area and for the purposes of the scoping study the all scenario tests assumed 2008 Birmingham weather data. Furthermore emissions were scaled over 24 hours using traffic flow profiles for a weekday Saturday and Sunday derived from Warrington automatic traffic count data. An average speed of 30 km/h was assumed on all road links. Background concentrations were derived using Defra's sector based maps. Relevant sector concentrations were adjusted to account for the wider impact of the scenario and double counting effects.

MEASURE DESCRIPTION

2. HGV and Delivery management

Summary description

Freight Consolidation Centres are distribution centres, situated close to a town centre, shopping centre or construction sites, at which part loads are consolidated and from which a lower number of consolidated loads are delivered to the target area.

Freight Consolidation Centres (FCCs) are increasingly promoted in local authority strategic plans and industry trade publications as a tool to help achieve improvements in local air quality and greater efficiency through optimisation of land use, faster deliveries and in the case of the construction industry reduced material and time wastage.

Note, the measure, HGV and delivery management could encompass a range of measures including promoting the use of rail and inland waterways. FCC is being used as an illustration of one freight related measure that could deliver the objective of a lower number of consolidated loads are delivered to the target area.

MEASURE DESCRIPTION

Implementation method

Suitable locations

Freight consolidation centres are not suitable for every town and city, they are typically better suited to specific environments. These are typically busy city centres where access can be difficult (e.g. historic road layouts) causing congestion, air quality issues, conflict in shared road space and difficulty in provision of adequate loading space.

Catchment area

Consolidation centres need to have a large enough number of outlets being served to ensure a level of throughput which is economically viable. Therefore some locations which would not necessarily fit into this 'historic centre' category become suitable when viewed as an implementation covering multiple towns\cities which are in fairly close proximity to each other. This then provides the greater levels of throughput and efficiency needed. Examples of clusters of towns that fall into this category could be Warrington\St Helens, Bristol\Bath, Derby\Nottingham\Leicester, and Cardiff\Newport. The combined potential throughput and the potential to cover several of the deliveries in an existing supply chain will make the centre more viable commercially.

Appropriateness of measure

It should be noted that the decision to implement a FCC should ideally be arrived at after a comprehensive investigation and scoping study of all the various freight options, as there may be other options that can be implemented in advance of a FCC that garner some or all of the same benefits. That process has not been specified as part of the Warrington LEZ study and therefore we are not proposing the FCC is the most appropriate freight action. Rather, FCC is used as a 'short-hand' way of referring to a significant set of freight related measures that have the similar outcome; producing a lower number of consolidated loads delivered to the target area.

Implementation assumptions

- The FCC would be open to receive deliveries on a 24/7 basis
- The FCC would make deliveries to stores 6 ½ days a week, 7am-7pm
- The FCC is located approximately 6 miles by road from the area being served
- No operator's management charge or profit margin has been added into the FCC operating costs
- Deliveries would be made to the store as a simple drop-off at the delivery entrances to the stores (or other applicable entrance)

MEASURE DESCRIPTION

- The retail\office mix and total number of stores used in the model is based on an average from five different town centre studies.
- The voluntary participation scenario assumes a 20% take up primarily focused on the medium sized stores.
- There are sufficient problems with direct deliveries that there is some incentive to retailers to participate

Implementation is based on the following retail mix and take-up as given in Table 25 (Lewis *et al.* 2010).

Table 25: Breakdown of the different retail participation levels used in the analysis

Store type	Voluntary participation level (percentage)				
	20	**40**	**60**	**80**	**100**
Supermarket	0	0	0	1	2
Department store	0	0	1	1	1
Franchised department store	0	0	0	0	0
Large store	1	1	2	2	2
Medium store	8	12	15	18	21
Small store	10	23	35	48	57
Barrow	1	1	1	1	1
Food outlet	4	10	16	23	29
Office	2	5	8	10	13
Total stores	**26**	**52**	**78**	**104**	**125**

Boundary assumptions

- Spatial extent: serving the town centre and ideally also the Bridge Street Shopping Centre (to ensure sufficient throughput).
- Location: potentially be on the north or north east side of city; near/at current business parks and warehousing would be ideal, near

MEASURE DESCRIPTION
Motorways and main routes, and also within reach of other urban areas (e.g. St Helens) to maximise potential throughput. • Vehicles: aimed at intercepting HGV trips in first instance (vehicles over 3.5 tonne gross vehicle weight) • Emissions criteria: assume a range of types of HGV are used for transhipment of goods from FCC to the town centre retailers • Year of introduction: 2012, for comparative purposes in scoping phase. • How effective and what proportion of HGV trips is the max that could/should be diverted to consolidation? It is suggested to model 20% take up by retailers and also a mandatory 100% take-up, based on a typical town centre mix of retailers. The 100% take-up would under mandatory conditions, such as if a HGV weight bans was put in place or the landlord specified the FCC must be used (e.g. if all Bridge Street retailer tenants were under such conditions). The above suggests modelling Study Zone A (for comparative purposes in the scoping stage) and then potentially a wider area for the future detailed assessment.
Indicative costs, staff requirements and transhipment vehicle mileages Costs of different types of FCC are set out below in Table 26 and Table 27. The difference between them is solely the size and type of vehicle used for transhipment of goods from the FCC to the town centre. Total annual operating costs are based on the total cost of operating the centre on the basis described, including all staff, vehicles, fuel and warehousing costs etc. This is also converted to a cost per pallet figure to show the cost that would need to be charged for the centre to break even under these conditions. In many instances where FCC are set up some form of subsidy has been used to reduce the costs passed on to the users, either initially or an ongoing basis and no inference should be taken that these costs would be considered as viable for the businesses that would be asked to use the consolidation centre

Table 26: Summary of FCC using 7.5 tonne rigid vehicles in High Street Scenario

	Mandatory participation	Voluntary participation

MEASURE DESCRIPTION

	Shared centre	Dedicated centre	Shared centre	Dedicated centre
Total FCC annual cost	£4,065,690	£4,128,518	£500,647	£688,099
Cost per pallet	£7.87	£7.99	£10.36	£14.25
Total staff	101	104	12	19
Total vehicles	45		5	
Total vehicle runs per week	1243		117	
Total mileage per week	14916		1404	

Table 27: Summary of FCC using 9 tonne electric vehicle in High Street Scenario

	Mandatory participation		Voluntary participation	
	Shared centre	Dedicated centre	Shared centre	Dedicated centre
Total FCC annual cost	£4,624,948	£4,687,776	£546,001	£733,453
Cost per pallet	£8.95	£9.07	£11.30	£15.18
Total staff	94	96	12	19
Total vehicles	74		7	
Total vehicle runs per week	1243		117	
Total mileage per week	14916		1404	

Air quality impacts and other benefits

Emissions impacts

MEASURE DESCRIPTION

Table 28 below shows the impacts on emissions for a mandatory freight consolidation centre. This is modelled for the FCC options using an Electric Vehicle to make the transhipment to the town centre.

Table 28: Emissions impacts for Test 2a (FCC, 100% uptake)

Area	Total NOx (t/a)	NOx % of baseline	NOx Petrol Cars	NOx Diesel Cars	NOx Rigid HGV	NOx Artic HGV	NOx Buses
AREA C	4.8	80.5%	19.9%	35.4%	26.7%	5.5%	12.5%
	Total PM (t/a)	**PM % of baseline**	**PM Petrol Cars**	**PM Diesel Cars**	**PM Rigid HGV**	**PM Artic HGV**	**PM Buses**
AREA C	0.50	91.8%	47.5%	37.1%	10.1%	1.7%	3.7%
	Total C (t/a)	**C % of baseline**	**C Petrol Cars**	**C Diesel Cars**	**C Rigid HGV**	**C Artic HGV**	**C Buses**
AREA C	842	93.7%	60.2%	47.5%	10.1%	1.7%	3.7%

Table 29 below shows the effect of a voluntary freight consolidation centre with 20 percent uptake. This is modelled for the FCC options using an Electric Vehicle to make the transhipment to the town centre.

Table 29: Emissions impacts for test 2b (FCC, 20% uptake)

Area	Total NOx (t/a)	NOx % of baseline	NOX Petrol Cars	NOX Diesel Cars	NOX Rigid HGV	NOX Artic HGV	NOX Buses
AREA C	5.7	95.0%	16.9%	30.0%	35.3%	7.3%	10.6%
	Total PM (t/a)	**PM % of baseline**	**PM Petrol Cars**	**PM Diesel Cars**	**PM Rigid HGV**	**PM Artic HGV**	**PM Buses**
AREA C	0.53	97.9%	44.5%	34.8%	14.8%	2.4%	3.5%
	Total C (t/a)	**C % of baseline**	**C Petrol Cars**	**C Diesel Cars**	**C Rigid HGV**	**C Artic HGV**	**C Buses**
AREA C	884	98.4%	44.5%	34.8%	14.8%	2.4%	3.5%

Air quality impacts

The impact of the FCC with a mandatory 100% uptake was estimated to reduce annual mean NO_2 by approximately 0.9 µg/m^3 within

MEASURE DESCRIPTION

area C.

The impact of the FCC with a voluntary 20% uptake was estimated to reduce annual mean NO_2 by approx 0.2 µg/m^3 within area C.

More detailed estimates would require information concerning the weight distribution of goods vehicles in Warrington.

Assumptions

The scenarios are for 2012. The total distances travelled by goods vehicles in the town centre are assumed to reduce through elimination of partially-full loads. According to the NAEI 47.1% of rigid vehicles are less than 7.5 t and therefore 52.9% are all other vehicles. Hence, it is assumed that the reduction in the mileage travelled by goods vehicles to be representative of the weight ratio. It's also assumed that the baseline mileage is undertaken by the same vehicle categories as per the scenarios. The scenario assumes vehicle mileage within the town centre although for a detailed study the mileage between the FCC and the town centre would need to be considered.

The air quality impact was estimated using road traffic emission rates estimated for Wilson Patton Street and relevant receptor located at number 9.

MEASURE DESCRIPTION

3. New Infrastructure Measures (New road bridge and link road)

Summary description

To provide new infrastructure measures such as a bypass/bridge for a river or canal crossing. The aim of this measure would be to reduce through-traffic movements in the centre.

Implementation method

Bridge or tunnel linking point A to point B

Suitable locations

MEASURE DESCRIPTION

In the vicinity of Parker Street and Wilson Patten Street.

Catchment area

Likely to be within area B. However, the catchment area would be influenced by the extent of bypass once it is determined. One possible area would extend towards Wilderspool Causeway.

Boundary assumptions

- Spatial extent: At this stage there is only rough indication as to where a new relief road might be located. However, a likely candidate appears to be a link between Parker Street where a new junction will be developed and a principle road to the south of Warrington (e.g. possibly Wilderspool Causeway)
- Area affected: Depending on the extent of the relief road but could affect traffic in area B and A?
- This measure will possibly affect traffic between the Bridge Street and Sankey Way roundabouts. Also, wherever the relief road meets the principle road to the south of the town centre.
- *Year of introduction: 2012*

Indicative costs

In terms of indicative costs, an elevated road (bridge) costs about 10 times that of a surface road, and tunnels probably cost more than 10 times more than bridges. For example, indicative costs are £78,000 per yard to build a bridge, £142,00 per yard for a tunnel and £17,045 per yard for an average three lane motorway[7].

Air quality impacts and other benefits

Emissions impacts

Table 30 shows the emissions impacts of a new bridge with average vehicle speeds of 35 km/h.

Table 30: Emissions impacts for test 3a (new bridge, vehicle speeds changed to 35 km/h)

[7] http://www.bbc.co.uk/news/magazine-13924687

MEASURE DESCRIPTION

Area	Total NOx (t/a)	NOx % of baseline	NOX Petrol Cars	NOX Diesel Cars	NOX Rigid HGV	NOX Artic HGV	NOX Buses
AREA B	19.9	93.3%	16.8%	28.4%	37.5%	7.6%	9.6%
	Total PM (t/a)	PM % of baseline	PM Petrol Cars	PM Diesel Cars	PM Rigid HGV	PM Artic HGV	PM Buses
AREA B	1.88	98.0%	44.4%	34.2%	15.7%	2.5%	3.2%
	Total C (t/a)	C % of baseline	C Petrol Cars	C Diesel Cars	C Rigid HGV	C Artic HGV	C Buses
AREA B	2,984	93.4%	56.5%	26.3%	11.9%	2.5%	2.7%

Table 31 shows the impact of a new bridge with average speeds of 25 km/h. Emissions increase compared to the baseline because it is assumed that the influx of traffic will cause a reduction in overall journey time with more start stops.

Table 31: Emissions impacts for test 3b (new bridge, vehicle speeds changed to 25 km/h)

Area	Total NOx (t/a)	NOx % of baseline	NOX Petrol Cars	NOX Diesel Cars	NOX Rigid HGV	NOX Artic HGV	NOX Buses
AREA B	23.3	109.5%	15.3%	28.8%	37.7%	7.7%	10.5%
	Total PM (t/a)	PM % of baseline	PM Petrol Cars	PM Diesel Cars	PM Rigid HGV	PM Artic HGV	PM Buses
AREA B	1.97	102.9%	42.6%	33.9%	17.1%	2.8%	3.6%
	Total C (t/a)	C % of baseline	C Petrol Cars	C Diesel Cars	C Rigid HGV	C Artic HGV	C Buses
AREA B	3,485	109.1%	56.6%	25.8%	12.1%	2.6%	2.9%

Air quality impacts

The impact of new infrastructure which effectively improves journey time (speed 35 km/h) was estimated to reduce annual mean NO_2 by approx 0.1 µg/m^3 within area B. The impact of reducing journey time (speed 25 km/h) was estimated to increase NO_2 by approximately 0.4 µg/m^3 within area B. More detailed estimates would require a traffic model run to assess the redistribution of traffic flows and average speeds. The new infrastructure has not yet been considered. This would have negative air pollution effects in its vicinity.

Assumptions

MEASURE DESCRIPTION

The impact on traffic from introducing a by-pass and bridge in the vicinity Parker Street is not fully understood. It was agreed by Warrington Council that perhaps a scheme may either increase or reduce overall travel time. In terms of the modelling it was assumed that adjusting the average speed would have the same effects as increasing or reducing travel time. The assessment does not account for additional junction effects at the bridge location.

The air quality impact was estimated using road traffic emission rates estimated for Wilson Patton Street and relevant receptor located at number 9.

MEASURE DESCRIPTION

4. Route management plans

Summary description

A route management plan designed to prioritise traffic (or certain vehicle types) along defined routes.

Implementation method

A route management plan would encourage goods vehicles to use a defined route using a combination of signage, route maps and traffic restriction orders.

Suitable locations

A route management plan would operate along the ring road travelling from the west to the south west, including all junctions with exits and entrances to the town centre.

Catchment area
Town centre and ring road.

Boundary assumptions

- Spatial extent - Area B
- Vehicles affected - HGVs

MEASURE DESCRIPTION

- Test (a). All HGVs restricted. : so increase HGV on ring-road and decrease in interior roads.
- Test year - 2012
- Displacement effects will be considered based on data provided

Indicative costs

Table 32 includes indicative costs associated with installing infrastructure associated with route management.

Table 32: Costs associated with route management plans

START-UP / CAPITAL COSTS	Technical basis		
	Scheme option		
Warrington			**Year of Introduction**
Roadside equipment	Including installation	Unit cost	Unit
Local route signage		1,300	per item
Strategic route signage		7,000	per item
TOTAL for roadside equipment			
Other set-up costs			
Design and implementation		8,000	per item
Marketing and information campaign		5,000	per item
Traffic management/safety strategic roads		3,500	average per site
Traffic management/safety local roads		500	average per site
TRO set-up costs		5,000	per item

Air quality impacts and other benefits

MEASURE DESCRIPTION

Emissions impacts

Table 33: Emissions impacts for test 4 (HGV routing)

Area	Total NOx (t/a)	NOx % of baseline	NOX Petrol Cars	NOX Diesel Cars	NOX Rigid HGV	NOX Artic HGV	NOX Buses
AREA B	22.0	103.3%	15.5%	27.6%	39.1%	8.0%	9.7%
AREA C	5.2	86.7%					
	Total PM (t/a)	**PM % of baseline**	**PM Petrol Cars**	**PM Diesel Cars**	**PM Rigid HGV**	**PM Artic HGV**	**PM Buses**
AREA B	1.94	101.4%	43.0%	33.6%	17.2%	2.8%	3.3%
AREA C	0.51	94.5%					
	Total C (t/a)	**C % of baseline**	**C Petrol Cars**	**C Diesel Cars**	**C Rigid HGV**	**C Artic HGV**	**C Buses**
AREA B	3,228	101.1%	55.9%	25.8%	12.8%	2.7%	2.8%
AREA C	860	95.7%					

Air quality impacts

The impact of a route management strategy was estimated to reduce annual average NO_2 by around 0.7 µg/m^3 along Bridge Street/ Wilson Patten Street and Parker Street, along the ring road and increase NO_2 on the ring road to the north by approximately 1.2 µg/m^3. Although an increase was estimated on the ring road in area B, there are far fewer relevant receptors compared to the town centre. Pollution dispersion may also be more favourable on the ring road.

More detailed estimates would require classification of the traffic in the town centre and ring road.

Assumptions

The test assumes that 75% of rigid and articulated goods vehicles are removed from typical by-directional links in the vicinity of Bridge/Wilson Patton/Parker Street area. The corresponding value of goods vehicles are then redistributed onto the ring road between Bridge street and Sankey Way roundabouts.

The air quality impact was estimated using road traffic emission rates estimated for Wilson Patton and Priestley Street and relevant receptors located at number 9 Wilson Patten Street and 9 Manley Gardens respectively.

MEASURE DESCRIPTION

MEASURE DESCRIPTION

5. Rapid take-up of low emission private cars, vans and HGVs

Summary

Rapid take-up of low emission/alternative fuelled vehicles (AFV) - private cars, vans and HGVs - with support from WBC through provision of refuelling/charging points and incentives/rewards for users of these vehicles within the town centre.

Implementation method

Rapid take-up of low emission vehicles will require action at international, national and local level. However, the most influential interventions are likely to be international and national. At local level, actions might be taken to support consumers/buyers move to lower carbon vehicles if they require infrastructure for refuelling that Local Authorities can play a part in facilitating. However, it is likely that if there is robust and sustained demand for low carbon vehicles that the private sector will see a business opportunity and step in. Therefore, there is probably a limited role for the public sector at a local level to do.

As a highways authority, planning authority and land-owner then WBC might be in a position to actively encourage or invite the installation of measure that encourage or support use of low-carbon vehicles by other organisations and individuals, such as:

- Re-charging/re-fuelling infrastructure;
- Priority access or parking;
- Graduated parking charges.

WBC and other public authorities might also choose to deploy low carbon options in their own fleets. For example, the EC-level Clean Vehicle Directive requires Public Sector organisations to take into account the whole-life costs of the vehicles they are purchasing, including the societal costs of emissions (AQ and GHG) and fuel used, and place a value on these operating costs and impacts using a standard formula and input data. The outcome of this must be a consideration in the choice of which vehicle and service supplier to

MEASURE DESCRIPTION

award future contracts.

Suitable locations for EV charging infrastructure

- Re-charging/re-fuelling infrastructure: on-street, car-parks, loading bays, own-depot installations;
- Priority access or parking: public and private (partner) car parks;
- Graduated parking charges: public car parks, potentially private (partner) car parks.

Catchment area

Whole urban area, but best placed where drivers wish to park their cars for a significant period (to enable sufficient charge) such as shopping centres, major employment centres, business parks.

Appropriateness of measure

The measure requires a significant contribution to success from organisations and factors outside of WBC control (i.e. EC legislators, vehicle manufacturers, national governments.

Implementation assumptions

Currently the Alternative Fuel Vehicle (passenger car) market is growing 35% per annum[8] however this is from a very low base and the number of registered vehicles per annum is around 25,000 vehicles per annum from a total of 2million vehicles registered in the year up to end December 2011[9]. This equates to only 1.3% of the total new car market, up from 1.1% total in 2011, so a rise in the total share p.a. of only 0.1%). It is likely that the growth rate of AFV sales will be exponential and so the % of new car sales will continue to grow from the current 0.1% of total car sales per year.

At the upper limit, if the target to completely decarbonise transport by 2050 is to be met then the overall share of new car sales by AFV will need increase on average by 2.5% per year (e.g. 2.5%, then 5%, then 7.5% of new car sales etc.). Assuming this happens at an even rate between now and 2050 – which is unlikely – then in 8 years' time (2020) we could assume 20% of the new car market sales would be AFV and the 2012 vehicles are still being used (i.e. they haven't exited the fleet). The cumulative total of AFV would be 1.8 million vehicles after 8 years of sales. If this total UK car fleet is 28 million vehicles then AFV would represent just 6% of the total UK

[8] http://www.smmt.co.uk/2012/06/new-car-market-grows-in-may-as-registrations-rise-7-9/
[9] http://www.smmt.co.uk/2012/01/new-car-market-betters-forecast-but-was-down-4-4-in-2011-to-1-94-million/

MEASURE DESCRIPTION

fleet in 2020, which could be assumed to be replicated in the Warrington area.

It is then assumed that the AFV are zero emission in urban areas, and equally applied to cars, vans or smaller HGV fleets.

Boundary assumptions

- Spatial extent - Area A
- Vehicles affected – Cars, HGVs
- Test (a) - 1% uptake of electric cars and smaller HGVs
- Test year – 2012
- Displacement effects - none

Indicative costs

This will be based on costs of providing infrastructure but not costs to motorists, which will need to be broadly in line with current motoring costs to be acceptable and lead to take-up. The costs of putting in EV infrastructure are based on the following information.

Table 34: Typical EV Charging Point equipment and installation costs

	Post Costs	**Install Costs***	**Total Costs**
7kW twin on-street (per unit)	£3000	£3000	£6000
22kW twin on street (per unit)	£6000	£4000	£10000
DC_50kW (per unit	£15000	£15000	£30000

Capital/set-up: For example, we might suggest a 20 x 22kW on-street charging points, at total investment/capital costs of £200,000.

Electricity would be paid for by the users.

Running: other maintenance/running/replacement costs might be assumed at 15% p.a., so £30,000 p.a.

MEASURE DESCRIPTION

Air quality impacts and other benefits

Emissions impacts

Table 35: 1% uptake of EV cars and smaller HGVs (rigids <7.5 tonnes)

Area	**Total NOx (t/a)**	**NOx % of baseline**	**NOX Petrol Cars**	**NOX Diesel Cars**	**NOX Rigid HGV**	**NOX Artic HGV**	**NOX Buses**
AREA A	35.0	99.4%	16.0%	28.4%	37.8%	7.8%	10.1%
	Total PM (t/a)	**PM % of baseline**	**PM Petrol Cars**	**PM Diesel Cars**	**PM Rigid HGV**	**PM Artic HGV**	**PM Buses**
AREA A	3.14	99.1%	43.5%	34.0%	16.4%	2.7%	3.4%
	Total C (t/a)	**C % of baseline**	**C Petrol Cars**	**C Diesel Cars**	**C Rigid HGV**	**C Artic HGV**	**C Buses**
AREA A	5,222	99.1%	56.4%	26.1%	12.1%	2.6%	2.8%

Air quality impacts

The impact of encouraging an uptake of 1% EVs cars and rigid goods vehicles <7.5 tonnes was estimated to reduce annual mean NO_2 by approximately 0.05 $\mu g/m^3$ within area A. A 10% uptake would therefore be required to reduce NO_2 concentrations by 0.5 $\mu g/m^3$.

Assumptions

It is assumed that cars, vans and smaller HGVs could, potentially, be replaced by zero-emission full-electric vehicles. Currently only a very small proportion of the UK vehicle fleet is electric, and potential future uptake will be limited (12 percent uptake by 2020 is considered a highly optimistic scenario).

The air quality impact was estimated using road traffic emission rates estimated for Wilderspool Causeway and relevant receptor located at number 143.

MEASURE DESCRIPTION

6. Bus fleet improvements

Summary description

Warrington Bus Fleet to be improved through investment in new dedicated gas vehicles able to run on natural gas and/or biomethane.

Implementation method

Suitable location / Catchment area

Entire urban area of Warrington, served by Network Warrington.

Appropriateness of measure

Heavy duty vehicles consume significant large volumes of fuel and produce emissions accordingly. Targeting new technology investment on these vehicles has been shown to be overall more cost-effective than applying to smaller vehicles, all other factors being equal.

Implementation assumptions

a) It is assumed that the current average replacement rate for the national bus fleet, typically 5% per year, is the case for Network Warrington and that a priority is made on replacing the oldest 10-12m vehicles with new CNG / biomethane vehicles.

b) Given a fleet of around 200 vehicles this means that after 4 years approximately 20% of the bus fleet are CNG, c. 40 vehicles.

c) A CNG refuelling stations is required to service c 50 vehicles.

Boundary assumptions

- Spatial extent - Area A
- Vehicles affected - Buses only
- Test (a) – 20% buses converted to CNG

MEASURE DESCRIPTION

- Test (b) – 40% buses converted to CNG
- Test year - 2012

Indicative costs

CNG refuelling station

The cost of a filling station relevant to a fleet of 40-50 buses is given in Table 36.

If station payback is over 10 years then the following table gives the 'through the nozzle' cost. A 5000kg per day capacity station is of sufficient capacity for 45 – 55 CNG buses, with the larger and smaller sized stations included for comparison

Table 36: CNG station costs and fuel price

Station Size (kg/day)	Ave Capital Cost	Est. Civils etc[1]	Base NG delivered[4] Price/kg	Capital payback (p/kg)	Fixed Opex[3] (p/kg)	Operator's Margin (p/kg)	Fuel Duty (p/kg)	Fuel Price (p/kg)
2000	£250,000	£80,000	28	11	10	9	26.15	84.15
5000[5]	£350,000	£120,000	28	7	8	8	26.15	77.15
10000[6]	£700,000	£140,000	28	6	7	8	26.15	75.15

[1] – Includes approx planning costs, connection to close proximity gas main (where applicable), 3 phase electricity on site connection and civils/foundation construction.
[3] – Includes electricity usage, compressor and ancillary equipment servicing, emergency breakdown cover, cylinder re-evaluation (every 10 years)
[4] – Gas price based on 55p/therm divided by 2.217 to get to kg plus 3ppkg gas transportation costs through gas main
[5] – Contains extra storage to cater for faster refuelling times
[6] – Contains extra storage and extra compressor to cater for faster refuelling times and redundancy

Operating costs would be recovered through the price of gas, but can be separated out to an annual cost if that is more relevant.

The above costs are worked on the basis that the refuelling station investment (and running costs) are repaid in 10 years from the sale of CNG at the price specified.

Vehicle costs

MEASURE DESCRIPTION

The additional capital cost of a CNG bus over a standard diesel bus is £30,000. This will be repaid through lower running costs, due to lower price of fuel per mile and enhanced Bus Service Operators Grant (or £0.06 per km). Cost calculations can determine how quickly the lower gas fuel costs can pay-off the extra vehicle capital costs.

The assumptions used for the comparable diesel bus:

- Annual mileage 40,000 p.a.
- Cost of diesel to bus operator is £1.30 per litre (inc VAT)
- BSOG paid at rate of £0.346 per litre of diesel (and possibly reducing in future years)
- Fuel consumption of 8 mpg (single deck bus)

Based on the assumption that a CNG bus costs 30,000 more to purchase, costs 1 pence a mile more to maintain than the diesel equivalent but consumes gas at a rate of 0.5kg per mile (at £0.77 per kg ex VAT) and qualifies for enhance BSOG at £0.06 p per km the **years to break-even over a diesel equivalent is 3.5 years.** After that point the additional capital costs could have been paid off and the bus is cheaper to run.

Air quality impacts and other benefits

Emissions impacts

Table 37: Emissions impacts for test 6a (20% of buses converted to CNG)

Area	Total NOx (t/a)	NO_x % of baseline	NO_x Petrol Cars	NO_x Diesel Cars	NO_x Rigid HGV	NO_x Artic HGV	NO_x Buses
AREA A	34.6	98.4%	16.3%	28.9%	38.3%	7.9%	8.6%
	Total PM (t/a)	**PM % of baseline**	**PM Petrol Cars**	**PM Diesel Cars**	**PM Rigid HGV**	**PM Artic HGV**	**PM Buses**
AREA A	3.14	99.4%	43.9%	34.2%	16.4%	2.7%	2.8%

MEASURE DESCRIPTION

Table 38: Emissions impacts for test 6b (40% of buses converted to CNG)

Area	Total NOx (t/a)	NOx % of baseline	NOX Petrol Cars	NOX Diesel Cars	NOX Rigid HGV	NOX Artic HGV	NOX Buses
AREA A	34.1	96.8%	16.6%	29.4%	38.9%	8.0%	7.1%
	Total PM (t/a)	**PM % of baseline**	**PM Petrol Cars**	**PM Diesel Cars**	**PM Rigid HGV**	**PM Artic HGV**	**PM Buses**
AREA A	3.13	98.9%	44.1%	34.4%	16.5%	2.7%	2.3%

Air quality impacts

The impact of converting 20% of the bus fleet to CNG was estimated to reduce annual NO_2 by approximately 0.08 µg/m^3 within area A. A 40% conversion would reduce NO_2 by approx 0.1 µg/m^3. Carbon emissions have not been calculated at this stage.

Assumptions

Based on COPERT data, CNG emissions are assumed to be 79 percent lower for NOx and 83 percent lower for PM. No other changes are made.

The air quality impact was estimated using road traffic emission rates estimated for Wilderspool Causeway and relevant receptor located at number 143.

MEASURE DESCRIPTION

7. Bio-methane refuelling station/ hub

Summary description

HGV fleets to be cleaned-up through investment in dual fuel and dedicated gas vehicles.

Implementation method

MEASURE DESCRIPTION

Rapid take-up of low emission HGV will require actions at international, national and local level, however the most influential are likely to be at national levels. At local level actions might be taken to support fleet operators to move to lower carbon vehicles if they require infrastructure for refuelling that Local Authorities can play a part in facilitating. However, it is likely that if there is robust and sustained demand for low carbon vehicles that the private sector will see a business opportunity and step in. Therefore, there is probably a limited role for the public sector at a local level.

As a highways authority, planning authority and land-owner, WBC might be in a position to actively encourage or invite the installation of measure that encourage or support use of low-carbon HGV by other organisations and individuals, such as:

- Re-charging/re-fuelling infrastructure;
- Priority access or parking at over-night lorry parking facilities;
- Access to areas where otherwise there are HGV bans or restrictions.

WBC and other public authorities might also choose to deploy HGV in their own fleets. For example, the EC-level Clean Vehicle Directive requires Public Sector organisations to take into account the whole-life costs of the vehicles they are purchasing, including the societal costs of emissions (AQ and GHG) and fuel used, and place a value on these operating costs and impacts using a standard formula and input data. The outcome of this must be a consideration in the choice of which vehicle and service supplier to award future contracts.

Suitable technologies for Low Carbon HGV and supporting infrastructure

One promising option for low carbon / emission HGV is the use of natural gas or biomethane – the important element being methane – a substitute fuel to diesel. This is currently subject of a DfT grant funding competition to stimulate take up and increase the number of refuelling stations.

Catchment area / suitable locations

Outside the urban area on or near strategic roads. Refuelling infrastructure is best placed where HGV operators wish to use their vehicles, such as: motorway refuelling stations, overnight lorry parks, freight consolidation centres, weighbridges, pallet network hubs, ports etc.

Appropriateness of measure

The measure requires a significant contribution to success from organisations and factors outside of WBC control (i.e. EC legislators,

MEASURE DESCRIPTION
vehicle manufacturers, national governments. The contribution from WBC is likely to be small in context of investments from vehicle operators and other support service organisations. *Implementation assumptions* Currently there are just a few hundred gas and dual-fuel HGV in operation in the UK. New fleet sales are about 8% of the total fleet size, so most of the fleet turns over in around 12 years. This suggests that even if 100% of all HGV sales are dual fuel or dedicated gas then it will take 3 years to reach 20% of the UK fleet. It is likely that more HGV operators will choose dual-fuel over dedicated gas as it gives them the option to recover costs fast due to lower capital costs, plus the option of running on diesel only in emergencies when gas is not available. For gas and dual fuel HGV to increase in number significantly a number of national-led initiatives are required: - HM Treasury to agree the current rolling 3 year duty differential that discounts the duty paid on gas as a road fuel is extended to 10 years minimum (to give confidence to investors), and ensure the current duty discount is maintained or even widened; - Encouragement to invest in gas refuelling stations, including off-setting capital allowances etc. It is not assumed that one filling station and the actions of WBC will stimulate a significant market for gas HGV, rather this is a contribution to a general promotion of natural gas and biomethane as a road fuel.
Boundary assumptions • Spatial extent - SZA • Vehicles affected - HGVs only • Test (7a) - 20% switch to CNG or dual fuel for all HGVs in study area • Test year - 2012
Indicative costs The costs considered here are just those for and organisation in Warrington to invest in a gas refuelling station suitable for HGV. *CNG refuelling station*

MEASURE DESCRIPTION

The cost of a filling station relevant to a fleet of 40-50 dedicated gas articulated HGV (or 30% more dual fuel (as they use less gas)) is given in Table 39.

If station payback is over 10 years then the following table gives the 'through the nozzle' cost. A 5000kg per day capacity station is of sufficient capacity for 45 – 55 gas HGV, with the larger and smaller sized stations included for comparison

Table 39: CNG station costs and fuel price

Station Size (kg/day)	Ave Capital Cost	Est. Civils etc[1]	Base NG delivered[4] Price/kg	Capital payback (p/kg)	Fixed Opex[3] (p/kg)	Operator's Margin (p/kg)	Fuel Duty (p/kg)	Fuel Price (p/kg)
2000	£250,000	£80,000	28	11	10	9	26.15	84.15
5000[5]	£350,000	£120,000	28	7	8	8	26.15	77.15
10000[6]	£700,000	£140,000	28	6	7	8	26.15	75.15

[1] – Includes approx planning costs, connection to close proximity gas main (where applicable), 3 phase electricity on site connection and civils/foundation construction.
[3] – Includes electricity usage, compressor and ancillary equipment servicing, emergency breakdown cover, cylinder re-evaluation (every 10 years)
[4] – Gas price based on 55p/therm divided by 2.217 to get to kg plus 3ppkg gas transportation costs through gas main
[5] – Contains extra storage to cater for faster refuelling times
[6] – Contains extra storage and extra compressor to cater for faster refuelling times and redundancy

Operating costs would be recovered through the price of gas, but can be separated out to an annual cost if that is more relevant.

The above costs are worked on the basis that the refuelling station investment (and running costs) are repaid in 10 years from the sale of CNG at the price specified.

Vehicle costs

The additional capital cost of a dedicated gas HGV over a standard diesel HGV is £35,000 and the cost of a dual fuel vehicle are £25,000 more than diesel option. This will be repaid through lower running costs, due to lower price of fuel per mile. Cost calculations can determine how quickly the lower gas fuel costs can pay-off the extra vehicle capital costs. This can be supplied from previous studies done by TTR, if relevant to the Warrington study.

Air quality impacts and other benefits

Emissions impacts

Table 40: Emissions impacts for test 7a (20% of HGVs converted to CNG)

Area	**Total NOx (t/a)**	**NOx % of baseline**	**NOX Petrol Cars**	**NOX Diesel Cars**	**NOX Rigid HGV**	**NOX Artic HGV**	**NOX Buses**
AREA A	32.6	92.8%	17.3%	30.7%	34.2%	7.0%	10.8%
	Total PM (t/a)	**PM % of baseline**	**PM Petrol Cars**	**PM Diesel Cars**	**PM Rigid HGV**	**PM Artic HGV**	**PM Buses**
AREA A	3.06	96.8%	45.0%	35.1%	14.0%	2.3%	3.5%

Table 41: Emissions impacts for test 7a (20% of HGVs converted to dual fuel)

Area	**Total NOx (t/a)**	**NOx % of baseline**	**NOX Petrol Cars**	**NOX Diesel Cars**	**NOX Rigid HGV**	**NOX Artic HGV**	**NOX Buses**
AREA A	33.8	96.1%	16.7%	29.7%	35.8%	7.4%	10.5%
	Total PM (t/a)	**PM % of baseline**	**PM Petrol Cars**	**PM Diesel Cars**	**PM Rigid HGV**	**PM Artic HGV**	**PM Buses**
AREA A	3.13	99.0%	44.1%	34.4%	15.6%	2.6%	3.4%
	Total C (t/a)	**C % of baseline**	**C Petrol Cars**	**C Diesel Cars**	**C Rigid HGV**	**C Artic HGV**	**C Buses**
AREA A	5,267	100.0%	56.5%	26.1%	12.0%	2.6%	2.8%

Air quality impacts

The impact of converting 20 percent of HGVs to CNG was estimated to reduce annual average NO_2 by around 0.3 µg/m^3 within area A. A 20% conversion to dual fuel would reduce NO_2 by around 0.2 µg/m^3.

MEASURE DESCRIPTION

Assumptions

For test 7a, 20 percent of rigids and artics are assumed to be converted to CNG. Emissions reductions are as for tests 6a and 6b.

For test 7b, 20 percent of rigids and artics are assumed to be converted to dual fuel. For this test it was assumed that 20% pre Euro V rigids and artics meet Euro V emission standards.

The air quality impact was estimated using road traffic emission rates estimated for Wilderspool Causeway and relevant receptor located at number 143.

MEASURE DESCRIPTION

8. Active Travel campaign (e.g. walking, cycling, shift to bus)

Summary description

Intensive active travel campaign & accompanying infrastructure, use of development control to ensure new developments maximise opportunity for active travel. A previous WBC study (LTP3/LSTF bid) reviewed the maximum impact seen to date in UK (e.g. approx 10% mode shift from car).

Some major improvements in active travel can be made, and a number of English towns and cities that have managed to halt or reverse the decline in active travel:

- 18% of trips in Cambridge are cycled, in York it is 10%.
- Cycling in London has doubled in less than a decade; Darlington achieved a 113% increase in just three years.
- Walking in the DfT's sustainable travel towns increased by 10-13% over three years.

However, we are some way short of the best in Europe as shown in Figure 29. The evidence suggests that much more can be done to increase mode share of active travel modes (walking, cycling), plus use of public transport.

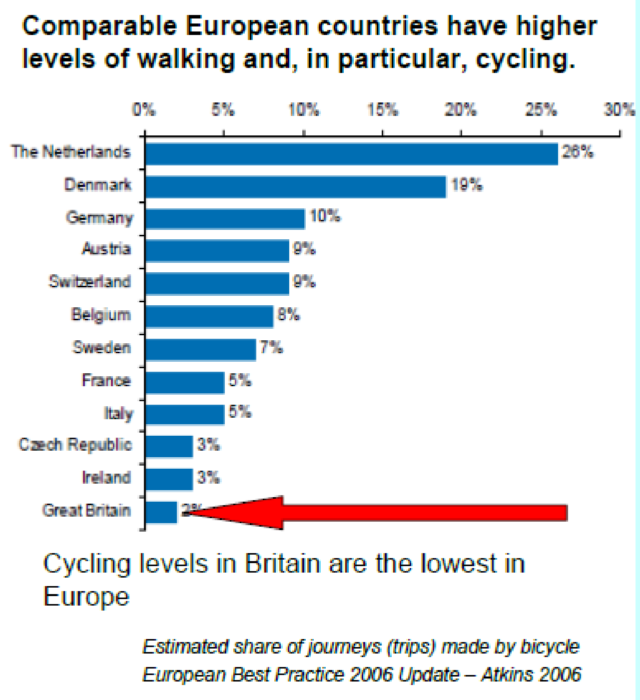


Figure 29: Cycling levels in Europe

Implementation method

The scheme would not necessarily be location-based but may have the greatest impact in the most congested parts of the town centre. Alternatively, a scheme may be associated with a specific development, by encouraging active travel to residents and/or businesses associated with that development.

Boundary assumptions

- Target area - Area A

MEASURE DESCRIPTION

- Vehicles affected - Cars
- Test (8a) - 5%, 10% 20% reduction in cars
- Test year - 2012

Indicative costs

Active travel is generally an extremely cost-effective measure, and as noted from the gap between UK and best in Europe there is plenty of scope to make investments before the point of no return is reached. DfT found that in the first three years of introducing their cycle towns programme, cycling rates increased by 27 percent and adults not taking any exercise decreased by 10%.

The health benefits of investing in cycling are estimated to be more than 2.5 times the cost. Benefit cost analysis of cycle training schemes have estimated that returns are of the order of 7:1. In dense urban aeras such as London where there are gerater health, congestion and air qualty benefits, the cost-benefits impacts have been shown to be more beneficial (4:1). The health benefits from cycling outweigh any safety risks from increased cycling by more than 20 times[10].

Air quality impacts and other benefits

Emissions impacts

Table 42: Emissions impacts for test 8a (5% reduction in car movements)

Area	Total NOx (t/a)	NOx % of baseline	NOX Petrol Cars	NOX Diesel Cars	NOX Rigid HGV	NOX Artic HGV	NOX Buses
AREA A	34.4	97.8%	15.6%	27.7%	38.6%	7.9%	10.3%
	Total PM (t/a)	**PM % of baseline**	**PM Petrol Cars**	**PM Diesel Cars**	**PM Rigid HGV**	**PM Artic HGV**	**PM Buses**
AREA A	3.04	96.1%	43.1%	33.6%	17.0%	2.8%	3.5%
	Total C (t/a)	**C % of baseline**	**C Petrol Cars**	**C Diesel Cars**	**C Rigid HGV**	**C Artic HGV**	**C Buses**
AREA A	5,051	95.9%	55.9%	25.9%	12.6%	2.7%	2.9%

[10] http://www.corporatecitizen.nhs.uk/data/files/resources/269/Active-Travel-The-Miracle-Cure.pdf

MEASURE DESCRIPTION

Table 43: Emissions impacts for test 8b (10% reduction in car movements)

Area	Total NOx (t/a)	NOx % of baseline	NOX Petrol Cars	NOX Diesel Cars	NOX Rigid HGV	NOX Artic HGV	NOX Buses
AREA A	33.6	95.5%	15.1%	26.8%	39.4%	8.1%	10.5%
	Total PM (t/a)	**PM % of baseline**	**PM Petrol Cars**	**PM Diesel Cars**	**PM Rigid HGV**	**PM Artic HGV**	**PM Buses**
AREA A	2.92	92.2%	42.6%	33.2%	17.7%	2.9%	3.7%
	Total C (t/a)	**C % of baseline**	**C Petrol Cars**	**C Diesel Cars**	**C Rigid HGV**	**C Artic HGV**	**C Buses**
AREA A	4,834	91.7%	55.4%	25.6%	13.1%	2.8%	3.1%

Table 44: Emissions impacts for test 8c (20% reduction in car movements)

Area	Total NOx (t/a)	NOx % of baseline	NOX Petrol Cars	NOX Diesel Cars	NOX Rigid HGV	NOX Artic HGV	NOX Buses
AREA A	32.0	91.1%	14.1%	25.0%	41.4%	8.5%	11.0%
	Total PM (t/a)	**PM % of baseline**	**PM Petrol Cars**	**PM Diesel Cars**	**PM Rigid HGV**	**PM Artic HGV**	**PM Buses**
AREA A	2.67	84.5%	41.3%	32.2%	19.3%	3.2%	4.0%
	Total C (t/a)	**C % of baseline**	**C Petrol Cars**	**C Diesel Cars**	**C Rigid HGV**	**C Artic HGV**	**C Buses**
AREA A	4,399	83.5%	54.1%	25.0%	14.4%	3.1%	3.4%

Air quality impacts

Encouraging a modal shift and reducing car of movements by 5%, 10% and 20% was estimated to reduce annual average NO_2 by approximately 0.2 µg/m^3, 0.4 µg/m^3 and 0.7 µg/m^3 within area A respectively.

Assumptions

Tests 8a, 8b and 8c assume a five, ten and 20 percent reduction in car movements. The air quality impact was estimated using road traffic emission rates estimated for Wilderspool Causeway and relevant receptor located at number 143.

MEASURE DESCRIPTION

9. Park and Ride

Summary description

A park and ride scheme aims to reduce traffic travelling and parking within the town centre by establishing and out of town car park and using buses to travel into the centre. Many towns in the UK have operational park and ride schemes, some which operate only at weekends and others throughout the week.

Implementation method

There is no year round Park and Ride scheme into the centre of Warrington. The only park and ride scheme to run in the borough operates specifically for Christmas shopping on Saturdays. This runs from two sites, to the north of the town centre (Warrington Collegiate campus) and south (Bruntwood Wilderspool Park). The local authority has reviewed potential sites for a park and ride or rapid transit system as part of the 3rd LTP. However, opportunities to develop a proposal will depend on funding.

Suitable locations

A suitable location will be one that has the space for a car park out of town, a suitable fast route into town and ideally has access to a major link road or motorway.

Catchment area

This depends on the route and numbers of services operating.

Boundary assumptions

- Target area - Dependent on route
- Vehicles affected - Buses and cars
- Test - No test undertaken
- Test year - 2012

Indicative costs

There will be set up costs associated with land purchase, facilities at the site (toilets etc.), signage, landscaping, fencing, CCTV cameras etc. There will also be operating costs which will depend on the number of bus services and revenue from the cost of the parking/bus fare.

Air quality impacts and other benefits

Emissions impacts

For the scenario modelled, the Park and Ride would save 1.2 g NOx, 0.2 g PM and 0.2 g C per kilometre as shown in Table 45 for a single bus and car. The likely location and frequency of the service is not known at this stage, so aggregated emissions calculations have not been made.

Table 45: Emission impacts of a Park and Ride scheme.

Net emissions impact calculation (best case example)			
	Emission (2012)		
	NOx (g/km)	PM (g/km)	C (g/km)
Double decker bus	5.65	0.17	238
Passenger car*	0.17	0.03	48
Assuming a best case patronage of 46 (i.e. two thirds of capacity) with an average car occupancy of 1.59 the number of cars removed would be approximately 28			
	Equivalent emissions (g/km)		
	NOx (g/km)	PM (g/km)	C (g/km)
Passenger car*	4.8	0.8	1330.1
Difference using the bus	1.2	0.2	0.2

Air quality impacts

MEASURE DESCRIPTION

Air quality impacts have not been estimated at this stage, since potential scenarios for the Park and Ride are not currently available.

Assumptions

The bus emission rate is fleet weighted according to the NAEI for 2012 and is given in ;

Table 46: Fleet weighted bus emission rates

Buses Pre-Euro 1OK	0.00
Buses Euro 1OK	0.01
Buses Euro 2OK	0.09
Buses Euro 3OK	0.30
Buses Euro 4OK	0.18
Buses Euro 5OK	0.42
Buses Euro 6OK	0.00

A bus patronage of 46 is assumed (this is a best-case assumption) and an average car occupancy of 1.59 has been assumed.

MEASURE DESCRIPTION

10. Compulsory purchase

Summary description

Compulsory purchase orders (CPO) gives local authorities the power to take over land and/or housing. This is typically done to improve the quality of the housing on the land. However, it could have the potential to be used for specific areas such as close to motorways where levels of air quality are deemed to be unacceptable for people to live in. This would allow local authorities to move people to areas with a better quality of air and to use the land for other purposes.

Implementation method

To remove existing Air Quality Management Areas would involve compulsory purchase of a number of residential properties and changing

MEASURE DESCRIPTION

use to non-residential and a total block on development to residential in these areas in the future. Other areas close to the objectives need also to be considered.

Current AQMAs:

Parker Street town centre: 35 properties on Parker Street and Wilson Patten Street

Sankey Green Island: 14 properties on Baxter Street and Sankey Green Island

Motorway AQMA: 40 Properties

For areas currently close to the air quality objectives and may need designating:

Chester Road: 138 properties

Wilderspool Causeway: 122 properties

Knutsford Road: 144 properties

Crosfield Street: 19 properties

Mersey Street: 6 properties

Appropriateness of measure

This is considered to be a last resort once all other options have been considered. There will be political and moral implications of compulsory purchasing of people's homes.

There will be additional issues of re-housing

Also the areas that are compulsory purchases will be redeveloped for alternative use. This may increase traffic impact on other areas leading to further air quality issues outside of those redeveloped

Boundary assumptions

MEASURE DESCRIPTION
• Affected properties removed • Test year - 2012
Indicative costs House prices can vary considerable across Warrington depending upon location and type of house. But based on an average house price in Warrington of £178,000 for 2012 and not including legal costs, indicative costs would be: Parker Street: £6,000,000 Sankey Green: £2,500,000 Motorway: £7,100,000 Total to remove existing AQMAs would be £15,300,000 For areas close to the objective, cost would be £76,000,000
Air quality impacts and other benefits There would be no impact on emissions or pollution concentrations, although there would no longer be relevant exposure at locations currently above the air quality objective for NO_2. Therefore no AQMAs would be required and Warrington would meet the national objectives.

B. Scoping Options – Model Set up

Traffic modelling

For the scoping phase the impacts of scenarios were considered within the three study areas A, B or C depending upon the relevance and as shown in Figure 30. Traffic model data applicable to the light grey shaded roads were assigned to each zone to assist the analysis phase. Traffic flow and vehicle composition data were provided by Warrington Council in the form of a peak hour traffic model and separate classification counts. The peak hour traffic model outputs were scaled to AADT and then split in accordance with the classification data. In total traffic activity was considered on 378 separate road links. Road traffic speed was assumed to be 30 km/h on all links.

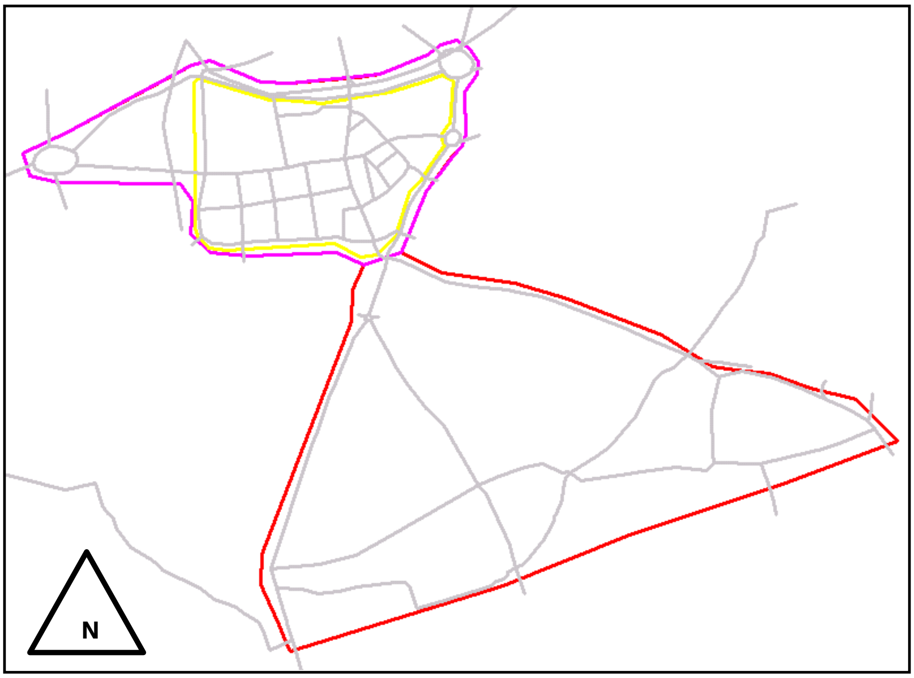


Figure 30: Assessment areas applied for the scoping phase (Area A = red+pink: Area B = pink: Area C = yellow)

Emissions modelling

Road traffic emissions for all tests were estimated using the Emissions Factor Toolkit (EFT) v5.1. The tool kit allows the user to input the traffic flow and vehicle composition including the percentage of cars, light goods vehicles, taxis, rigid goods vehicles, artic goods vehicles and buses. Further inputs can be undertaken to refine existing vehicle emission standards.

Air quality modelling

The impacts on nitrogen dioxide (NO_2) and PM_{10} concentrations were estimated using the ADMS Roads air pollution model. Impacts were estimated at worst case roadside locations within zones as being indicative of the impact as shown in Table 47 and Figure 31. The table indicates which specific road link and receptor locations were applied for each test. Concentrations are broadly indicative of likely changes in the areas considered (these changes would not be uniform throughout the affected areas). Measures considered in the detailed assessment phase are more robust.

Table 47. Receptor modelling

	Receptor@ Priestley	Receptor@ Patten	Receptor@ Wilder
Grid coordinate	359579-388303	360437-387865	360843-387346
Test 1	Area A		
Test 2		Area C	
Test3		Area B	
Test4	Area B	Area C	
Test5			Area A
Test6			Area A
Test7			Area A
Test8			Area A

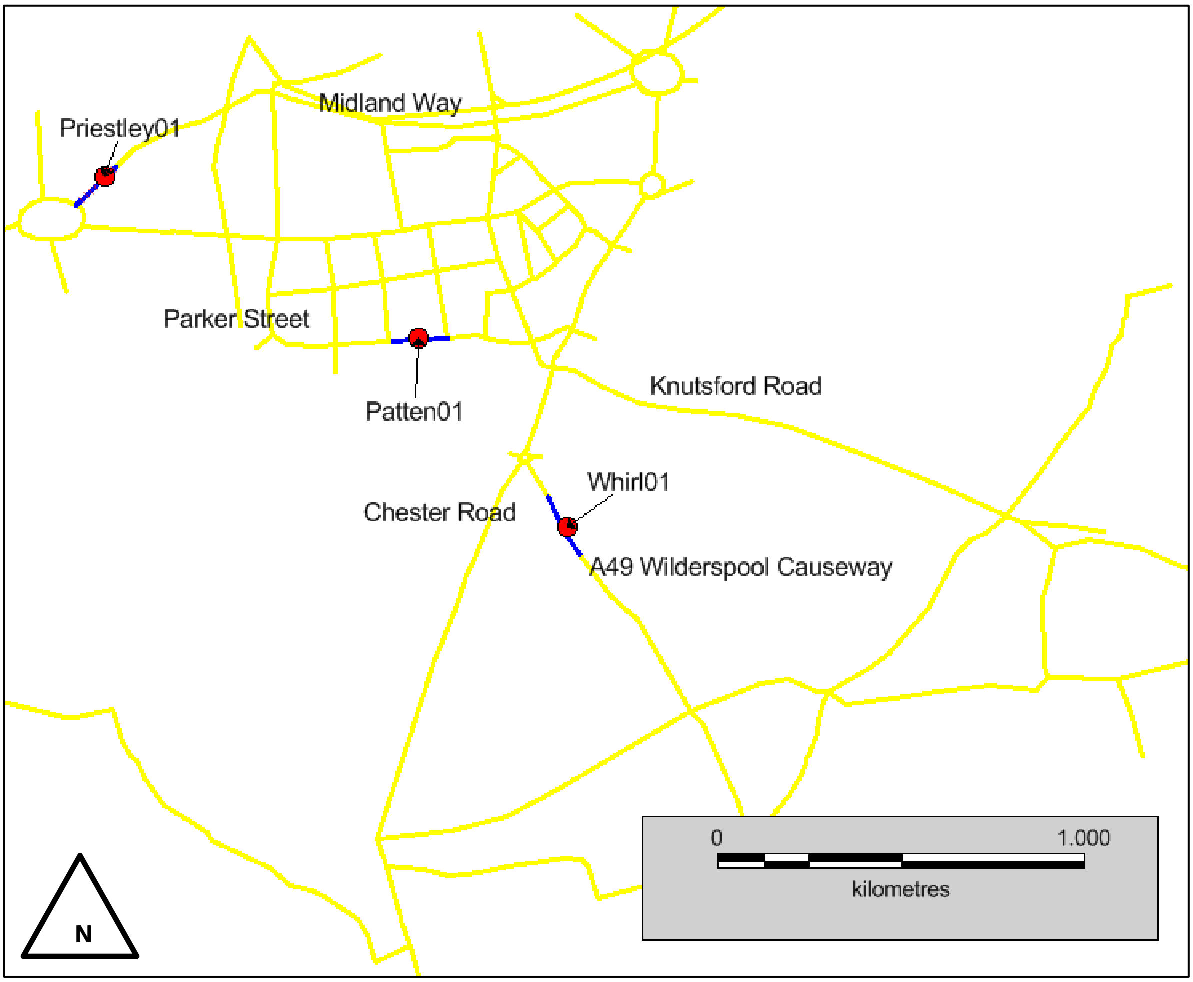


Figure 31: Receptor modelling map. Modelled road links in blue and receptors in red

Results

The results are reported as mass of emissions in tonnes per annum (t/a) with the percentage contribution from a specific source for that pollutant. Having run a scenario, new annual emissions values are presented as a percentage of the original mass.

Emissions emitted into a volume of air form concentrations and are expressed in micrograms per metre cubed ($\mu g/m^3$). This is the metric applied when assessing potential health impacts. Changes in concentrations of a pollutant are typically expressed in units of $\mu g/m^3$.

Baseline

Table 48 shows the baseline total nitrogen oxides (NO_x), particle matter (PM) and carbon (C) emissions from the modelled Warrington road network in 2012 within the study zones, along with the percentage contribution to emissions from petrol cars, diesel cars, rigid HGV, articulated HGVs and buses. It is not known at this stage what additional emission contributions come from minor roads within the study area. However, it is expected that emissions from the modelled major roads will dominate.

Table 48: Total modelled emissions from the road network in Warrington, 2012.

<table>
<tr><th>Area</th><th>Total NOx (t/a)</th><th>NO_X Petrol Cars</th><th>NO_X Diesel Cars</th><th>NO_X Rigid HGV</th><th>NO_X Artic HGV</th><th>NO_X Buses</th></tr>
<tr><td>AREA A</td><td>35.2</td><td rowspan="3">16.0%</td><td rowspan="3">28.5%</td><td rowspan="3">37.7%</td><td rowspan="3">7.7%</td><td rowspan="3">10.0%</td></tr>
<tr><td>AREA B</td><td>21.3</td></tr>
<tr><td>AREA C</td><td>6.0</td></tr>
<tr><td></td><td>Total PM (t/a)</td><td>PM Petrol Cars</td><td>PM Diesel Cars</td><td>PM Rigid HGV</td><td>PM Artic HGV</td><td>PM Buses</td></tr>
<tr><td>AREA A</td><td>3.16</td><td rowspan="3">43.6%</td><td rowspan="3">34.0%</td><td rowspan="3">16.3%</td><td rowspan="3">2.7%</td><td rowspan="3">3.4%</td></tr>
<tr><td>AREA B</td><td>1.92</td></tr>
<tr><td>AREA C</td><td>0.54</td></tr>
<tr><td></td><td>Total C (t/a)</td><td>C Petrol Cars</td><td>C Diesel Cars</td><td>C Rigid HGV</td><td>C Artic HGV</td><td>C Buses</td></tr>
<tr><td>AREA A</td><td>5,269</td><td rowspan="3">56.5%</td><td rowspan="3">26.1%</td><td rowspan="3">12.1%</td><td rowspan="3">2.6%</td><td rowspan="3">2.8%</td></tr>
<tr><td>AREA B</td><td>3,194</td></tr>
<tr><td>AREA C</td><td>898</td></tr>
</table>

Table 49 shows the proportion of vehicle kilometres by vehicle type in the study area in 2012. 2008 traffic flows in the traffic model were scaled to 2012 using local factors derived from TEMPRO. Although cars are responsible for most of the vehicle kilometres, comparison with Table 49 shows that heavy vehicles contribute disproportionately to emissions, particularly for NOx where they contribute nearly half of modelled emissions.

Table 49: Proportion of vehicle kilometres driven within study area, 2012

Vehicle kilometres per year				
Area	**Cars**	**Rigid HGVs**	**Articulated HGVs**	**Bus & Coaches**
A,B,C	95.0%	3.9%	0.4%	0.6%

C. Scoping Options - Summary of air quality impacts

					Baseline		Background						Without measure			Adjusted source component				With measure			Diff
	Test Link	Receptor location	Distance from road centre to receptor (m)	Direction from road source to receptor	Road Nox ug/m³	Road PM ug/m3	Nox ug/m3	Sector influenced NOX reduction ug/m3	PM10 ug/m3	Sector influenced PM reduction ug/m3	NO2 ug/m3	Sector influenced NO2 reduction ug/m3	Total NO2 ug/m3	Road NO2 ug/m3	Total PM10 ug/m3	NOX Adjustment factor	PM Adjustment factor	Road Nox ug/m3	Road PM ug/m3	**Total NO2 ug/m3**	**Road NO2 ug/m3**	**Total PM10 ug/m3**	**Overall scenario effect ug/m3**
Test 1 LEZ																							
AREA A	Preistley Street adjacent to Edelsten Street	9 Manley Gardens	16.3	North West	0.2	0.02	77.1	76.8	18.7	18.6	40.0	39.9	40.1	0.1	18.7	1.0	0.9	0.2	0.02	40.0	0.1	18.6	-0.13
Test 2a FCC (Mandatory 100% uptake)																							
AREA C	Between Bold and Winmarleigh Street	9 Wilson Patton Street	9.3	North	0.3	0.03	49.7	47.9	16.8	16.7	30.2	29.3	30.4	0.2	16.8	0.8	0.9	0.3	0.03	29.4	0.1	16.7	-0.95
Test 2b FCC (voluntary 20% uptake)																							
AREA C	Between Bold and Winmarleigh Street	9 Wilson Patton Street	9.3	North	0.3	0.03	49.7	49.3	16.8	16.8	30.2	30.0	30.4	0.2	16.8	1.0	1.0	0.3	0.03	30.1	0.2	16.8	-0.24
Test 3a New Bridge (35 km/h)																							
AREA B	Between Bold and Winmarleigh Street	9 Wilson Patton Street	9.3	North	0.3	0.03	49.7	49.5	16.8	16.8	30.2	30.1	30.4	0.2	16.8	1.0	1.0	0.3	0.03	30.3	0.2	16.8	-0.10
Test 3b New Bridge (25 km/h)																							
AREA B	Between Bold and Winmarleigh Street	9 Wilson Patton Street	9.3	North	0.3	0.03	49.7	50.6	16.8	16.8	30.2	30.6	30.4	0.2	16.8	1.1	1.0	0.4	0.03	30.8	0.2	16.9	0.46
Test 4 Re-route																							

					Baseline		Background						Without measure			Adjusted source component				With measure			Diff
	Test Link	Receptor location	Distance from road centre to receptor (m)	Direction from road source to receptor	Road Nox ug/m^3	Road PM ug/m3	Nox ug/m3	Sector influenced NOX reduction ug/m3	PM10 ug/m3	Sector influenced PM reduction ug/m3	NO2 ug/m3	Sector influenced NO2 reduction ug/m3	Total NO2 ug/m3	Road NO2 ug/m3	Total PM10 ug/m3	NOX Adjustment factor	PM Adjustment factor	Road Nox ug/m3	Road PM ug/m3	**Total NO2 ug/m3**	**Road NO2 ug/m3**	**Total PM10 ug/m3**	**Overall scenario effect ug/m3**
AREA B	Preistley Street adjacent to Edelsten Street	9 Manley Gardens	16.3	North West	0.2	0.02	77.1	79.5	18.7	18.8	40.0	41.3	40.1	0.1	18.7	1.3	1.1	0.3	0.02	41.4	0.1	18.8	**1.24**
AREA C	Between Bold and Winmarleigh Street	9 Wilson Patton Street	16.3	North West	0.3	0.03	49.7	48.3	16.8	16.7	30.2	29.5	30.4	0.2	16.8	0.8	0.9	0.3	0.03	29.6	0.1	16.8	**-0.74**
Test 5 EV 1% uptake (cars, Rigids)																							
AREA A	Wilderspool Causeway between Central Avenue and Fletcher Street	143 Wilderspool Causeway	11.4	North East	0.3	0.02	49.7	49.6	16.8	16.8	30.2	30.2	30.3	0.1	16.8	1.0	1.0	0.3	0.02	30.3	0.1	16.8	**-0.05**
Test 6a 20% CNG buses																							
AREA A	Wilderspool Causeway between Central Avenue and Fletcher Street	143 Wilderspool Causeway	11.4	North East	0.3	0.02	49.7	49.6	16.8	16.8	30.2	30.1	30.3	0.1	16.8	1.0	1.0	0.3	0.02	30.3	0.1	16.8	**-0.08**
Test 6b 40% CNG buses																							
AREA A	Wilderspool Causeway between Central Avenue and Fletcher Street	143 Wilderspool Causeway	11.4	North East	0.3	0.02	49.7	49.4	16.8	16.8	30.2	30.1	30.3	0.1	16.8	1.0	1.0	0.3	0.02	30.2	0.1	16.8	**-0.15**
Test 7a 20% CNG HGV																							
AREA A	Wilderspool Causeway between Central Avenue and Fletcher Street	143 Wilder pool Causeway	11.4	North East	0.3	0.02	49.7	49.0	16.8	16.8	30.2	29.9	30.3	0.1	16.8	0.9	1.0	0.3	0.02	30.0	0.1	16.8	**-0.34**
Test 7b 20% dual fuel HGV																							

					Baseline		Background							Without measure			Adjusted source component				With measure			Diff
	Test Link	Receptor location	Distance from road centre to receptor (m)	Direction from road source to receptor	Road Nox ug/m^3	Road PM ug/m3	Nox ug/m3	Sector influenced NOX reduction ug/m3	PM10 ug/m3	Sector influenced PM reduction ug/m3	NO2 ug/m3	Sector influenced NO2 reduction ug/m3	Total NO2 ug/m3	Road NO2 ug/m3	Total PM10 ug/m3	NOX Adjustment factor	PM Adjustment factor	Road Nox ug/m3	Road PM ug/m3	**Total NO2 ug/m3**	**Road NO2 ug/m3**	**Total PM10 ug/m3**	**Overall scenario effect ug/m3**
AREA A	Wilderspool Causeway between Central Avenue and Fletcher Street	143 Wilderspool Causeway	11.4	North East	0.3	0.02	49.7	49.4	16.8	16.8	30.2	30.0	30.3	0.1	16.8	1.0	1.0	0.3	0.02	30.1	0.1	16.8	**-0.19**
Test 8a Modal shift 5% reduction in cars																							
AREA A	Wilderspool Causeway between Central Avenue and Fletcher Street	143 Wilderspool Causeway	11.4	North East	0.3	0.02	49.7	49.4	16.8	16.7	30.2	30.0	30.3	0.1	16.8	1.0	1.0	0.3	0.02	30.2	0.1	16.8	**-0.18**
Test 8b Modal shift 10% reduction in cars																							
AREA A	Wilderspool Causeway between Central Avenue and Fletcher Street	143 Wilderspool Causeway	11.4	North East	0.3	0.02	49.7	49.0	16.8	16.7	30.2	29.8	30.3	0.1	16.8	1.0	0.9	0.3	0.02	30.0	0.1	16.7	**-0.36**
Test 8c Modal shift 20% reduction in cars																							
AREA A	Wilderspool Causeway between Central Avenue and Fletcher Street	143 Wilderspool Causeway	11.4	North East	0.3	0.02	49.7	48.3	16.8	16.6	30.2	29.5	30.3	0.1	16.8	0.9	0.8	0.2	0.02	29.6	0.1	16.6	**-0.72**

D. Automatic Number Plate Recognition (ANPR) Camera Survey

Introduction

The scoping meeting in July 2012 highlighted concerns over the limited traffic data and that this may hinder the effective testing of options. For example, in order to manage the routing of heavy goods vehicles there needs to be an understanding of the current situation. For this reason WBC conducted comprehensive automatic number plate recognition survey and ATC survey across the town centre in May 2013.

The ANPR survey included the following elements;

- To apply cameras at 16 sites capturing vehicles across all lanes across the town centre and approach roads. This was required because on urban roads goods vehicles typically travel in all lanes.
- Conducted on a neutral day of the week (i.e. Tuesday, Wednesday or Thursday). The traffic composition and traffic flows are generally different on Mondays and Friday's. Equally, traffic activity on weekends differs from that of weekdays. The most effective survey would involve observing traffic Thursday to Saturday. For this study, given the nature of the measures under review, a single weekday was deemed sufficient.
- The location of cameras shown in Figure 32 would need to be applied with information captured in both directions (i.e. 32 cameras)

These cameras provided the baseline for the town centre and the connecting roads plus information for benchmarking as well as monitoring the effects of various options. The information gathered included vehicle flows, vehicle mode, and destination of travel.

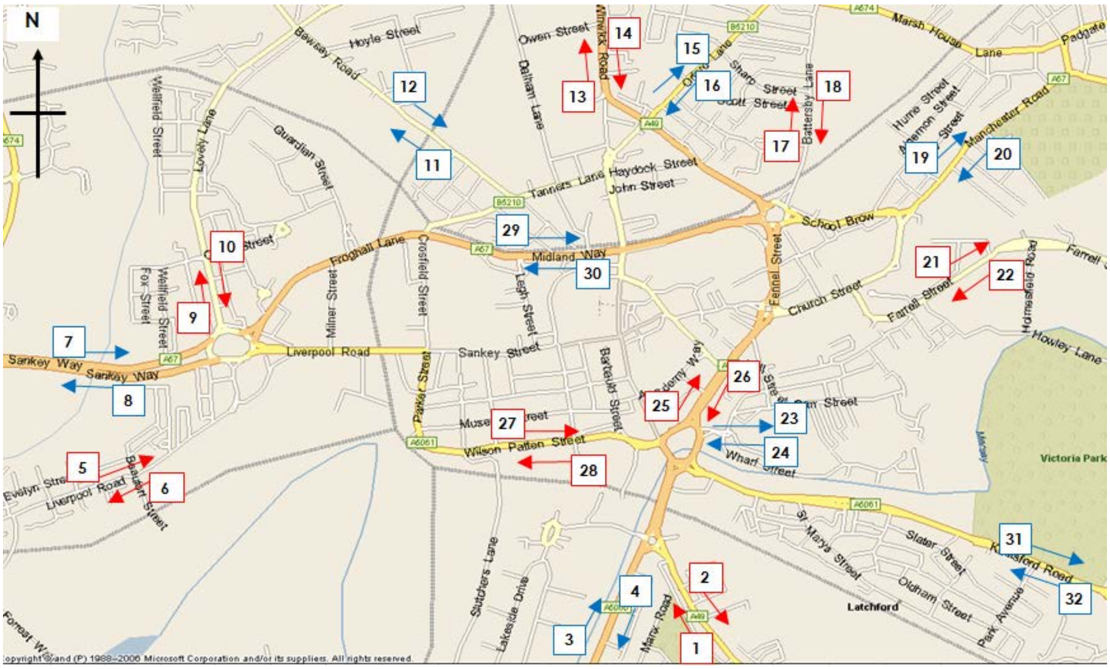


Figure 32: ANPR camera locations

Data analysis

Data checks

Following completion of the survey a number of checks were conducted to ensure that the data were of sufficient quality to represent the traffic situation in Warrington. The results of these comparative checks are shown in Appendix C. One of the more important checks is the one where a sample of registration plate details from the video recorded by the ANPR camera is checked manually and then compared to the automatic recognition file. The overall performance of the ANPR survey was 95%.

Origin-destination

A trip matrix was used as the basis for the detailed data analysis. This is given in Table 50 where the camera IDs correspond to Figure 32

Table 50: Trip matrix format

To and from cordon camera Locations	Camera ID into the town	Camera ID out of the town
a. A49 Winwick Road	14	13
b. B5210 Orford Lane	16	15
c. Battersby Lane	18	17
d. A67 Manchester Road	20	19
e. Farrell Street	22	21
f. Wharf Street	24	23
g. A6061 Knutsford Road	32	31
h. Wilderspool Causeway	1	2
i. A5060 Chester Road	3	4
j. Old Liverpool Road	5	6
k. A57 Sankey Way	7	8
l. Lovely Lane	10	9
m. Bewsey Rd	12	11

Dealing with unique vehicles in the dataset

Individual camera data were provided as a series of text files. Each vehicle observation had an ID, registration number and time stamp. There is a requirement to anonymise all observations prior to matching to the DVLA database as no details of vehicles are allowed to be identified to a specific location and or time of day. Due to this requirement, analysis of the observed data to determine origin-destination of vehicles proved extremely difficult and time consuming. Therefore, the team had to develop an alternative approach which best optimised the dataset. The following describes how the data were sorted and analysed.

1. All 119,756 trips (by cordon entry/exit and duration) were grouped within seven time periods as shown in Table 51. A trip is defined as having taken place between two cameras and/or observed by a single camera. On this basis, a trip (between exit and entry points) may include several sub trips.

Table 51: Initial time period grouping criteria

From	to	Reference Period
00:00:00	07:00:00	NightAM
07:00:00	09:00:00	AMPeak
09:00:00	11:00:00	AMoffPeak
11:00:00	14:00:00	DayInterPeak
14:00:00	16:00:00	PMoffPeak
16:00:00	18:00:00	PMPeak
18:00:00	00:00:00	NightPM

2. 88,771 vehicles were captured by a cordon entry and exit camera combination with or without sub-trips. Of this, 30,985 vehicles were identified by an entry and or exit camera only. These were vehicles parked in the town centre prior to the survey or entering the town but not leaving until after the survey. It is noted that there may also be vehicles managing to bypass the cameras having been singularly observed. For these observations, trip duration could not be calculated.

3. To better represent vehicles within a particular period, the classification system corresponded to the mid-time of each trip. An example of filtered output is shown in Table 52. Here, the trip identified is from camera location 03 to 08. In the sample, vehicle MV55NGO has undertaken this trip twice in different periods and over similar durations. These results would need to be mined into further to determine if any sub-trips were involved.

Table 52: Sample of results

Entry-exit	**Sub-route**	**Mid Time**	**Duration (mins)**	**Reg No**	**Reference Period**	**Period ID**
3-8	03-08	11:36:09	5	MV55NGO	DayInterPeak	4
3-8	03-08	14:51:12	7	MV55NGO	PMoffPeak	5
3-8	03-08	13:14:16	6	MV58NFD	DayInterPeak	4
3-8	03-08	08:18:13	7	MV58VOK	AMPeak	2
3-8	03-08	16:48:07	10	MV59PZH	PMPeak	6
3-8	03-08	12:04:31	6	MV59TGU	DayInterPeak	4
3-8	03-08	16:39:53	187	MV59WEA	PMPeak	6
3-8	03-08	13:21:21	5	MV60NLK	DayInterPeak	4
3-8	03-08	14:41:08	6	MV61SUH	PMoffPeak	5

4. Once all of the 119,756 observations were sorted, a total of 27,716 independent trip variations and 19,427 unique values were determined. If the actual duration was applied, this would result in even higher levels of unique values so the durations were rounded up to the nearest ten minutes. Clearly, over 16 percent

of unique values are unacceptable with the majority of these having duration, which is the important element of this study.

5. The next steps involved a series of tests looking at adjusting the trip descriptors to reduce the uniqueness of the database, where

   - The period ID is 1 of 4: am-peak (AM), inter-peak (IP), pm-peak (PM) or off-peak (OP) where:
   1. OP: 6pm-7am;
   2. AM: 7am-9am;
   3. IP: 9am-4pm;
   4. PM: 4pm-6pm.
   - Duration is rounded up to 10 minutes (as stated before).
   - Sub-route includes any inner sites that the vehicle has been detected at in-between entering and leaving Warrington.
   - Using the full string as the descriptor gave too many unique values: 14,678 out of 88,771.

Taking various parameters out of the descriptor string gave the following uniqueness as shown in Table 53.

Table 53: Results of the grouping exercise

Adjustment	Descriptor	Unique values	out of
All	Entry-exit & Sub-route & Duration (mins) & Entry Period id & Exit Period id	14,678	88,771
Remove Duration	Entry-exit & Sub-route & Entry Period id & Exit Period id	3,106	88,771
Remove Sub-route	Entry-exit & Entry Period id & Exit Period id	221	88,771
Remove Exit Period id	Entry-exit & Entry Period id	5	88,771
Remove Entry Period id	Entry-exit	0	88,771
Add in Durations	Entry-exit Duration (mins)	2,095	88,771

The only practical way to clear the uniqueness is to use “Entry-exit” & “Entry Period id”, and delete the five problematic records. However, it this was done, this would lose detail in the dataset and not allow the low emissions options to be adequately assessed.

Another option considered creating different files for the same ANPR data to get different information as identified below:

- One file with the ANPR data marked up by count site and time period – for deriving fleet composition data by link.
- Another file (with the same ANPR data) marked up by entry/exit only Etc.

After further discussion it was decided to sort the data according to the following description and round up to 10 minutes;

Entry-Exit" & "Entry period id" & "Duration"

This gave 4,880 unique entries for the data with an entry and exit site. However, if duration was rounded according to the bins described in Table 54, unique entries would reduce to 1,802 out of 88,771.

Table 54: Duration bins

Duration banding	
Minutes	Hours
0 to 15	0 to 0.25
15 to 30	0.25 to 0.5
30 to 45	0.5 to 0.75
45 to 60	0.75 to 1
60 to 90	1 to 1.5
90 to 120	1.5 to 2
120 to 150	2 to 2.5
150 to 180	2.5 to 3
180 to 210	3 to 3.5
210 to 240	3.5 to 4
240 to 300	4 to 5
300 to 360	5 to 6
360 to 420	6 to 7
420 to 480	7 to 8
480 to 540	8 to 9
540 to 600	9 to 10
600 to 9999	Over 10 hours

If the coarser banding shown in Table 55 was applied this would reduce the unique entries to 1,328 out of 88,771.

Table 55: Coarse duration bins

Duration banding	
Minutes	Hours
0 to 30	0 to 0.5
30 to 60	0.5 to 1
60 to 90	1 to 1.5
90 to 120	1.5 to 2
120 to 180	2 to 3

Duration banding	
180 to 240	3 to 4
240 to 300	4 to 5
300 to 360	5 to 6
360 to 420	6 to 7
420 to 480	7 to 8
480 to 540	8 to 9
540 to 600	9 to 10
600 to 9999	Over 10 hours

Using the bins shown in Table 54 further checks were undertaken of the following;

- Observation with an entry site but no exit site
- Observation with no entry site but an exit site
- Observation with no entry site and no exit site (i.e. vehicle only detected in the town centre)

Using the following descriptor: "Entry-Exit" & "Entry period id" & "Duration"

There are no unique values at all for the above data sets. However, if entry and exit sites are not known the duration is zero in all cases. Note that if the entry time is not known (i.e. for data-sets 2 & 4, the mid-point time (average of the first and last time vehicle is detected) applies.

If the mid-point time period for data-set 1 instead of entry period is applied, then number of unique entries dropped down to 1,604.

The final recommendation to deal with unique values was to sort the ANPR data according to the following descriptor;

"Entry-Exit" & "Entry period id" & "Duration for 88,771 and hence losing 1,802 trips.

As an example each single trip will have the following information characteristics;

Entry 1: Exit 8 (on the cordon)

AM Peak

0 to 15 minutes

Vehicle details

All data will be included in a separate file and sorted according to the following descriptor;

"Site" & "Entry period id" (no unique entries)

5. These data were analysed further to determine a hierarchy of route selection used by vehicles prior to matching. Hence, irrespective of vehicle type form an understanding of how traffic flows within the system.
6. The study team were unable to use these final descriptors to determine which way round vehicles traverse the ring road having entered and exited the cordon.

Determination of the most and least popular routes

Table 56 shows the full extent of vehicles observed entering and leaving Warrington within duration bins across all periods. Cells have been shaded to indicate the most (green) and least (blue) popular trip. The analysis showed that only a small fraction of vehicles entered and exited the town within a 15 minute period (e.g. ~0.02%) and that there was a tendency for vehicles to enter and leave using the same route. On the whole, the variation of trips across the day, in terms of the most popular, is less variable than the least popular. The routes from and to Winwick Road and similarly Sankey Way and from and to Sankey Way/Lovely Lane are key routes in Warrington.

Table 56: All vehicles observed between camera sites over all periods by duration

	Camera site	To Location Vehicles observed												
Duration (minutes)	From location	a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Cway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
0	a. A49 Winwick Road					1	1	1	1	1				
	b. B5210 Orford Lane								1					
	c. Battersby Lane			5	1		1					1		
	d. A67 Manchester Road				5		1						1	
	e. Farrell Street						2							
	f. Wharf Street	1		1				3				1		
	g. A6061 Knutsford Road	1				1		7	1	1	1			1
	h. Wilderspool Cway								1					
	i. A5060 Chester Road	1								4		3		
	j. Old Liverpool Road			1					1	1			1	
	k. A57 Sankey Way			1			1						5	
	l. Lovely Lane											4	10	1
	m. Bewsey Rd	1												
15	a. A49 Winwick Road	533	101	65	74	71	28	48	49	93	12	78	12	37
	b. B5210 Orford Lane	55	132	45	32	16	7	9	13	16	2	26	4	9
	c. Battersby Lane	35	28	176	56	30	13	24	29	40	5	30	4	10
	d. A67 Manchester Road	58	29	66	290	66	18	32	26	42	14	60	7	19
	e. Farrell Street	44	11	34	52	171	11	21	7	12	1	23	3	10
	f. Wharf Street	30	6	20	15	6	9	22	6	9		23		3
	g. A6061 Knutsford Road	42	19	27	20	31	29	203	34	40	7	56	10	22
	h. Wilderspool Cway	52	11	16	22	13	14	16	70	20	7	66	5	5
	i. A5060 Chester Road	56	14	21	24	14	10	17	33	118	3	51	7	8
	j. Old Liverpool Road	14	10	6	8	1	4	12	7	10	39	30	11	2
	k. A57 Sankey Way	82	27	33	46	30	17	45	48	39	53	411	21	26
	l. Lovely Lane	14	2	14	4	2	3	10	9	14	10	29	31	7
	m. Bewsey Rd	30	11	11	7	12	8	15	6	16	4	30	6	71
30	a. A49 Winwick Road	336	57	43	58	33	17	34	18	42	8	47	7	25
	b. B5210 Orford Lane	41	67	19	21	6	4	6	8	1	3	9	3	8

Duration (minutes)	Camera site / From location	To Location, Vehicles observed: a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Cway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	c. Battersby Lane	24	20	126	31	9	9	6	7	8	2	8	2	6
	d. A67 Manchester Road	36	28	36	186	31	6	16	10	10	8	38	2	10
	e. Farrell Street	27	5	14	25	123	9	17	3	8		16		4
	f. Wharf Street	17	6	2	14	7	4	12	4	1		12	2	
	g. A6061 Knutsford Road	28	11	9	17	22	14	121	26	19	3	29	2	5
	h. Wilderspool Cway	22	3	4	10	13	7	12	45	13	2	12		1
	i. A5060 Chester Road	23	10	9	10	6	9	13	13	82	1	26	2	8
	j. Old Liverpool Road	8	2	4	6			3	2	2	34	17	5	2
	k. A57 Sankey Way	56	7	13	29	14	12	15	16	21	24	301	11	10
	l. Lovely Lane	7	3	3	2	2		2	1	5	2	15	18	10
	m. Bewsey Rd	29	7	5	7	5	3	2	3	4	1	17	5	60
45	a. A49 Winwick Road	208	41	24	30	17	8	22	15	21	12	36	2	8
	b. B5210 Orford Lane	21	51	18	12	1		3	5	4		9		
	c. Battersby Lane	14	15	94	27	5	4	9	2	2	2	9	2	2
	d. A67 Manchester Road	25	10	19	155	20	8	15	9	6		16		3
	e. Farrell Street	15	2	11	13	102	6	10	7	2		7	1	
	f. Wharf Street	6		4	8	3		2	4	2	2	15	3	6
	g. A6061 Knutsford Road	16	4	3	4	27	12	99	17	7	1	18	4	2
	h. Wilderspool Cway	9	4	8	7	3	10	8	46	22	2	12		
	i. A5060 Chester Road	18	2	5	6	2	10	4	20	79		9	3	2
	j. Old Liverpool Road	3		3	2			2			32	12		4
	k. A57 Sankey Way	47	12	12	19	6	10	13	9	12	25	220	8	14
	l. Lovely Lane	2	3	6			5	4	1	8	5	9	17	4
	m. Bewsey Rd	11	9	3	3			1		3	3	2	2	37
60	a. A49 Winwick Road	311	44	53	31	24	17	27	22	26	7	63	5	13
	b. B5210 Orford Lane	22	69	32	14	3	3	6	3	3		6		4
	c. Battersby Lane	19	20	152	20	14	6	13	8	13	2	15	2	2
	d. A67 Manchester Road	33	17	44	225	33	7	14	8	14	4	28	2	4
	e. Farrell Street	16	4	10	13	138	5	18	9	9	2	6	1	3
	f. Wharf Street	7	5	6	16	4	1	7	5	6	2	13	3	
	g. A6061 Knutsford Road	28	4	10	21	42	15	199	34	27		24	1	4
	h. Wilderspool Cway	10	1	7	14	5	5	20	100	20		17		
	i. A5060 Chester Road	23	5	10	8	8	13	12	35	136	2	20		3
	j. Old Liverpool Road	6	3	2	1	2	2	2		2	29	23		3
	k. A57 Sankey Way	54	10	24	18	10	12	11	16	15	24	387	4	12
	l. Lovely Lane	4	2	9		1		3	2		3	15	22	4
	m. Bewsey Rd	13	9	6	3		2	3	2	2		12	3	44
90	a. A49 Winwick Road	201	29	37	25	8	8	12	15	11	3	35	4	10
	b. B5210 Orford Lane	20	31	23	10	3	2	2	2	4		5		2

Duration (minutes)	Camera site From location	To Location Vehicles observed a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Cway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	c. Battersby Lane	15	14	73	24	14	2	5	5	5		15		
	d. A67 Manchester Road	23	4	25	139	8	2	11	10	5		10		2
	e. Farrell Street	12	2	7	9	93		12	4	7		8		
	f. Wharf Street	7		3	5		3			7		9		
	g. A6061 Knutsford Road	13	5	10	9	29	14	129	35	13		7	1	2
	h. Wilderspool Cway	11	1		6	9	13	5	60	24		5	2	
	i. A5060 Chester Road	15		9	2	7	7	5	24	115		12	2	
	j. Old Liverpool Road	6					2				22	11		2
	k. A57 Sankey Way	41	5	11	12	3	8	12	11	7	12	281	10	16
	l. Lovely Lane	3	3	3		2		3	1		1	9	14	
	m. Bewsey Rd	7		4		2	2		2	3		9		29
120	a. A49 Winwick Road	131	12	10	14	6		3	6	17		42		8
	b. B5210 Orford Lane	3	20	18	9			4	2			6		1
	c. Battersby Lane	10	4	50	12	4		5	3	3		2		2
	d. A67 Manchester Road	18	7	21	83	9	3	2	5	6		8		1
	e. Farrell Street	4	2		5	49	3	7		3		2		
	f. Wharf Street					3						3		
	g. A6061 Knutsford Road	15		8	9	19	11	94	18	6		11	2	3
	h. Wilderspool Cway	8	2	3	2	4		10	51	14		7		
	i. A5060 Chester Road	13	5	3	4	3	5	7	10	63		15		1
	j. Old Liverpool Road				1		3	2			14	6		
	k. A57 Sankey Way	22	3	9	5	2	5	5	7	9	5	189	4	
	l. Lovely Lane	2								1		1	12	1
	m. Bewsey Rd	5	3	1	4						2			12
150	a. A49 Winwick Road	82	6	15	6	4	4	2	4	12		15	4	5
	b. B5210 Orford Lane	4	15	14	6					2				
	c. Battersby Lane	3	6	38	12			3	3	5				
	d. A67 Manchester Road	8		15	59	8			3	6		6		
	e. Farrell Street	10	2			24		4		2		2		
	f. Wharf Street							2	2			3		
	g. A6061 Knutsford Road	8		2	4	5	2	53	6	7		7		3
	h. Wilderspool Cway	8		2	3	3	2	7	36	11	2	3		
	i. A5060 Chester Road	4	2		5	3	2	3	11	55		13		
	j. Old Liverpool Road	1									9	9		
	k. A57 Sankey Way	13		4	6		5	5	9	12	6	122	4	2
	l. Lovely Lane	2			1	2						6	13	
	m. Bewsey Rd	3		2								3		12
180	a. A49 Winwick Road	63	2	11	9			5	7	9		14		2
	b. B5210 Orford Lane	4	9	9	2									

Duration (minutes)	Camera site / From location	a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Cway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
		To Location Vehicles observed												
	c. Battersby Lane	1	4	27	7					4		5		
	d. A67 Manchester Road	9	2	6	33	6	3	2	1	1		2		
	e. Farrell Street	4	1	2	2	22		3	3			3		
	f. Wharf Street	2		3	1		3			2				
	g. A6061 Knutsford Road	4		2	6	6	3	48	4	2		5		
	h. Wilderspool Cway	4			2	3		3	40	8		2		
	i. A5060 Chester Road	4			1	2	2		8	34		4	2	
	j. Old Liverpool Road										11	2	2	
	k. A57 Sankey Way	11		6	1			6	5	4	4	93		2
	l. Lovely Lane	1							2				6	
	m. Bewsey Rd			2	2							2		12
210	a. A49 Winwick Road	46		3	7	2	2		7	4	1	16	2	3
	b. B5210 Orford Lane	4	2	4	3									
	c. Battersby Lane	2		26	3									
	d. A67 Manchester Road	4		8	24	2		2	2	1		3		2
	e. Farrell Street			1		14								
	f. Wharf Street	2			3			3	3	2				
	g. A6061 Knutsford Road	4			4	6		36	5	3		4		
	h. Wilderspool Cway	4					2	4	22	4		3		
	i. A5060 Chester Road	8		2	3	2	2	2	7	41		2		
	j. Old Liverpool Road										8			
	k. A57 Sankey Way	14		1	3		2		3	4	3	80	3	3
	l. Lovely Lane			1						2			2	
	m. Bewsey Rd	3	2				2					2		4
240	a. A49 Winwick Road	82	7	16	4		8	7	12	13		13		4
	b. B5210 Orford Lane		14	4	2							5		
	c. Battersby Lane	6	2	30	6		3			3		5		
	d. A67 Manchester Road	5		8	49		7	2	5	2	3	3		
	e. Farrell Street	4		4	3	25		2		3		2		
	f. Wharf Street	4			3			3	4	2		2		2
	g. A6061 Knutsford Road	4		3	5	9	5	40	13	4		10	3	
	h. Wilderspool Cway	6			4	1	6	7	42	28		8		
	i. A5060 Chester Road	10		6	4		3	2	15	54		9		
	j. Old Liverpool Road	2									6	7		
	k. A57 Sankey Way	21		4	3	2	2	5	4	10	6	126	2	6
	l. Lovely Lane											2	2	
	m. Bewsey Rd	4	2	3								3		11
300	a. A49 Winwick Road	81	4	5	6	3	4	4	10	10		15		
	b. B5210 Orford Lane	7	11	4		2								

Duration (minutes)	Camera site From location	To Location Vehicles observed a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Cway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	c. Battersby Lane	3		18	5					3		4		
	d. A67 Manchester Road	7	2	5	32	7		4	4		1	4		
	e. Farrell Street				3	19		2						
	f. Wharf Street	4										2	2	2
	g. A6061 Knutsford Road	2		1		3		28	8	8		2		
	h. Wilderspool Cway	2		2	3	1		6	36	12		4		2
	i. A5060 Chester Road	10	1	4		3		1	11	48		8		
	j. Old Liverpool Road										5	6		
	k. A57 Sankey Way	17		6	8		2	2	5	5	2	115		4
	l. Lovely Lane	2							2		1		7	1
	m. Bewsey Rd											3		5
360	a. A49 Winwick Road	71	5		7	2		6	1	5		12	2	
	b. B5210 Orford Lane	2	13	6	3		2					2		
	c. Battersby Lane	4	5	18	2		2							
	d. A67 Manchester Road	3	2	6	47	4		2						
	e. Farrell Street			4	1	13		3						
	f. Wharf Street	2							2			3		
	g. A6061 Knutsford Road	4			4	5	2	33	5	3	2			2
	h. Wilderspool Cway								24	9		2		
	i. A5060 Chester Road	7	1		2				3	40		6		
	j. Old Liverpool Road										7	3	2	
	k. A57 Sankey Way	11			1	3	1	3			6	94		
	l. Lovely Lane				3								7	
	m. Bewsey Rd													8
420	a. A49 Winwick Road	98	6	4	5	2			4	3		12		
	b. B5210 Orford Lane	2	9	2	4									
	c. Battersby Lane		4	19	4									
	d. A67 Manchester Road	4		4	35	6						2		
	e. Farrell Street					14		6						
	f. Wharf Street													
	g. A6061 Knutsford Road				2	3		49	5	3		3		
	h. Wilderspool Cway		1	2	1			4	31	9				
	i. A5060 Chester Road								5	79		4	2	
	j. Old Liverpool Road										3	3		
	k. A57 Sankey Way	11					2	2		4	2	146	2	
	l. Lovely Lane											2	6	
	m. Bewsey Rd	2			2							3		2
480	a. A49 Winwick Road	214	8	26	13			5	4	3		33		
	b. B5210 Orford Lane	5	29	17	7					3				

Duration (minutes)	Camera site / From location	a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Cway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
		To Location Vehicles observed												
	c. Battersby Lane	2	15	62	13			2	2			2	4	
	d. A67 Manchester Road	8	8	12	110	6		2	6	2				
	e. Farrell Street			2	10	49		8	2			2		
	f. Wharf Street	2										4		
	g. A6061 Knutsford Road	3		4		13		86	24	6		3		
	h. Wilderspool Cway				2			14	124	31				
	i. A5060 Chester Road	3	2				2	5	14	233		8		
	j. Old Liverpool Road										16	13		
	k. A57 Sankey Way	24		3	2	1	2		2	2	14	420	5	3
	l. Lovely Lane				2							6	14	
	m. Bewsey Rd		2			2						4		8
540	a. A49 Winwick Road	208	3	22	8			6	4	3		24		4
	b. B5210 Orford Lane	2	28	12	3									
	c. Battersby Lane	6	4	46	11			2						2
	d. A67 Manchester Road	2	6	10	79	4		6	5					
	e. Farrell Street				2	54		5	4			2		
	f. Wharf Street											2		
	g. A6061 Knutsford Road	2		4	3	13		54	15	3				
	h. Wilderspool Cway	3						4	81	21		3		
	i. A5060 Chester Road	2							12	164	1	7		2
	j. Old Liverpool Road										15	9		
	k. A57 Sankey Way	19	3	4	3				3	3	10	354		5
	l. Lovely Lane	2										6	9	
	m. Bewsey Rd											3		13
600	a. A49 Winwick Road	139	4	4		2		2				22		2
	b. B5210 Orford Lane	2	24	5	1									
	c. Battersby Lane		8	38								2		
	d. A67 Manchester Road	7	5	8	58	4		6	5	2				
	e. Farrell Street			2	1	28		5	2					
	f. Wharf Street	1												
	g. A6061 Knutsford Road					9		95	16					
	h. Wilderspool Cway	4		1		3		3	62	24				
	i. A5060 Chester Road						2	2	11	126		3		
	j. Old Liverpool Road										8	5		
	k. A57 Sankey Way	17	2	2			2	4		2	7	260		8
	l. Lovely Lane												13	
	m. Bewsey Rd													11

What vehicles use which route?

The data was analysed with respect to individual vehicle emissions classes Table 57 shows a matrix of total trip observations for each route according to seven vehicle categories. Red, amber, green conditional formatting has been applied to indicate the variance of vehicle categories travelling between camera locations. The red values indicated that the dominant category was cars.

In terms of this study, interest was focused on goods vehicles. Light goods vehicles (LGVs) observed travelling between Farrell Street to Lovely Lane represented ~31 percent of the total traffic), although this represented only 12/38 observations. And for Wharf Street return (~20 percent) or 15/75 vehicles. Typically, in an urban context, you'd expect the proportion of LGVs to range between eight and 12 percent.

For articulated HGVs, higher proportions appear to be on the route from Manchester Road to Lovely Lane at ~6.4 percent which appears relatively high as is the return number of trips at 4.9 percent; also Winwick Road to Old Liverpool Road (~3.3 percent). Interestingly the artic traffic from Sankey Way is relatively low in comparison ranging from approximately zero to ~0.7 percent. Battersby Lane has by far the lowest artic activity.

In terms of rigid HGVs, higher proportions are reported on routes between Winwick Road to Wharf Street and Farrell Street; Wharf Street to Winwick Road (~4 percent) and, Old Liverpool Road (~3.9 percent); Farrell Street to Winwick Road (~4.4 percent); Wilderspool Causeway to Old Liverpool Road (~4.7 percent), Old Liverpool Road to Winwick Road (~4.9 percent). The highest number of trips observed was between Lovely Lane and Manchester Road at ~6.9 percent.

Table 57: Vehicle split by route all periods all durations (percentage)

All Periods: All Durations: From Directic

	a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Widerspool Cway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
a. A49 Winwick Road													
Car	87.5	81.1	88.0	78.8	78.0	81.7	83.8	78.3	80.3	76.7	84.3	80.3	88.1
Car/van	3.8	3.7	5.4	7.3	6.9	4.4	5.9	7.1	5.8	5.8	3.9	11.8	3.3
LGV	4.8	6.5	3.1	8.9	11.7	8.1	6.5	10.6	9.0	12.5	8.3	7.9	7.6
Bus/coach	0.9	8.0	2.5	1.2	0.2	0.4	1.3	0.3	0.8	0.8	0.4	0.0	0.0
Rigid HGV	1.7	0.7	0.8	2.4	2.8	3.5	1.7	2.7	2.3	0.8	1.9	0.0	0.5
Artic HGV	1.2	0.0	0.2	1.4	0.3	1.9	0.7	1.0	2.0	3.3	1.2	0.0	0.5
b. B5210 Orford Lane													
Car	77.4	93.9	93.6	87.9	86.3	84.0	86.6	77.3	89.3	88.6	88.3	71.4	84.0
Car/van	3.4	3.3	3.9	5.6	8.1	10.0	2.4	10.3	5.7	4.3	3.8	3.6	8.8
LGV	6.9	2.4	1.9	5.6	5.6	4.0	6.1	10.3	4.9	5.7	6.9	10.7	6.6
Bus/coach	9.7	0.4	0.3	0.4	0.0	0.0	2.4	1.0	0.0	0.0	0.3	14.3	0.0
Rigid HGV	2.1	0.1	0.3	0.4	0.0	2.0	2.4	1.0	0.0	1.4	0.7	0.0	0.6
Artic HGV	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c. Battersby Lane													
Car	84.9	96.6	93.0	89.4	89.5	88.1	86.5	87.5	86.6	84.9	89.3	84.0	88.7
Car/van	3.7	1.5	2.4	1.9	3.5	2.6	4.2	4.8	5.9	3.8	3.2	2.0	5.6
LGV	4.1	1.5	2.8	5.3	6.8	7.1	8.5	5.9	7.0	9.7	6.4	8.0	4.2
Bus/coach	6.9	0.5	1.5	2.7	0.0	1.1	0.4	1.4	0.3	1.1	0.5	4.0	0.0
Rigid HGV	0.4	0.0	0.3	0.7	0.2	1.1	0.4	0.3	0.3	0.0	0.5	2.0	1.4
Artic HGV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
d. A67 Manchester Road													
Car	80.5	88.7	86.8	90.3	88.0	84.4	77.7	82.4	82.5	78.4	83.6	75.5	77.8
Car/van	6.5	5.9	4.1	2.3	4.0	5.5	6.1	5.8	5.1	7.2	4.5	3.2	6.8
LGV	9.6	4.3	6.2	3.2	7.0	7.2	8.7	8.3	9.7	10.5	8.1	12.8	11.1
Bus/coach	0.9	0.5	1.9	2.7	0.0	0.6	3.9	0.2	0.1	0.7	0.0	1.1	0.5
Rigid HGV	1.3	0.0	0.8	0.5	0.0	1.9	2.2	2.5	1.3	2.6	2.8	1.1	3.4
Artic HGV	1.3	0.5	0.2	0.9	1.0	0.4	1.3	0.7	1.3	0.7	1.1	6.4	0.5

All Periods: All Durations: From Directio

	a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Cway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
e. Farrell Street													
Car	77.4	90.1	87.1	83.5	91.5	89.9	84.2	74.5	81.0	75.0	83.9	60.5	78.3
Car/van	6.3	4.4	3.9	4.8	3.5	3.9	7.7	8.2	7.2	7.9	4.1	5.3	7.7
LGV	11.2	5.5	9.0	10.1	3.9	5.0	7.7	14.5	10.5	17.1	9.7	31.6	14.0
Bus/coach	0.1	0.0	0.0	0.3	0.2	1.1	0.0	0.0	0.0	0.0	0.5	0.0	0.0
Rigid HGV	4.4	0.0	0.0	1.0	0.5	0.0	0.5	1.8	0.7	0.0	1.4	2.6	0.0
Artic HGV	0.5	0.0	0.0	0.3	0.4	0.0	0.0	0.9	0.7	0.0	0.5	0.0	0.0
f. Wharf Street													
Car	77.9	86.1	85.3	84.9	84.5	72.0	89.4	89.7	86.1	88.2	88.1	86.8	87.1
Car/van	6.3	8.3	6.8	4.3	6.9	6.7	3.5	3.6	4.5	2.6	2.5	3.8	1.6
LGV	8.8	2.8	6.8	8.0	6.9	20.0	5.1	5.5	7.8	5.3	6.3	7.5	9.7
Bus/coach	0.3	2.8	0.8	0.3	0.0	0.0	0.4	0.0	0.0	0.0	0.6	1.9	0.0
Rigid HGV	4.0	0.0	0.4	2.0	1.7	0.0	1.5	1.1	1.4	3.9	1.6	0.0	1.6
Artic HGV	2.8	0.0	0.0	0.3	0.0	1.3	0.1	0.0	0.2	0.0	0.8	0.0	0.0
g. A6061 Knutsford Road													
Car	77.2	84.4	85.4	80.0	93.9	91.3	88.5	83.9	79.5	67.8	87.4	86.6	81.6
Car/van	8.3	5.6	5.2	6.5	2.4	2.8	3.7	5.0	5.8	5.9	4.3	2.6	9.5
LGV	8.8	10.0	7.6	7.5	2.0	4.2	5.1	7.6	9.5	14.1	6.8	9.2	5.6
Bus/coach	2.1	0.0	0.7	3.5	1.0	0.0	2.0	0.6	0.6	0.8	0.1	0.3	2.3
Rigid HGV	1.8	0.0	1.0	1.5	0.7	1.2	0.2	1.3	3.5	9.3	1.0	0.7	1.1
Artic HGV	1.7	0.0	0.0	1.0	0.0	0.5	0.5	1.5	1.2	2.1	0.4	0.7	0.0
h. Wilderspool Cway													
Car	78.5	78.9	82.9	80.0	84.3	90.7	91.8	89.0	88.8	70.4	87.7	87.5	80.7
Car/van	6.6	9.2	5.9	6.3	6.9	2.2	1.6	1.2	3.7	8.3	4.8	5.1	6.7
LGV	10.0	9.2	8.5	10.3	7.8	6.3	3.3	3.4	6.1	14.2	5.0	6.8	10.9
Bus/coach	0.4	0.0	2.7	0.9	0.0	0.0	1.1	5.7	0.0	1.8	0.4	0.0	0.8
Rigid HGV	3.1	2.6	0.0	2.2	1.0	0.5	1.6	0.3	0.5	4.7	1.8	0.6	0.8
Artic HGV	1.4	0.0	0.0	0.3	0.0	0.3	0.5	0.4	0.9	0.6	0.3	0.0	0.0

All Periods: All Durations: From Directio

	a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Cway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
i. A5060 Chester Road													
Car	80.1	85.1	87.6	81.0	79.1	88.9	83.3	88.4	91.8	68.8	86.9	87.1	76.8
Car/van	5.7	3.3	5.0	6.1	5.2	3.6	5.8	3.8	2.0	8.4	5.3	2.3	8.9
LGV	8.6	10.7	6.5	9.3	11.9	5.1	7.7	5.6	3.4	17.3	5.7	6.8	12.8
Bus/coach	0.9	0.0	0.0	0.3	0.0	0.0	0.6	0.6	1.4	0.8	0.4	2.3	0.0
Rigid HGV	3.3	0.8	0.8	2.0	2.2	1.5	0.0	0.9	0.6	3.0	1.5	1.0	1.5
Artic HGV	1.4	0.0	0.1	1.2	1.5	0.8	2.6	0.6	0.7	1.7	0.3	0.5	0.0
j. Old Liverpool Road													
Car	70.5	75.9	84.8	76.2	65.1	86.8	70.8	82.4	75.2	65.7	87.4	74.1	85.0
Car/van	7.4	7.2	3.8	7.0	10.5	6.6	6.3	5.7	7.2	3.2	6.0	8.5	7.5
LGV	12.3	10.8	8.9	11.7	22.1	3.9	11.6	6.9	11.3	7.6	3.7	15.7	5.0
Bus/coach	1.6	6.0	2.5	0.4	0.0	0.0	0.0	1.2	0.5	22.2	0.8	0.3	2.5
Rigid HGV	4.9	0.0	0.0	4.4	2.3	2.6	9.6	3.8	3.6	0.9	1.3	1.2	0.0
Artic HGV	3.3	0.0	0.0	0.4	0.0	0.0	1.7	0.0	2.3	0.4	0.8	0.2	0.0
k. A57 Sankey Way													
Car	84.8	87.2	88.3	83.9	83.5	89.5	85.8	86.6	89.4	89.5	92.0	86.9	84.5
Car/van	5.3	5.2	4.2	5.2	5.0	3.4	4.5	4.3	4.1	3.0	2.0	4.7	5.8
LGV	7.3	5.8	6.5	7.3	9.5	5.0	8.2	7.0	5.5	5.1	2.4	6.8	7.7
Bus/coach	0.1	0.0	0.4	0.2	0.0	0.4	0.2	0.2	0.3	0.3	2.4	0.3	1.0
Rigid HGV	1.8	1.5	0.4	2.9	2.0	1.6	0.9	1.6	0.7	2.2	1.0	1.2	1.0
Artic HGV	0.7	0.3	0.1	0.5	0.0	0.0	0.4	0.2	0.1	0.0	0.2	0.2	0.0
l. Lovely Lane													
Car	83.7	92.0	90.2	73.5	77.8	93.2	88.8	83.4	87.3	76.3	88.1	76.7	84.4
Car/van	3.3	4.0	3.7	5.9	1.9	5.1	2.2	5.5	4.1	7.5	4.2	2.9	6.5
LGV	7.6	2.0	2.4	8.8	20.4	1.7	7.8	9.0	7.3	13.8	6.0	6.3	7.8
Bus/coach	3.3	2.0	2.4	0.0	0.0	0.0	0.4	0.7	0.0	0.2	0.4	12.9	1.3
Rigid HGV	1.1	0.0	1.2	6.9	0.0	0.0	0.9	1.4	1.3	1.9	1.0	0.5	0.0
Artic HGV	1.1	0.0	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.5	0.0
m. Bewsey Rd													
Car	85.6	83.6	87.5	75.5	70.6	86.4	78.8	77.3	77.7	60.0	83.1	88.9	89.8
Car/van	3.7	7.3	9.7	7.1	12.5	4.5	8.5	8.2	7.4	20.0	6.2	2.2	4.2
LGV	7.4	7.8	2.8	14.2	14.0	6.1	7.6	11.3	12.8	17.1	10.1	8.9	4.2
Bus/coach	0.5	0.9	0.0	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	1.1
Rigid HGV	1.9	0.4	0.0	3.2	2.2	3.0	0.0	3.1	1.6	2.9	0.6	0.0	0.4
Artic HGV	0.9	0.0	0.0	0.0	0.7	0.0	0.8	0.0	0.5	0.0	0.0	0.0	0.4

How does traffic vary by period?

To look at this issue, the number of vehicles using various routes within the four specific time periods was assessed. The tables below provide values that represent the ratio between the period mean hour and the mean of all observations over 24 hours. Conditional formatting has been applied whereby blue shaded cells represent the lower 50^{th} percentile values and red shaded cells the upper 50^{th} percentile values.

Table 58 shows these factors associated with all vehicle types. This analysis should not be confused with the previous data shown in Table 56 because here variation factors are derived based on individual routes. Hence, a high variation factor simply means that there has been a greater variation from the mean. In absolute terms this could occur with fairly low numbers of trips reported. Values which are nearer to 1 indicate that the period average is close to the 24 hour average. This table shows that the highest activity tends to occur during 7am to 9am and to a lesser degree over the night-time period (6pm to 7am) although there are variations by route. For example, the routes between Old Liverpool Road and Farrell Street, Sankey Way and Farrell Street and Chester Road have a higher variation in patronage during the morning peak compared to all other routes. Traffic activity on Wharf Street during the morning peak period is less variable when compared to inter and PM peak periods and picks up considerably during the inter peak period compared to other periods of the day. In terms of all vehicles, the routes associated with Winwick Road, Lovely Lane and Wharf Street show the least variation over the day.

Table 59 shows that there is a slightly different picture when comparing the period hourly mean with the 24 hour mean for arctic and rigid HGVs. Note that the blank spaces within the matrix indicate those routes void of HGV movements.

Some of the key findings from the table include:

- Traffic activity between Wharf Street to Farrell Street, Orford Lane to Liverpool Road, and Lovely Lane to Knutsford Road in the morning peak period is in the upper 50^{th} percentile for those routes.
- HGVs appear not to be attracted in the direction of Orford Lane across all periods.
- Five routes in particular maintain a HGV presence 24 hours a day (i.e. Winwick Road, Manchester Road, Knutsford, Widerspool Causeway and Sankey Way).
- The average hourly movement of HGVs tends to increase consistently between 9am and 4pm (i.e. in the upper 50^{th} percentile).
- There is a noticeable reduction in the average hourly numbers of HGVs travelling during 4pm to 6pm with the exception of routes Manchester Road to Orford Lane and Battersby Lane to Knutsford Road (although in terms of actual numbers of vehicles this variation is not significant).
- Winwick Road and perhaps to a lesser extent Chester Road and Sankey Way maintain period mean HGV trips in the upper 50th percentile from the morning to the evening peak when compared to the 24 hour mean.
- Highest trips are associated with leaving Warrington on Winwick Road, Manchester Road, Chester and Sankey Way and approach on Winwick Road and Sankey Way.

The pattern of trips by period differs once again for light goods vehicles (LGVs) as shown in Table 60. The table shows that

- There is a clear reduction in trips occurring after 6pm with period means residing in the lower 50th percentile. This may well be associated with the working times associated with retail and light industrial trading in Warrington.
- Most trips (upper 50th percentile) trips consistently occur between 9am and 4pm but tailing off between 4pm and 6pm.
- Some outbound routes sustain higher hourly mean LGV traffic during this period (e.g. Farrell Street, Chester Road and Sankey Way).
- Highest trips occur (upper 50th percentile) occur in the morning peak period out of Warrington on Knutsford Road, Wilderspool Causeway, Chester Road, Liverpool Road, Sankey Way and Lovely lane.
- There is a consistent level of travel during the night time period on all routes perhaps with the exception of outbound on Orford Lane.
- Noticeably, higher upper 50th percentile LGV trips occur from Old Liverpool Road to all outbound roads with the exception of Winwick and Bewsey Roads.

In terms of for buses and coaches trip patterns are presented in Table 61. The intensity of the red cells indicate those trips where the period count is in excess of the hourly average across all periods. This tends to be the situation in the morning peak period. The intensity of the pattern also indicates the fact that buses are operating on fixed time tables. This is in contrast other vehicle categories such as heavy and light goods vehicles where cells appear blue indicating low activity between locations as the evening approaches.

Table 58: All durations - **All vehicles** (ratio of period mean hour to mean of 24 hour)

		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
7am to 9am	a. A49 Winwick Road	2.2	1.1	2.1	1.2	2.1	1.3	1.3	2.1	1.9	1.5	1.8	0.8	1.3
	b. B5210 Orford Lane	1.3	1.9	2.4	2.0	2.3	2.2	1.3	2.5	3.0	1.4	2.0	0.0	2.2
	c. Battersby Lane	1.6	1.7	1.8	1.3	2.1	1.2	1.6	3.0	2.7	1.4	1.8	2.4	1.4
	d. A67 Manchester Road	1.5	1.9	1.7	2.0	1.7	1.1	1.7	1.7	1.9	1.0	1.5	1.9	1.7
	e. Farrell Street	2.2	1.6	1.4	1.4	1.9	1.2	2.4	2.2	2.3	1.4	1.8	0.6	2.9
	f. Wharf Street	0.5	0.0	0.4	0.2	0.4	0.3	0.4	0.3	0.8	0.6	0.6	0.0	0.0
	g. A6061 Knutsford Road	1.4	0.9	1.1	1.9	1.9	0.8	1.7	2.1	1.6	1.4	1.6	1.0	0.9
	h. Wilderspool Causeway	1.9	2.2	1.7	1.8	1.4	1.3	2.4	3.7	2.8	1.6	1.8	2.5	2.7
	i. A5060 Chester Road	2.1	1.2	1.4	2.1	1.3	1.4	2.1	2.5	3.9	1.3	1.8	1.9	1.8
	j. Old Liverpool Road	1.2	2.7	2.6	2.9	4.9	0.6	2.8	3.5	3.2	2.0	2.6	2.5	1.2
	k. A57 Sankey Way	2.3	1.7	3.2	2.8	3.7	1.6	2.5	2.6	3.1	1.6	3.1	2.7	2.8
	l. Lovely Lane	0.7	0.0	1.3	1.2	0.7	0.6	1.3	1.4	1.1	1.5	1.2	1.9	1.6
	m. Bewsey Rd	1.4	1.1	1.0	1.5	2.7	1.1	2.0	2.4	2.4	1.7	1.8	2.1	1.8
9am to 4pm	a. A49 Winwick Road	1.9	1.8	1.8	1.8	1.5	2.2	1.6	1.6	1.4	2.0	1.9	2.5	2.3
	b. B5210 Orford Lane	2.0	1.6	1.8	1.9	1.5	1.9	1.8	1.7	1.4	1.3	1.5	1.5	1.7
	c. Battersby Lane	1.8	1.8	1.8	1.9	1.6	2.2	1.5	1.2	1.3	1.5	1.3	1.6	1.7
	d. A67 Manchester Road	1.8	1.8	1.7	1.8	1.9	2.3	1.7	1.7	1.4	1.4	1.3	1.5	1.7
	e. Farrell Street	1.7	1.9	1.6	1.9	1.8	2.2	1.9	2.0	1.6	2.0	1.5	2.0	1.7

		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	f. Wharf Street	2.3	2.4	2.1	2.1	2.4	2.5	2.1	2.3	2.1	2.2	2.2	2.7	2.2
	g. A6061 Knutsford Road	1.8	1.7	1.7	1.8	2.2	2.2	1.7	1.9	1.9	1.6	1.4	1.8	1.9
	h. Wilderspool Cway	1.8	1.7	1.7	1.9	2.1	2.3	2.0	1.8	1.9	1.6	1.5	2.0	1.6
	i. A5060 Chester Road	1.6	2.1	1.3	1.5	1.7	2.4	1.8	1.9	1.7	1.8	1.5	2.0	1.9
	j. Old Liverpool Road	2.4	1.4	1.4	1.3	1.6	2.8	1.4	1.6	1.7	1.8	1.6	1.7	2.6
	k. A57 Sankey Way	1.9	1.6	1.3	1.3	1.3	2.2	1.3	1.4	1.4	1.9	1.7	1.5	1.9
	l. Lovely Lane	2.5	2.2	2.3	1.8	2.2	2.7	1.5	2.0	1.9	1.6	1.6	1.7	2.2
	m. Bewsey Rd	2.4	1.9	2.2	1.8	1.5	2.5	1.6	1.9	1.6	2.6	2.0	1.8	2.0
4pm to 6pm	a. A49 Winwick Road	1.0	1.9	1.6	1.9	2.0	1.2	2.1	1.8	1.8	1.5	1.6	0.6	1.2
	b. B5210 Orford Lane	1.2	1.7	1.0	1.6	2.3	1.4	1.6	1.9	1.6	1.2	2.1	1.7	1.7
	c. Battersby Lane	1.9	2.0	1.5	1.6	1.7	1.7	2.3	2.2	1.6	2.5	2.2	1.4	2.0
	d. A67 Manchester Road	1.4	1.4	1.6	1.4	1.6	1.6	2.4	1.9	2.0	2.9	2.3	1.9	1.9
	e. Farrell Street	1.3	2.0	2.3	1.8	1.3	1.4	0.9	1.5	1.9	1.9	2.1	0.9	1.3
	f. Wharf Street	1.4	2.3	2.5	2.3	1.0	1.3	2.6	1.9	2.1	2.1	2.3	0.7	1.5
	g. A6061 Knutsford Road	1.4	2.8	2.4	1.6	0.8	1.8	1.7	1.5	1.8	2.4	2.4	1.8	2.1
	h. Wilderspool Cway	1.3	0.8	1.7	1.2	1.4	1.2	0.7	0.8	0.9	1.9	2.1	1.1	1.5
	i. A5060 Chester Road	1.5	2.3	2.6	1.8	2.7	1.1	1.8	1.9	0.8	2.4	2.5	0.9	1.9
	j. Old Liverpool Road	1.0	1.2	1.7	1.8	0.6	0.6	2.2	1.4	1.5	1.7	1.7	1.5	0.9
	k. A57 Sankey Way	1.0	2.1	1.4	1.6	1.5	1.2	1.9	1.7	1.4	1.5	1.0	1.4	1.2

		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	l. Lovely Lane	0.5	1.4	0.4	1.6	1.3	0.4	1.8	1.3	1.8	1.6	2.1	1.0	1.4
	m. Bewsey Rd	1.2	2.8	2.2	2.2	2.3	1.5	1.8	1.4	2.2	1.0	2.1	2.1	1.5
6pm to 7am	a. A49 Winwick Road	0.3	0.4	0.3	0.4	0.4	0.3	0.5	0.4	0.5	0.3	0.3	0.3	0.2
	b. B5210 Orford Lane	0.4	0.4	0.3	0.3	0.3	0.3	0.5	0.3	0.4	0.7	0.4	0.8	0.3
	c. Battersby Lane	0.3	0.3	0.4	0.4	0.4	0.2	0.5	0.4	0.5	0.5	0.5	0.4	0.4
	d. A67 Manchester Road	0.4	0.4	0.4	0.3	0.3	0.2	0.3	0.4	0.5	0.5	0.6	0.4	0.4
	e. Farrell Street	0.4	0.3	0.4	0.3	0.4	0.2	0.3	0.2	0.3	0.2	0.5	0.5	0.3
	f. Wharf Street	0.3	0.2	0.3	0.3	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.4
	g. A6061 Knutsford Road	0.4	0.4	0.4	0.3	0.3	0.3	0.4	0.3	0.3	0.4	0.5	0.5	0.4
	h. Wilderspool Cway	0.4	0.4	0.4	0.4	0.3	0.2	0.3	0.2	0.2	0.4	0.5	0.2	0.3
	i. A5060 Chester Road	0.4	0.2	0.5	0.4	0.3	0.2	0.3	0.2	0.2	0.3	0.4	0.3	0.3
	j. Old Liverpool Road	0.2	0.5	0.4	0.4	0.2	0.1	0.3	0.2	0.2	0.3	0.3	0.3	0.1
	k. A57 Sankey Way	0.3	0.4	0.4	0.5	0.3	0.2	0.5	0.4	0.4	0.3	0.3	0.4	0.2
	l. Lovely Lane	0.3	0.4	0.3	0.5	0.3	0.2	0.5	0.3	0.4	0.5	0.5	0.5	0.2
	m. Bewsey Rd	0.2	0.2	0.2	0.3	0.2	0.1	0.3	0.2	0.3	0.0	0.2	0.2	0.3

Table 59: All durations - **All artic and rigid HGVs** (ratio of period mean hour compared to mean 24 hour)

		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
7am to 9am	a. A49 Winwick Road	1.8	4.8	2.4	1.5	4.3	2.8	1.4	3.7	1.6	0.0	1.6		0.0
	b. B5210 Orford Lane	1.6	0.0	0.0	0.0		0.0	6.0	0.0		12.0	0.0		0.0
	c. Battersby Lane	0.0		6.0	0.0	0.0	8.0	0.0	0.0	6.0	0.0	4.0	0.0	0.0
	d. A67 Manchester Road	2.0	0.0	7.2	1.9	2.0	6.5	0.0	0.9	1.1	0.0	1.4	3.4	1.5
	e. Farrell Street	3.3			2.4	3.3		0.0	4.0	0.0		4.5	0.0	
	f. Wharf Street	0.9		0.0	3.4	12.0	0.0	1.5	2.4	5.1	8.0	4.0		0.0
	g. A6061 Knutsford Road	2.4		4.0	0.0	6.0	3.6	1.7	2.8	0.8	1.7	1.9	3.0	6.0
	h. Wilderspool Causeway	1.6	6.0		3.0	0.0	4.0	3.0	1.7	4.0	1.3	2.1	0.0	0.0
	i. A5060 Chester Road	2.0	0.0	1.7	2.9	0.0	1.3	6.0	2.4	1.5	2.2	2.9	0.0	0.0
	j. Old Liverpool Road	0.0			1.8	6.0	0.0	2.5	0.0	0.9	1.7	0.0	1.6	
	k. A57 Sankey Way	2.0	0.0	0.0	1.4	6.0	0.0	3.1	2.1	3.6	0.0	0.6	2.7	6.0
	l. Lovely Lane	0.0		0.0	1.0			12.0	0.0	0.0	1.0	0.8	0.0	
	m. Bewsey Rd	2.0	0.0		0.0	0.0	6.0	0.0	4.0	3.0	0.0	0.0		0.0
9am to 4pm	a. A49 Winwick Road	2.2	1.4	2.1	1.5	1.7	1.8	2.0	1.9	2.0	2.1	1.8		3.4
	b. B5210 Orford Lane	2.7	3.4	3.4	3.4		0.0	0.0	3.4		0.0	1.7		3.4
	c. Battersby Lane	3.4		1.7	3.4	3.4	0.0	0.0	0.0	1.7	3.4	2.3	3.4	3.4

		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	d. A67 Manchester Road	1.7	0.0	0.7	2.0	2.9	1.2	2.6	2.4	1.7	2.7	2.7	1.5	2.6
	e. Farrell Street	2.2			2.7	1.9		3.4	1.1	3.4		1.7	3.4	
	f. Wharf Street	2.3		3.4	2.4	0.0	3.4	2.6	2.7	1.5	1.1	1.7		0.0
	g. A6061 Knutsford Road	1.8		2.3	2.1	1.7	0.7	2.2	2.1	2.8	2.6	2.5	2.6	1.7
	h. Wilderspool Causeway	2.4	1.7		2.6	3.4	1.1	1.7	2.4	0.6	2.7	1.8	3.4	3.4
	i. A5060 Chester Road	2.0	3.4	2.4	1.8	2.7	2.3	0.9	1.4	2.6	2.8	2.2	3.4	3.4
	j. Old Liverpool Road	3.1			2.1	1.7	3.4	2.5	3.4	2.9	1.5	3.4	2.7	
	k. A57 Sankey Way	2.9	3.4	3.4	2.9	1.7	3.0	2.1	1.9	2.4	3.4	1.9	2.0	1.7
	l. Lovely Lane	3.4		0.0	2.0			0.0	1.7	2.6	2.4	2.5	3.4	
	m. Bewsey Rd	2.9	3.4		2.7	1.7	1.7	3.4	2.3	2.6	3.4	3.4		3.4
4pm to 6pm	a. A49 Winwick Road	0.8	2.4	2.4	2.3	0.9	0.5	0.7	0.5	0.3	0.0	1.6		0.0
	b. B5210 Orford Lane	0.8	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0		0.0
	c. Battersby Lane	0.0		0.0	0.0	0.0	4.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0
	d. A67 Manchester Road	0.7	12.0	2.4	0.4	0.0	1.1	1.5	0.0	0.5	0.0	0.2	0.0	1.5
	e. Farrell Street	0.7			0.0	1.1		0.0	4.0	0.0		0.0	0.0	
	f. Wharf Street	1.8		0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0		0.0
	g. A6061 Knutsford Road	0.5		0.0	2.4	0.0	1.2	0.9	0.9	0.8	0.8	0.5	0.0	0.0
	h. Wilderspool Causeway	1.1	0.0		0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.8	0.0	0.0

		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	i. A5060 Chester Road	0.6	0.0	0.0	1.1	0.0	1.3	0.0	2.4	0.5	0.0	0.5	0.0	0.0
	j. Old Liverpool Road	1.2			2.8	0.0	0.0	0.7	0.0	0.9	3.4	0.0	0.8	
	k. A57 Sankey Way	0.0	0.0	0.0	0.0	0.0	1.5	1.0	1.6	0.0	0.0	0.6	0.8	0.0
	l. Lovely Lane	0.0		0.0	0.0			0.0	0.0	0.0	0.0	1.3	0.0	
	m. Bewsey Rd	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
6pm to 7am	a. A49 Winwick Road	0.3	0.0	0.0	0.5	0.1	0.4	0.4	0.2	0.5	0.7	0.4		0.0
	b. B5210 Orford Lane	0.0	0.0	0.0	0.0		1.8	0.9	0.0		0.0	0.9		0.0
	c. Battersby Lane	0.0		0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0
	d. A67 Manchester Road	0.5	0.0	0.0	0.4	0.0	0.0	0.2	0.4	0.7	0.4	0.1	0.5	0.0
	e. Farrell Street	0.1			0.0	0.2		0.0	0.0	0.0		0.2	0.0	
	f. Wharf Street	0.2		0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.0	0.3		1.8
	g. A6061 Knutsford Road	0.4		0.0	0.4	0.0	0.7	0.3	0.1	0.1	0.1	0.1	0.0	0.0
	h. Wilderspool Cway	0.1	0.0		0.0	0.0	0.6	0.5	0.3	0.9	0.0	0.4	0.0	0.0
	i. A5060 Chester Road	0.4	0.0	0.3	0.3	0.4	0.2	0.5	0.4	0.2	0.0	0.1	0.0	0.0
	j. Old Liverpool Road	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	
	k. A57 Sankey Way	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.2	0.0	0.0	0.6	0.2	0.0
	l. Lovely Lane	0.0		1.8	0.6			0.0	0.9	0.5	0.4	0.2	0.0	
	m. Bewsey Rd	0.0	0.0		0.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0		0.0

Table 60: All durations - **All LGVs** (period mean hour compared to 24 mean hour)

		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
7am to 9am	a. A49 Winwick Road	2.2	1.5	0.8	1.8	2.7	2.2	0.3	2.5	2.1	3.2	1.4	0.0	1.5
	b. B5210 Orford Lane	1.8	0.0	1.7	2.6	1.7	6.0	2.4	6.0	0.0	3.0	1.2	0.0	2.0
	c. Battersby Lane	2.4	0.0	2.5	1.2	2.5	1.3	0.5	1.7	3.6	1.3	2.5	3.0	4.0
	d. A67 Manchester Road	1.6	3.0	2.5	1.6	2.1	2.8	2.4	2.7	2.5	0.4	1.5	1.0	1.0
	e. Farrell Street	2.3	2.4	1.5	0.9	2.7	1.3	2.6	1.5	2.3	3.7	0.6	0.0	2.4
	f. Wharf Street	1.4	0.0	1.9	0.5	0.0	0.8	1.2	1.5	1.5	0.0	2.7	0.0	0.0
	g. A6061 Knutsford Road	1.2	2.7	1.1	0.8	2.0	1.0	1.0	3.1	2.2	2.3	1.1	0.4	1.2
	h. Wilderspool Causeway	1.4	1.7	1.5	1.5	0.0	1.0	0.0	3.1	0.9	2.6	2.1	1.0	3.0
	i. A5060 Chester Road	1.4	0.9	1.4	1.4	1.5	1.2	1.0	1.3	1.6	0.9	3.2	0.4	1.4
	j. Old Liverpool Road	0.8	5.3	2.6	3.4	5.7	4.0	3.1	4.4	3.4	1.8	1.7	2.4	0.0
	k. A57 Sankey Way	1.3	0.6	1.8	2.2	3.8	2.4	2.4	3.0	2.4	3.8	2.6	2.6	3.8
	l. Lovely Lane	0.0	0.0	0.0	0.0	0.0	0.0	2.7	3.7	1.0	2.5	1.1	2.5	4.0
	m. Bewsey Rd	1.5	0.7	0.0	2.2	3.8	0.0	3.4	4.4	4.5	4.0	2.7	3.0	3.1
9am to 4pm	a. A49 Winwick Road	2.2	2.3	1.9	2.1	1.9	2.1	2.4	2.0	1.8	2.1	2.2	3.4	2.4
	b. B5210 Orford Lane	2.1	2.0	2.9	2.2	1.5	1.7	2.7	1.4	2.3	2.6	1.9	3.4	2.3
	c. Battersby Lane	1.7	2.3	1.4	1.8	1.9	2.7	1.2	1.0	1.5	1.9	1.6	1.7	1.1

		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	d. A67 Manchester Road	2.1	2.6	2.1	1.8	1.9	2.1	2.2	1.8	1.6	1.9	1.9	2.3	2.2
	e. Farrell Street	1.7	2.1	1.7	2.4	1.7	2.3	1.7	2.4	1.7	1.3	2.3	2.3	1.5
	f. Wharf Street	2.4	3.4	2.3	2.9	2.6	2.1	2.1	2.6	2.5	3.4	2.1	2.6	3.4
	g. A6061 Knutsford Road	2.1	0.4	2.5	2.5	1.7	2.2	2.1	2.1	2.2	1.8	2.0	2.1	2.4
	h. Wilderspool Cway	2.3	2.4	1.6	2.5	3.0	2.4	3.4	2.3	2.8	1.5	1.7	2.9	1.7
	i. A5060 Chester Road	2.1	2.6	1.8	2.2	2.1	2.7	2.0	1.7	2.0	2.1	1.6	2.4	2.2
	j. Old Liverpool Road	3.2	1.1	1.7	1.8	1.4	2.3	1.8	2.2	1.5	2.2	2.0	2.1	3.4
	k. A57 Sankey Way	2.2	2.5	1.6	1.3	1.6	2.3	1.7	1.8	1.9	1.6	2.0	1.8	2.1
	l. Lovely Lane	2.0	0.0	3.4	2.3	1.9	3.4	1.9	1.8	2.2	1.7	2.1	1.7	2.3
	m. Bewsey Rd	2.8	2.5	3.4	2.2	1.3	3.4	2.0	2.2	1.9	1.7	1.7	2.6	2.5
4pm to 6pm	a. A49 Winwick Road	0.8	0.7	1.5	1.4	1.3	0.9	1.3	0.9	1.5	1.6	1.4	0.0	0.8
	b. B5210 Orford Lane	1.2	3.8	0.0	0.9	3.4	0.0	0.0	0.0	2.0	0.0	1.8	0.0	0.0
	c. Battersby Lane	2.4	4.0	2.5	0.8	2.2	1.3	4.4	5.1	1.7	2.0	1.9	3.0	4.0
	d. A67 Manchester Road	1.1	0.0	0.4	1.6	1.5	0.7	1.2	1.7	1.2	2.3	2.0	1.0	1.6
	e. Farrell Street	1.3	2.4	2.3	0.9	2.2	1.3	0.9	1.5	1.5	1.8	0.9	0.0	1.8
	f. Wharf Street	1.0	0.0	1.9	0.5	3.0	0.0	1.9	1.0	1.8	0.0	1.5	0.0	0.0
	g. A6061 Knutsford Road	1.4	5.3	0.5	1.6	2.0	0.5	1.5	1.0	1.8	2.7	1.9	2.1	2.4
	h. Wilderspool Causeway	1.1	0.0	1.5	0.4	1.5	1.0	0.0	0.6	0.5	1.0	2.4	1.0	2.0

		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	i. A5060 Chester Road	1.2	0.0	2.8	1.6	1.5	1.2	3.0	2.0	1.6	2.0	2.0	0.9	1.4
	j. Old Liverpool Road	0.0	1.3	0.9	1.5	1.3	0.0	2.1	0.0	2.9	0.9	0.0	1.0	0.0
	k. A57 Sankey Way	1.6	1.3	1.5	2.0	0.8	1.0	1.2	1.5	1.3	0.0	1.0	1.4	0.8
	l. Lovely Lane	1.7	12.0	0.0	1.3	1.1	0.0	1.3	0.0	0.5	1.3	1.6	0.5	0.0
	m. Bewsey Rd	0.0	2.7	0.0	1.1	1.9	0.0	0.0	0.0	1.0	2.0	2.0	0.0	0.0
6pm to 7am	a. A49 Winwick Road	0.2	0.3	0.5	0.2	0.2	0.2	0.3	0.2	0.3	0.0	0.2	0.0	0.2
	b. B5210 Orford Lane	0.2	0.2	0.0	0.1	0.3	0.0	0.0	0.2	0.3	0.0	0.4	0.0	0.3
	c. Battersby Lane	0.2	0.0	0.3	0.6	0.1	0.0	0.4	0.3	0.2	0.3	0.3	0.0	0.0
	d. A67 Manchester Road	0.3	0.0	0.3	0.4	0.3	0.2	0.1	0.2	0.4	0.4	0.3	0.3	0.2
	e. Farrell Street	0.4	0.0	0.4	0.3	0.2	0.2	0.4	0.1	0.3	0.3	0.4	0.6	0.4
	f. Wharf Street	0.2	0.0	0.0	0.2	0.0	0.6	0.3	0.1	0.0	0.0	0.1	0.5	0.0
	g. A6061 Knutsford Road	0.3	0.4	0.3	0.1	0.3	0.4	0.3	0.1	0.1	0.1	0.3	0.3	0.0
	h. Wilderspool Causeway	0.2	0.3	0.5	0.2	0.0	0.2	0.0	0.0	0.1	0.5	0.2	0.0	0.2
	i. A5060 Chester Road	0.3	0.3	0.2	0.2	0.2	0.0	0.2	0.4	0.3	0.3	0.2	0.3	0.2
	j. Old Liverpool Road	0.0	0.2	0.4	0.1	0.0	0.0	0.1	0.0	0.1	0.3	0.5	0.2	0.0
	k. A57 Sankey Way	0.2	0.2	0.5	0.5	0.3	0.1	0.4	0.2	0.3	0.4	0.2	0.3	0.0
	l. Lovely Lane	0.5	0.0	0.0	0.4	0.7	0.0	0.2	0.3	0.4	0.3	0.3	0.5	0.0
	m. Bewsey Rd	0.1	0.0	0.0	0.2	0.3	0.0	0.3	0.0	0.0	0.0	0.2	0.0	0.0

Table 61: All durations **- All Buses and Coaches** (period mean hour compared to 24 mean hour)

		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
7am to 9am	a. A49 Winwick Road	2.3	0.8	0.0	1.2	6.0	0.0	4.0	0.0	1.8	0.0	0.0		
	b. B5210 Orford Lane	1.3	8.0	0.0	0.0			6.0	12.0			0.0	0.0	
	c. Battersby Lane	1.4	0.0	1.2	0.8		8.0	0.0	7.2	12.0	6.0	4.0	12.0	
	d. A67 Manchester Road	0.0	0.0	2.4	2.6		0.0	2.7	0.0	0.0	6.0		0.0	0.0
	e. Farrell Street	0.0			0.0	0.0	12.0					0.0		
	f. Wharf Street	12.0	0.0	6.0	12.0			0.0				4.0	0.0	
	g. A6061 Knutsford Road	0.0		6.0	1.7	8.0		1.2	4.0	6.0	12.0	0.0	0.0	0.0
	h. Wilderspool Causeway	3.0		3.6	0.0			0.0	1.1		0.0	7.2		0.0
	i. A5060 Chester Road	1.0			6.0			0.0	6.0	2.4	0.0	6.0	1.3	
	j. Old Liverpool Road	6.0	4.8	3.0	0.0				12.0	0.0	1.6	0.0	8.0	0.0
	k. A57 Sankey Way	12.0		0.0	0.0		0.0	3.0	4.0	3.0	12.0	1.7	0.9	0.0
	l. Lovely Lane	0.0	0.0	6.0				0.0	0.0		0.0	4.2	1.2	0.0
	m. Bewsey Rd	12.0	0.0					0.0						0.0
9am to 4pm	a. A49 Winwick Road	1.6	2.5	2.9	1.4	1.7	1.7	1.5	2.3	1.8	0.0	2.3		
	b. B5210 Orford Lane	2.4	0.0	0.0	0.0			1.7	0.0			0.0	0.0	
	c. Battersby Lane	2.0	0.0	2.6	2.7		1.1	3.4	0.7	0.0	1.7	2.3	0.0	
	d. A67 Manchester Road	1.7	0.0	2.1	1.9		2.3	1.9	0.0	0.0	0.0		3.4	3.4

		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	e. Farrell Street	0.0			3.4	3.4	0.0					3.4		
	f. Wharf Street	0.0	3.4	1.7	0.0			3.4				2.3	3.4	
	g. A6061 Knutsford Road	2.1		1.7	2.0	1.1		2.6	1.1	1.7	0.0	3.4	0.0	1.7
	h. Wilderspool Causeway	0.9		0.3	0.0			1.7	2.5		0.0	0.7		3.4
	i. A5060 Chester Road	2.0			1.7			3.4	1.7	1.5	1.7	1.1	1.9	
	j. Old Liverpool Road	0.0	0.7	0.9	0.0				0.0	3.4	2.2	0.0	0.0	3.4
	k. A57 Sankey Way	0.0		2.3	1.1		3.4	2.6	0.0	0.9	0.0	2.0	1.3	1.7
	l. Lovely Lane	0.0	0.0	1.7				0.0	0.0		3.4	1.8	2.4	0.0
	m. Bewsey Rd	0.0	3.4					2.1						1.7
4pm to 6pm	a. A49 Winwick Road	2.0	1.8	1.8	3.6	0.0	6.0	0.0	4.0	0.9	0.0	0.0		
	b. B5210 Orford Lane	1.7	0.0	0.0	12.0			0.0	0.0			0.0	0.0	
	c. Battersby Lane	1.4	0.0	1.2	0.8		0.0	0.0	2.4	0.0	0.0	0.0	0.0	
	d. A67 Manchester Road	0.0	0.0	2.4	1.4		4.0	2.7	12.0	12.0	6.0		0.0	0.0
	e. Farrell Street	0.0			0.0	0.0	0.0					0.0		
	f. Wharf Street	0.0	0.0	0.0	0.0			0.0				0.0	0.0	
	g. A6061 Knutsford Road	2.4		0.0	1.7	0.0		0.6	4.0	0.0	0.0	0.0	0.0	6.0
	h. Wilderspool Cway	3.0		1.2	0.0			6.0	2.0		12.0	2.4		0.0
	i. A5060 Chester Road	2.0			0.0			0.0	0.0	2.4	0.0	2.0	1.3	
	j. Old Liverpool Road	0.0	0.0	6.0	12.0				0.0	0.0	1.8	4.0	0.0	0.0

		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	k. A57 Sankey Way	0.0		4.0	0.0		0.0	0.0	4.0	6.0	0.0	2.4	1.8	0.0
	l. Lovely Lane	0.0	0.0	0.0				0.0	0.0		0.0	0.0	2.2	12.0
	m. Bewsey Rd	0.0	0.0					0.0						0.0
6pm to 7am	a. A49 Winwick Road	0.3	0.1	0.0	0.4	0.0	0.0	0.4	0.0	0.4	1.8	0.6		
	b. B5210 Orford Lane	0.1	0.6	1.8	0.0			0.0	0.0			1.8	1.8	
	c. Battersby Lane	0.3	1.8	0.1	0.1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	d. A67 Manchester Road	0.9	1.8	0.0	0.2		0.0	0.0	0.0	0.0	0.0		0.0	0.0
	e. Farrell Street	1.8			0.0	0.0	0.0					0.0		
	f. Wharf Street	0.0	0.0	0.0	0.0			0.0				0.0	0.0	
	g. A6061 Knutsford Road	0.4		0.0	0.3	0.0		0.1	0.0	0.0	0.0	0.0	1.8	0.0
	h. Wilderspool Causeway	0.5		0.9	1.8			0.0	0.0		0.0	0.0		0.0
	i. A5060 Chester Road	0.3			0.0			0.0	0.0	0.3	0.9	0.0	0.4	
	j. Old Liverpool Road	0.9	0.7	0.0	0.0				0.0	0.0	0.1	1.2	0.6	0.0
	k. A57 Sankey Way	0.0		0.0	1.2		0.0	0.0	0.6	0.0	0.0	0.1	0.7	0.9
	l. Lovely Lane	1.8	1.8	0.0				1.8	1.8		0.0	0.2	0.0	0.0
	m. Bewsey Rd	0.0	0.0					0.7						0.9

What is the typical trip duration of vehicles according to different routes and what proportion of vehicles can be characterised as through traffic?

Both of the above questions can be addressed by applying similar analysis. As previously mentioned in developing a low emissions strategy for Warrington the attention is to focus on reducing the disproportionate level of emissions produced by goods vehicles. In the first instance it was necessary to determine the average duration of all trips on all routes. To do this, weighting was applied to account for the number of trips within each duration bin. The result of this exercise for all vehicles is shown in Table 62.

The top of the table shows the weighted duration according to each route and the lower half of the table provides the number of observations upon which the duration is based. Conditional formatting applied to upper half of the table indicates the duration above (red) and below (green) 20 minutes. Twenty minutes was decided by Warrington Council to be a reasonable cut off period to differentiate through traffic from trips incorporating business in the town centre. The following conclusions are made on through traffic and trip duration:

- Trips from Old Liverpool Road tend to be associated with through traffic as do trips to Lovely Lane originating from Knutsford Road, River Road, Chester Road, and Sankey Way might also predominately be considered as through traffic.
- There is also an element of through traffic associated with Bewsey Road to Knutsford Road, River Road and Chester Road. It should be noted that these events should be observed in the context of trip numbers presented in the lower part of the table.
- Cars travelling towards Winwick Road and from Sankey Way (weighted average duration of 159 minutes and 208 minutes respectively) are likely to include an element of business in the town centre.
- Sankey Way to Lovely Lane had a weighted average duration of nine minutes (~4.5K vehicles observed) provides fairly robust evidence that this route is predominately through traffic. Trips in the opposite direction, with an average weighted duration of 11 minutes, are also likely to be through traffic.

Overall, for cars, over a 24 hour period the percentage considered to be through traffic is ~37%.

Table 63 focuses on articulated HGVs. Those routes that have no artic HGV observations are denoted by 'na'. The pattern of shading is clearly different from that of all vehicles in Table 63. Conclusions regarding these vehicles are:

- All routes observed have less than 21 trips except for Winwick Road to Winwick Road which has 49.
- On the majority of routes (i.e. 62 out of 103), only two artic HGVs were observed.
- Through traffic is likely for those routes with green shaded cells in the upper part of the table). For these, the weighted average duration is fairly consistent (i.e. between 8 - 15 minutes). One of the reasons for this is because the weighting is based on low observation rates for these particular routes.
- Higher duration events with similarly high trip rates are associated with the following routes; Winwick Road (return), Manchester Road to Chester Road, Old Liverpool Road and Sankey Way (~43, 60, and 55 minutes respectively). These type of durations suggest retail type drop offs.

- There are occasions where artic. HGVs visit Wharf Street for durations ranging between ~40 minutes to just over two hours.
- Most artic HGVs leaving Wharf Street head towards Winwick Road and Sankey Way although the weighted average duration to get to Sankey Way is ~21 minutes.
- Another key route for artic. HGVs would appear to be Winwick Road to Chester Road and observations would suggest that the majority of this traffic is simply passing through.

Overall, in terms of through traffic, it is likely that only 17% of artic. HGVs qualify as being considered through traffic. This is because these drivers are unlikely to choose to drive through an urban area with added fuel and time implications unless there was good reason to do so (i.e. a diversion etc.). The survey also shows that 83% of visiting vehicles undertake some form of business in the town.

Table 64 focuses on those rigid HGVs observed in Warrington. The obvious difference is the pattern of the low duration events seen with the articulated HGVs as more routes are used to enter and leave the town over shorter periods. Some observations on these vehicles are:

- Rigid HGVs travelling to Lovely Lane take more than 20 minutes which suggest that these vehicles (i.e. 184 observed) undertake business before leaving.
- Rigid HGVs travelling **to** Wharf Street also exceed the 20 minute weighted average duration threshold but are below when travelling **from** Wharf Street. This suggests that drivers heading towards Wharf Street are conducting business in the town.
- Winwick to Farrell Street which just exceeds the 20 minute duration threshold (32 observed) suggest that activity consists of a rapid delivery before leaving the town again. It would be interesting to find out what can be delivered in such a short time span.

Overall, the survey suggests that ~48% of rigid HGVs could be considered through traffic.

The final analysis was conducted for LGVs (see

Table **65**). In total 6,102 LGVs were observed crossing the cordon over the 24 hour period. Information from this table on these trips includes:

- The majority of LGVs enter and leave the town via Sankey Way (duration 70 minutes) followed by Winwick Road (duration 90 minutes).

- LGVs that enter Warrington using Knutsford Road appear to be conducting business before leaving the town (duration of ~40 minutes).

It is difficult to confirm the rationale for some of these patterns without fully appreciating the spatial characteristics of retail servicing and light industrial activity associated with these vehicle types. **In other words, the movements of HGVs around Warrington could be considered more prescribed whereas the movements associated with LGVs are less so.**

Table 62: Weighted average duration and observed vehicle count, 24 hour period (All vehicles)

All vehicles	From	a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. A49 Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
		To												
All periods		Weighted average duration (minutes)												
a. A49 Winwick Road		159	43	79	56	26	30	37	24	24	36	117	63	49
b. B5210 Orford Lane		43	115	117	88	25	41	32	24	35	10	27	15	14
c. Battersby Lane		79	140	131	65	17	19	32	19	17	10	25	79	42
d. A67 Manchester Road		56	108	89	138	52	17	88	47	18	16	18	15	18
e. Farrell Street		21	34	27	49	128	18	141	80	33	10	24	21	12
f. Wharf Street		30	29	15	23	33	32	11	16	15	11	28	31	33
g. A6061 Knutsford Road		37	30	46	81	151	22	147	137	66	11	17	14	23
h. A49 Wilderspool Causeway		24	36	19	34	87	22	145	217	184	11	18	9	15
i. A5060 Chester Road		24	53	16	22	46	28	72	151	261	14	30	12	20
j. Old Liverpool Road		36	14	11	11	13	18	11	9	9	99	85	9	29
k. A57 Sankey Way		117	27	30	19	20	28	16	19	23	94	208	9	98
l. Lovely Lane		63	27	35	39	24	13	12	20	13	9	11	119	39
m. Bewsey Rd		49	27	54	27	21	25	14	14	13	28	75	28	91
All periods		Observed vehicles during period												
a. A49 Winwick Road		3849	553	232	679	726	388	690	983	1385	112	730	77	198
b. B5210 Orford Lane		553	791	352	233	108	42	74	91	110	61	278	20	171
c. Battersby Lane		232	192	1353	553	471	259	245	340	706	177	576	34	58
d. A67 Manchester Road		679	174	523	2134	566	460	214	422	841	296	1291	87	199
e. Farrell Street		719	80	449	384	1240	165	169	94	142	68	424	34	133
f. Wharf Street		388	31	273	292	51	62	976	430	416	64	480	47	58

All vehicles		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. A49 Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
g. A6061 Knutsford Road		690	79	277	188	285	587	1970	452	334	358	1796	295	172
h. A49 Wilderspool Causeway		983	69	360	304	87	344	172	1132	420	161	1357	168	107
i. A5060 Chester Road		1385	109	785	629	125	377	144	311	1738	229	1396	388	193
j. Old Liverpool Road		112	73	148	266	80	73	290	156	210	522	372	1081	35
k. A57 Sankey Way		730	310	725	1464	489	488	1713	1247	1358	363	4606	4566	197
l. Lovely Lane		77	39	72	87	50	51	225	141	308	1036	3872	369	58
m. Bewsey Rd		198	221	64	143	125	60	111	92	176	29	169	27	541

Table 63: Weighted average duration and observed vehicle count, 24 hour period (Articulated HGVs)

Arctic HGVs		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. A49 Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	From	**To**												
All periods		**Weighted average duration (minutes)**												
a. A49 Winwick Road		69	8	na	38	32	9	85	24	15	15	39	330	56
b. B5210 Orford Lane		8	na	na	na	na	na	na	na	na	na	na	na	na
c. Battersby Lane		na	na	na	na	na	na	na	na	na	8	na	na	na
d. A67 Manchester Road		38	79	128	43	39	71	64	80	43	60	55	na	8
e. Farrell Street		32	53	95	na	53	na	23	165	41	64	75	na	na
f. Wharf Street		9	na	na	41	na	na	8	na	8	23	21	na	na
g. A6061 Knutsford Road		85	165	na	74	59	42	na	84	38	42	49	na	na
h. A49 Wilderspool Causeway		24	na	na	8	135	41	na	86	23	53	24	na	na
i. A5060 Chester Road		15	115	108	79	8	83	65	91	48	54	60	8	na
j. Old Liverpool Road		15	na	na	8	na	na	26	na	26	105	30	8	na
k. A57 Sankey Way		39	38	8	26	na	105	38	68	53	64	75	8	na
l. Lovely Lane		330	330	23	135	na	135	na	23	105	27	8	na	na
m. Bewsey Rd		56	na	na	na	8	na	8	na	8	105	na	na	8

All periods	a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. A49 Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	Observed vehicles during period												
a. A49 Winwick Road	49	3	0	9	4	11	13	14	19	4	5	1	2
b. B5210 Orford Lane	3	0	0	0	0	0	0	0	0	0	0	0	0
c. Battersby Lane	0	0	0	0	0	0	0	0	0	1	0	0	0
d. A67 Manchester Road	9	19	4	4	10	9	2	7	21	17	17	0	1
e. Farrell Street	4	1	5	0	1	0	2	1	4	4	2	0	0
f. Wharf Street	11	0	0	2	0	0	1	0	1	1	5	0	0
g. A6061 Knutsford Road	13	2	0	7	6	7	0	8	14	14	13	0	0
h. A49 Wilderspool Causeway	14	0	0	1	2	2	0	2	7	5	4	0	0
i. A5060 Chester Road	19	6	6	2	1	12	7	7	8	9	9	1	0
j. Old Liverpool Road	4	0	0	1	0	0	7	0	7	1	3	2	0
k. A57 Sankey Way	5	2	1	7	0	2	14	5	13	2	4	7	0
l. Lovely Lane	1	1	3	2	0	2	0	1	1	8	8	0	0
m. Bewsey Rd	2	0	0	0	1	0	1	0	1	1	0	0	2

Table 64: Weighted average duration and observed vehicle count, 24 hour period (Rigid HGVs)

Rigid HGVs		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. A49 Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	From	**To**												
All periods		**Weighted average duration (minutes)**												
a. A49 Winwick Road		61	21	124	41	23	8	61	21	18	11	29	23	125
b. B5210 Orford Lane		21	75	30	135	na	na	15	8	na	8	15	55	8
c. Battersby Lane		124	330	110	15	8	8	8	8	8	na	8	33	23
d. A67 Manchester Road		41	na	38	74	na	22	30	15	8	18	10	45	10
e. Farrell Street		23	120	154	45	13	105	8	8	8	75	8	49	na
f. Wharf Street		8	na	8	8	na	na	8	8	10	8	8	na	8
g. A6061 Knutsford Road		61	600	19	33	64	23	38	14	10	8	8	43	8
h. A49 Wilderspool Causeway		21	8	105	45	na	60	30	na	8	9	11	48	8
i. A5060 Chester Road		18	233	55	15	8	32	75	45	27	14	12	47	8
j. Old Liverpool Road		11	na	na	8	23	41	8	8	17	30	8	20	na
k. A57 Sankey Way		29	34	46	14	16	20	12	11	32	31	21	23	8
l. Lovely Lane		23	na	23	26	na	na	23	8	11	8	9	45	na
m. Bewsey Rd		125	229	na	24	8	50	na	13	8	38	na	54	15

All periods	a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. A49 Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
	Observed vehicles during period												
a. A49 Winwick Road	67	12	2	9	32	16	14	31	48	4	13	1	5
b. B5210 Orford Lane	12	1	2	1	0	0	2	1	0	1	2	3	1
c. Battersby Lane	2	1	6	2	1	3	1	1	2	0	2	3	1
d. A67 Manchester Road	9	0	12	7	0	9	5	10	10	10	32	18	7
e. Farrell Street	32	2	2	5	3	1	1	2	1	1	6	9	0
f. Wharf Street	16	0	1	6	0	0	15	5	6	2	8	0	1
g. A6061 Knutsford Road	14	1	4	3	2	10	3	5	12	35	17	12	2
h. A49 Wilderspool Causeway	31	2	1	9	0	4	5	0	2	8	25	10	1
i. A5060 Chester Road	48	2	10	9	3	8	1	7	5	9	19	24	3
j. Old Liverpool Road	4	0	0	12	1	2	28	6	10	4	4	17	0
k. A57 Sankey Way	13	6	8	39	11	8	17	20	13	14	35	80	1
l. Lovely Lane	1	0	1	6	0	0	2	2	4	20	38	3	0
m. Bewsey Rd	5	2	0	6	1	3	0	3	3	2	0	4	2

Table 65: Weighted average duration and observed vehicle count, 24 hour period (LGVs)

LGVs		a. A49 Winwick Road	b. B5210 Orford Lane	c. Battersby Lane	d. A67 Manchester Road	e. Farrell Street	f. Wharf Street	g. A6061 Knutsford Road	h. A49 Wilderspool Causeway	i. A5060 Chester Road	j. Old Liverpool Road	k. A57 Sankey Way	l. Lovely Lane	m. Bewsey Rd
		To												
All periods	From	Weighted average duration (minutes)												
a. A49 Winwick Road		91	40	77	29	10	15	29	12	11	33	50	18	44
b. B5210 Orford Lane		40	83	113	96	33	8	20	63	219	42	40	93	39
c. Battersby Lane		77	236	58	26	17	18	21	46	26	11	17	103	175
d. A67 Manchester Road		29	147	55	59	43	14	89	23	27	39	18	67	65
e. Farrell Street		10	151	28	55	56	26	146	42	57	63	28	53	58
f. Wharf Street		15	23	12	25	53	24	13	9	11	8	18	19	41
g. A6061 Knutsford Road		29	35	33	149	236	100	40	74	63	32	32	44	80
h. A49 Wilderspool Causeway		12	99	9	38	140	20	135	68	53	34	25	35	73
i. A5060 Chester Road		11	108	13	34	122	93	190	87	78	61	31	31	46
j. Old Liverpool Road		33	15	10	11	18	43	40	98	34	58	39	9	257
k. A57 Sankey Way		50	21	27	25	14	119	49	70	83	105	71	11	108
l. Lovely Lane		18	8	8	18	14	8	56	85	29	18	14	66	161
m. Bewsey Rd		44	28	71	23	10	11	12	13	20	78	45	65	38
All periods		Observed vehicles during period												
a. A49 Winwick Road		185	38	10	66	82	34	59	100	119	15	54	6	16
b. B5210 Orford Lane		38	21	7	12	7	2	5	11	13	5	22	3	12
c. Battersby Lane		10	5	36	30	33	20	22	21	51	18	38	7	7

d. A67 Manchester Road		66	11	35	63	41	33	22	36	82	37	108	21	27
e. Farrell Street		82	6	43	40	45	9	14	14	18	15	41	16	24
f. Wharf Street		34	1	19	24	4	14	51	23	33	4	32	4	6
g. A6061 Knutsford Road		59	5	19	19	9	39	84	36	36	53	128	37	13
h. A49 Wilderspool Causeway		100	7	32	35	8	24	6	40	28	26	68	14	15
i. A5060 Chester Road		119	12	52	60	18	24	21	22	49	50	85	33	28
j. Old Liverpool Road		15	4	14	30	16	4	35	13	27	39	14	173	4
k. A57 Sankey Way		54	17	50	106	44	31	148	101	92	27	90	315	20
l. Lovely Lane		6	1	2	9	11	1	19	16	24	145	234	23	4
m. Bewsey Rd		16	18	2	21	18	4	7	11	21	7	19	6	23

What are the characteristics of the traffic at any given camera site?

To answer this question, the observed traffic data was split into emissions based fleet components to better understand the fleet. Based on this type of information, measures that target vehicle fuels, engines sizes and weights can be considered. The fleet proportions for Warrington town centre and three key routes (combined inbound and outbound directions) are shown in Table 66. For reference, the split according to the assumed UK fleet from the National Atmospheric Emissions Inventory (NAEI) is also presented. The following observations to compare the Warrington fleet with national predictions are given below;

- There is little variation between the fleet in Warrington as a whole and the three key access roads.
- Petrol cars are not as new as the expected national fleet (NAEI). In fact the number of Euro 5 cars is substantially lower.
- There are 10% less Euro 5 Diesel cars than expected in the national fleet.
- Petrol LGVs are older than might be expected but the numbers are generally low and not of concern for overall emissions.
- The diesel LGV fleet as a whole is older than expected (~15% lower Euro 5 vehicles than the national fleet) although the fleet on Winwick Road is similar to the expected national fleet.
- Compared to the national fleet, higher proportions of Euro III and IV Rigid HGVs, but lower Euro V and no Euro VI vehicles are observed
- Articulated HGVs on Winwick Road are cleaner than the national fleet, although no Euro VI vehicles were observed (compared to 11% assumed in the NAEI). However, in Warrington as a whole, the artic. HGV fleet is older than the expected national fleet.
- The pattern for buses is similar to that of artic. HGVs which suggests that newer buses are being operated on Winwick road compared to the other two access roads.

The main conclusion regarding the fleet makeup would suggest that if the NAEI fleet projections for Warrington were applied to the observed traffic composition and flows, then this would undoubtedly lead to emissions being underestimated. The fleet information collected from the ANPR study therefore are likely to give a better representation of emissions.

Table 66: Year 2013 vehicle fleet make up

Vehicle cat.	Euro Standard	Catalyst Status	Warrington Town	Old Liverpool Road	Sankey Way	Winwick Rd	NAEI (2013)[11]
			%	%	%	%	%
Petrol cars	Aggregate Euro Composition						
	Pre-Euro 1	NA + failed	0.04	0.04	0.04	0.04	0.02
	Euro 1	ok	0.01	0.02	0.01	0.01	0.01
	Euro 2	ok	0.09	0.11	0.08	0.08	0.05
	Euro 3	ok	0.39	0.38	0.38	0.38	0.31
	Euro 4	ok	0.34	0.33	0.35	0.34	0.33
	Euro 5	ok	0.14	0.12	0.15	0.15	0.28

[11] UK Fleet Composition Data (Base 2011). rtp_fleet_projection_Base2011_final. NAEI REF. ED57422004

Vehicle cat.	Euro Standard	Catalyst Status	Warrington Town %	Old Liverpool Road %	Sankey Way %	Winwick Rd %	NAEI (2013) [11] %
	Euro 6	ok	0.00	0.00	0.00	0.00	-
Diesel cars	Aggregate Euro Composition						
	Pre-Euro 1	NA	0.00	0.00	0.00	0.00	-
	Euro 1	NA	0.00	0.01	0.00	0.00	0.00
	Euro 2	NA	0.02	0.02	0.02	0.02	0.02
	Euro 3	NA	0.20	0.22	0.20	0.19	0.19
	Euro 4	NA	0.47	0.46	0.48	0.45	0.36
	Euro 5	NA	0.30	0.29	0.30	0.34	0.43
	Euro 6	OK	0.00	0.00	0.00	0.00	-
Petrol LGVs	Aggregate Euro Composition						
	Pre-Euro 1	NA	0.21	NA	0.16	0.12	0.14
	Euro 1	NA	0.06	NA	0.17	0.00	0.02
	Euro 2	NA	0.30	NA	0.33	0.28	0.17
	Euro 3	NA	0.15	NA	0.17	0.00	0.24
	Euro 4	NA	0.25	NA	0.17	0.29	0.26
	Euro 5	NA	0.03	NA	0.00	0.32	0.16
	Euro 6	OK	0.00	NA	0.00	0.00	-
Diesel LGVs	Aggregate Euro Composition						
	Pre-Euro 1	0	0.00	0.00	0.00	0.00	0.00
	Euro 1	0	0.02	0.02	0.02	0.01	0.00
	Euro 2	0	0.04	0.04	0.04	0.04	0.02
	Euro 3	0	0.28	0.28	0.29	0.21	0.13
	Euro 4	0	0.42	0.42	0.42	0.44	0.45
	Euro 5	0	0.24	0.24	0.22	0.31	0.39
	Euro 6	0	0.00	0.00	0.00	0.00	-
Rigid HGV	Aggregate Euro Composition	0					
	Pre-Euro I	0	0.00	0.00	0.00	0.00	-
	Euro I	0	0.01	0.14	0.01	0.01	-
	Euro II	0	0.04	0.03	0.03	0.04	0.04
	Euro III	0	0.28	0.33	0.35	0.24	0.23
	Euro IV	0	0.31	0.26	0.32	0.30	0.19
	Euro V	0	0.09	0.06	0.07	0.10	0.12
	Euro V	0	0.27	0.18	0.22	0.30	0.35
	Euro VI	0	0.00	0.00	0.00	0.00	0.07
Artic HGV	Aggregate Euro Composition						
	Pre-Euro I	0	0.00	0.00	0.00	0.00	-
	Euro I	0	0.00	0.00	0.00	0.00	-
	Euro II	0	0.01	0.00	0.02	0.00	0.00
	Euro III	0	0.18	0.30	0.24	0.11	0.09
	Euro IV	0	0.30	0.50	0.17	0.28	0.14
	Euro V	0	0.13	0.05	0.14	0.15	0.16
	Euro V	0	0.38	0.16	0.43	0.45	0.49
	Euro VI	0	0.00	0.00	0.00	0.00	0.11
	Euro II SCRRF	0	0.00	0.00	0.00	0.00	-

Vehicle cat.	Euro Standard	Catalyst Status	Warrington Town	Old Liverpool Road	Sankey Way	Winwick Rd	NAEI (2013) [11]
			%	%	%	%	%
	Euro III SCRRF	0	0.00	0.00	0.00	0.00	-
Bus & Coach	Aggregate Euro Composition						
	Pre-Euro I	0	0.02	0.17	0.13	0.01	0.00
	Euro I	0	0.01	0.08	0.09	0.01	0.01
	Euro II	0	0.10	0.05	0.23	0.13	0.08
	Euro III	0	0.11	0.34	0.21	0.18	0.30
	Euro IV	0	0.47	0.12	0.20	0.17	0.18
	Euro V	0	0.07	0.06	0.04	0.12	0.10
	Euro V	0	0.21	0.18	0.11	0.37	0.29
	Euro VI	0	0.00	0.00	0.00	0.00	0.04
	Euro II +SCR	0	0.00	0.00	0.00	0.00	-
	Euro III + SCR	0	0.00	0.00	0.00	0.00	-
	Euro IV + SCR	0	0.00	0.00	0.00	0.00	-

Table 67: Problems associated with ANPR data capture

Site Code	Site Name	Problem
001	1 NB	20:00 – 21:45 – heavy rain making it difficult to read plate
002	1 SB	03:30 – 05:00 – too dark to see some plates. 20:00 – 21:45 – heavy rain making it difficult to read plate
003	2 NB	00:00 – 04:30 – too dark to see some plates and HGVs cut off 20:00 – 22:00 – heavy rain making it difficult to read plate
004	2 SB	20:15 – 21:45 – heavy rain making it difficult to read plate
005	3 NB	06:30 – 07:15 - Bright light making it difficult to collect all plates
007	4 EB	06:15 – 06:30 - camera moved 00:47:39 - 00:48:29 21:00 – 21:45 – heavy rain making it difficult to read plate
008	4 WB	21:15 – 21:45 – heavy rain making it difficult to read plate
011	6 NB	20:30 – 22:30 – heavy rain making it difficult to read plate
012	6 SB	19:30 – 21:00 – noisy tape, with periods where it is impossible to see plate
014	7 SB	14:45 – 15:15 – noisy tape, with periods where it is impossible to see plate
028	14 WB	20:45 – 24:00 – heavy rain making it difficult to read plate
031	16 EB	20:45 – 21:30 – heavy rain making it difficult to see plates
032	16 WB	08:00 – 09:00 – Bright light making it difficult to see plates 20:15 – 21:30 – heavy rain making it difficult to see plates

Table 68: The overall percentage site comparison between manual and ANPR samples

Site	MCC	ANPR	%
1	7702	6998	91%
	8304	7466	90%
2	9758	9003	92%
	10782	10053	93%
3	4406	4065	92%
	4306	4210	98%
4	21893	20860	95%
	21117	20203	96%
5	8581	8340	97%

	7615	7231	95%
6	2842	2731	96%
	2638	2458	93%
7	13897	12593	91%
	14571	14105	97%
8	4025	3940	98%
	3488	3464	99%
9	7410	7051	95%
	6617	6298	95%
10	10048	9334	93%
	10442	9574	92%
11	5899	5683	96%
	5081	4938	97%
12	4193	4085	97%
	4248	4188	99%
13	17569	17361	99%
	16125	15988	99%
14	11464	11159	97%
	14956	13641	91%
15	8949	8200	92%
	8153	7896	97%
16	9225	8784	95%
	10376	9052	87%
Overall	296680	280952	95%

F. Summary of Automatic Traffic Count data

Table 69: ATC data for Warrington (raw data from NDC)

Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
1	A49 Wilderspool Causeway, Att - Casualties Sign, OSGR: SJ 60896 87228	North	30	Tue, 14 May 2013	Mon, 27 May 2013	103448	7842	7389	48881	47.3	8906	8.6	446	0.4	29.9	33.3
		South	30	Tue, 14 May 2013	Mon, 27 May 2013	108919	8234	7780	29388	27.0	4308	4.0	199	0.2	27.9	31.5
		Two way	30	Tue, 14 May 2013	Mon, 27 May 2013	212367	16075	15169	78269	36.9	13214	6.2	645	0.3	28.9	32.4
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
2	A5060 Chester Road, Att - No Loading Sign, OSGR: SJ 60612 87304	North	30	Mon, 13 May 2013	Sun, 26 May 2013	128645	9879	9189	62168	48.3	14897	11.6	718	0.6	28.4	34.0
		South	30	Mon, 13 May 2013	Sun, 26 May 2013	138382	10725	9884	46774	33.8	11118	8.0	620	0.4	28.2	32.9
		Two way	30	Mon, 13 May 2013	Sun, 26 May 2013	267027	20604	19073	108942	40.8	26015	9.7	1338	0.5	28.3	33.6
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed

Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
3	Old Liverpool Road, Att - lc9, OSGR: SJ 59233 87792	East	30	Mon, 13 May 2013	Sun, 26 May 2013	57498	4507	4107	19400	33.7	3810	6.6	172	0.3	28.3	32.4
		West	30	Mon, 13 May 2013	Sun, 26 May 2013	57223	4420	4087	25012	43.7	4950	8.7	141	0.2	29.5	33.3
		Two way	30	Mon, 13 May 2013	Sun, 26 May 2013	114721	8926	8194	44412	38.7	8760	7.6	313	0.3	28.9	32.9
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
4	Sankey Way, Att - lc147, OSGR: SJ 58911 88118	East	40	Mon, 13 May 2013	Sun, 26 May 2013	261429	19961	18674	45377	17.4	7589	2.9	850	0.3	35.7	40.5
		West	40	Mon, 13 May 2013	Sun, 26 May 2013	261955	19898	18711	84293	32.2	20089	7.7	2120	0.8	37.9	43.2
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
5	Lovely Lane, Att - Collision Sign, OSGR: SJ 594111 88334	North	30	Wed, 8 May 2013	Tue, 21 May 2013	100604	7679	7370	15524	15.4	2047	2.0	61	0.1	25.6	30.0
		South	30	Wed, 8 May 2013	Tue, 21 May 2013	106429	8043	7746	7572	7.1	1195	1.1	92	0.1	20.7	27.7
		Two way	30	Wed, 8 May 2013	Tue, 21 May 2013	207033	15721	15118	23096	11.2	3242	1.6	153	0.1	23.1	29.1

Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
6	Bewsey Road, Att - lc12, OSGR: SJ 60025 88871	North	30	Mon, 13 May 2013	Sun, 26 May 2013	35261	2798	2519	6776	19.2	1329	3.8	80	0.2	26.6	30.6
		South	30	Mon, 13 May 2013	Sun, 26 May 2013	31977	2564	2284	6214	19.4	1204	3.8	78	0.2	26.9	30.6
		Two way	30	Mon, 13 May 2013	Sun, 26 May 2013	67238	5362	4803	12990	19.3	2533	3.8	158	0.2	26.7	30.6
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
7	Winwick Road, Att - Railings, OSGR: SJ 60574 89100	North	30	Tue, 14 May 2013	Mon, 27 May 2013	153379	11417	10956	22997	15.0	2288	1.5	96	0.1	26.1	30.0
		South	30	Tue, 14 May 2013	Mon, 27 May 2013	170342	12866	12167	42694	25.1	10239	6.0	497	0.3	26.3	31.8
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
8	Oxford Lane, Att - Direction Sign, OSGR: SJ 60781 88941	North	30	Mon, 13 May 2013	Sun, 26 May 2013	51854	3966	3704	2956	5.7	401	0.8	23	0.0	22.9	27.3
		South	30	Mon, 13 May 2013	Sun, 26 May 2013	48127	3615	3438	2163	4.5	392	0.8	17	0.0	18.8	25.9

Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
		Two way	30	Mon, 13 May 2013	Sun, 26 May 2013	99981	7580	7142	5119	5.1	793	0.8	40	0.0	20.9	26.8
Site No.	**Location.**	**Direction.**	**Speed Limit (mph)**	**Start Date.**	**End Date.**	**Total Vehicles.**	**5 Day Ave.**	**7 Day Ave.**	**No. > Speed Limit.**	**%. > Speed Limit.**	**No. > ACPO Limit.**	**%. > ACPO Limit.**	**No. > DfT Limit.**	**%. > DfT Limit.**	**Mean Speed**	**85%ile Speed**
9	Battersby Lane, Att - Hump Sign, OSGR: SJ 61201 88844	North	30	Fri, 24 May 2013	Mon, 27 May 2013	24283	6348	6071	9752	40.2	2073	8.5	82	0.3	29.2	33.3
		South	30	Fri, 24 May 2013	Mon, 27 May 2013	22500	5909	5625	10036	44.6	1868	8.3	69	0.3	29.3	33.3
		Two way	30	Fri, 24 May 2013	Mon, 27 May 2013	46783	12256	11696	19788	42.3	3941	8.4	151	0.3	29.2	33.3
Site No.	**Location.**	**Direction.**	**Speed Limit (mph)**	**Start Date.**	**End Date.**	**Total Vehicles.**	**5 Day Ave.**	**7 Day Ave.**	**No. > Speed Limit.**	**%. > Speed Limit.**	**No. > ACPO Limit.**	**%. > ACPO Limit.**	**No. > DfT Limit.**	**%. > DfT Limit.**	**Mean Speed**	**85%ile Speed**
9	Battersby Lane, Att - Hump Sign, OSGR: SJ 61201 88844	North	30	Thu, 9 May 2013	Tue, 14 May 2013	42719	7630	7120	13211	30.9	2133	5.0	72	0.2	28.2	32.0
		South	30	Thu, 9 May 2013	Tue, 14 May 2013	38642	6875	6440	16701	43.2	3123	8.1	83	0.2	29.0	33.1
		Two way	30	Thu, 9 May 2013	Tue, 14 May 2013	81361	14505	13560	29912	36.8	5256	6.5	155	0.2	28.6	32.7
Site No.	**Location.**	**Direction.**	**Speed Limit - PSL (mph)**	**Start Date.**	**End Date.**	**Total Vehicles.**	**5 Day Ave.**	**7 Day Ave.**	**No. > Speed Limit.**	**%. > Speed Limit.**	**No. > ACPO Limit.**	**%. > ACPO Limit.**	**No. > DfT Limit.**	**%. > DfT Limit.**	**Mean Speed**	**85%ile Speed**
10	Manchester Road, Att - L/C26,	North	30	Mon, 13 May	Sun, 26 May	136729	10554	9766	19722	14.4	2968	2.2	223	0.2	24.6	29.8

Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
	OSGR: SJ 61570 88657			2013	2013											
		South	30	Mon, 13 May 2013	Sun, 26 May 2013	139101	10683	9936	29568	21.3	4615	3.3	175	0.1	26.0	30.9
		Two way	30	Mon, 13 May 2013	Sun, 26 May 2013	275830	21237	19702	49290	17.9	7583	2.7	398	0.1	25.3	30.4
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
11	Farrell Street, Att - lc, OSGR: SJ 61693 88409	East	30	Mon, 13 May 2013	Sun, 26 May 2013	78245	6068	5589	59986	76.7	22110	28.3	1199	1.5	33.0	37.1
		West	30	Mon, 13 May 2013	Sun, 26 May 2013	68709	5334	4908	52282	76.1	18566	27.0	820	1.2	32.9	36.9
		Two way	30	Mon, 13 May 2013	Sun, 26 May 2013	146954	11402	10497	112268	76.4	40676	27.7	2019	1.4	33.0	37.1
Site No.	Location.	Direction.	Speed Limit (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
12A	Wharf Street, Att - Railings, OSGR: SJ60907 87895	East	30	Fri, 24 May 2013	Mon, 27 May 2013	17364	4591	4341	174	1.0	23	0.1	1	0.0	21.1	24.2
Site No.	Location.	Direction.	Speed Limit - PSL	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed

Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
			(mph)													
12B	Whalley Street, Att - Fence, OSGR: SJ 60969 87806	East	30	Tue, 14 May 2013	Mon, 27 May 2013	6554	590	468	113	1.7	22	0.3	0	0.0	22.2	25.5
		West	30	Tue, 14 May 2013	Mon, 27 May 2013	57544	4056	4110	768	1.3	67	0.1	0	0.0	21.0	25.1
		Two way	30	Tue, 14 May 2013	Mon, 27 May 2013	64098	4646	4578	881	1.4	89	0.1	0	0.0	21.1	25.1
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
12C	Wharf Street, Att - L/C 15, OSGR: SJ 61141 87743	East	30	Tue, 14 May 2013	Mon, 27 May 2013	7525	661	538	2282	30.3	678	9.0	83	1.1	27.2	32.9
		West	30	Tue, 14 May 2013	Mon, 27 May 2013	7581	665	542	2056	27.1	525	6.9	43	0.6	27.0	32.2
		Two way	30	Tue, 14 May 2013	Mon, 27 May 2013	15106	1325	1079	4338	28.7	1203	8.0	126	0.8	27.1	32.4
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
13	Mersey Street, Att - LC19, OSGR: SJ 60914 88048	North	40	Mon, 13 May 2013	Sun, 26 May 2013	200788	14860	14342	84	0.0	40	0.0	9	0.0	24.5	28.2
		South	40	Mon, 13 May	Sun, 26 May	199963	15172	14283	3353	1.7	641	0.3	79	0.0	25.5	32.2

Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
				2013	2013											
Site No.	Location.	Direction.	Speed Limit (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
14a	Wilson Patten Street, Att - Direction Sign, OSGR: SJ 60368 87840	East	30	Thu, 9 May 2013	-	10056	10056	10056	2215	22.0	383	3.8	25	0.2	24.1	31.1
		West	30	Thu, 9 May 2013	-	13644	13644	13644	1801	13.2	414	3.0	57	0.4	24.6	29.5
		Two way	30	Thu, 9 May 2013	-	23700	23700	23700	4016	16.9	797	3.4	82	0.3	24.4	30.2
Site No.	Location.	Direction.	Speed Limit (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
14b	Wilson Patten Street, Att - Direction Sign, OSGR: SJ 60368 87840	East	30	Fri, 24 May 2013	Mon, 27 May 2013	35201	9536	8800	16052	45.6	3739	10.6	145	0.4	27.9	33.8
		West	30	Fri, 24 May 2013	Mon, 27 May 2013	45748	12329	11437	15459	33.8	3228	7.1	142	0.3	28.0	32.4
		Two way	30	Fri, 24 May 2013	Mon, 27 May 2013	80949	21865	20237	31511	38.9	6967	8.6	287	0.4	27.9	33.1
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
14c	Wilson Patten Street, Att - Direction	East	30	Tue, 14 May 2013	Wed, 22 May 2013	96811	11273	10771	33059	34.1	5819	6.0	260	0.3	27.3	32.4

Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
	Sign, OSGR: SJ 60368 87840	West	30	Tue, 14 May 2013	Wed, 22 May 2013	126861	14916	14112	26663	21.0	4713	3.7	230	0.2	26.1	30.9
		Two way	30	Tue, 14 May 2013	Wed, 22 May 2013	223672	26189	24882	59722	26.7	10532	4.7	490	0.2	26.6	31.8
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
15	Midland Way, Att - ARMCO, OSGR: SJ 60422 88443	East	30	Tue, 14 May 2013	Mon, 27 May 2013	110782	8666	7913	45505	41.1	14020	12.7	866	0.8	27.4	34.2
		West	30	Tue, 14 May 2013	Mon, 27 May 2013	101635	7824	7260	29169	28.7	8981	8.8	512	0.5	25.8	32.9
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
16A	A50 Knutsford Road, Att - 30mph Warning Sign, OSGR: SJ 61969 87408	East	30	Thu, 9 May 2013	Sat, 18 May 2013	88886	9442	8889	57666	64.9	12399	13.9	469	0.5	31.3	34.7
Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed

Site No.	Location.	Direction.	Speed Limit - PSL (mph)	Start Date.	End Date.	Total Vehicles.	5 Day Ave.	7 Day Ave.	No. > Speed Limit.	%. > Speed Limit.	No. > ACPO Limit.	%. > ACPO Limit.	No. > DfT Limit.	%. > DfT Limit.	Mean Speed	85%ile Speed
16B	A50 Knutsford Rd, Att - 30mph Warning Sign, OSGR: SJ 61969 87408	West	30	Mon, 13 May 2013	Sun, 26 May 2013	137442	10586	9817	61875	45.0	12246	8.9	410	0.3	29.4	33.6

G. TEEM Emissions Modelling

Model overview

The Transport and Enhanced Emissions Model (TEEM) is a compilation of road traffic activity data held on a central database which can be used to test the impact on emissions for various traffic management measures. The aim of the tool is to provide a standard reporting platform for city and district wide authorities it can also be used to test localised planning applications. The tool forms part of a modular structure under the umbrella of Geographical Specific Emissions Inventories (GSEIs). Hence, the structure has been designed with a view of applying Geographical Information Systems (GIS) to assist the modelling setup and if appropriate presenting results. The GSEI system has a modular structure to allow the easy incorporation of different elements and new data. It consists of the following modules:

- Module 1: Road network and characteristics
- Module 2: Road traffic activity
- Module 3: Road vehicle fleet
- Module 4: Road emission factor database

The tool is web based and thus can be accessed by TRL and the end user simultaneously. Specific road traffic activity data underlying the TEEM is based on data collected by the end user, in this case WBC. TEEM Version 1.1 applied in this study includes the following attributes;

- Accepts different levels of traffic input data depending on what's available;
- Speed and flow profiles – these are assigned to any given link to scale speed and flow over 24 hours – speed/flow profiles are typically derived from surveys and can be assigned to vary by link depending on the availability of these data;
- Source apportionment results can be displayed as tables, charts or as GIS maps via a user interface;
- Results can be exported into various formats and metrics;
- Has a 'project' save facility – this allows all input information to be uploaded into TEEM from previous sessions.

TEEM is flexible enough to be able to generate simple outputs from basic datasets and complex outputs from detailed datasets (and more complex calculation routines) where they are available.

Pollutants

The pollutants included in TEEM are NO_X, PM10, PM2.5 (exhaust and non-exhaust) HC and CO_2.

The levels of uncertainty which can be expected for each of these pollutants are:

- Low uncertainty: CO_2, NO_X, HC;
- Medium uncertainty: PM10, PM2.5
- High uncertainty: None.

It is noted that the version of TEEM used in this study includes the most recent emission factors dataset applied in the NAEI.[12]

Spatial representation and resolution

Calculations are based primarily on vector (link-based) data. The road network is included at an individual link resolution (link length varies).

Temporal resolution

TEEM applies average daily traffic (ADT) values as input, but these values are then scaled over 24 hours using diurnal flow and speed profiles. Profiles may differ over a seven day period.

Output and visualisation

The road link data are referenced to geographical locations in a Geographical Information System (GIS) visualised through an embedded interface. This has a number of important advantages. For example, the data on link characteristics and activity which are required for the calculation of emissions can be obtained quickly and in a consistent manner. It also enables the impacts of the transport networks on local air pollution to be determined more easily via the mapping of pollutant emissions. There are also temporal charting and source apportionment charting utilities.

Emissions output

For the work reported here results are provided in terms of mass (tonnes per annum) and rates (g/km/s) used by the pollution dispersion model.

Road network and characteristics

The starting point for this specific phase of the analysis is the creation of a road network (i.e. the study area) compiled of a number of separate links upon which traffic characteristics can then be applied using TEEM. The road network shown in Figure 12 is made up of 111 separate road links (listed in Appendix G). Each road link has a unique ID. This ID is applied in TEEM and also in the air dispersion model ADMS Roads. In this respect spatial results of emissions and pollutant concentrations can be easily cross matched to their source. The road network and individual links are accessible via the TEEM interface.

[12] NAEI: http://naei.defra.gov.uk/data/ef-transport

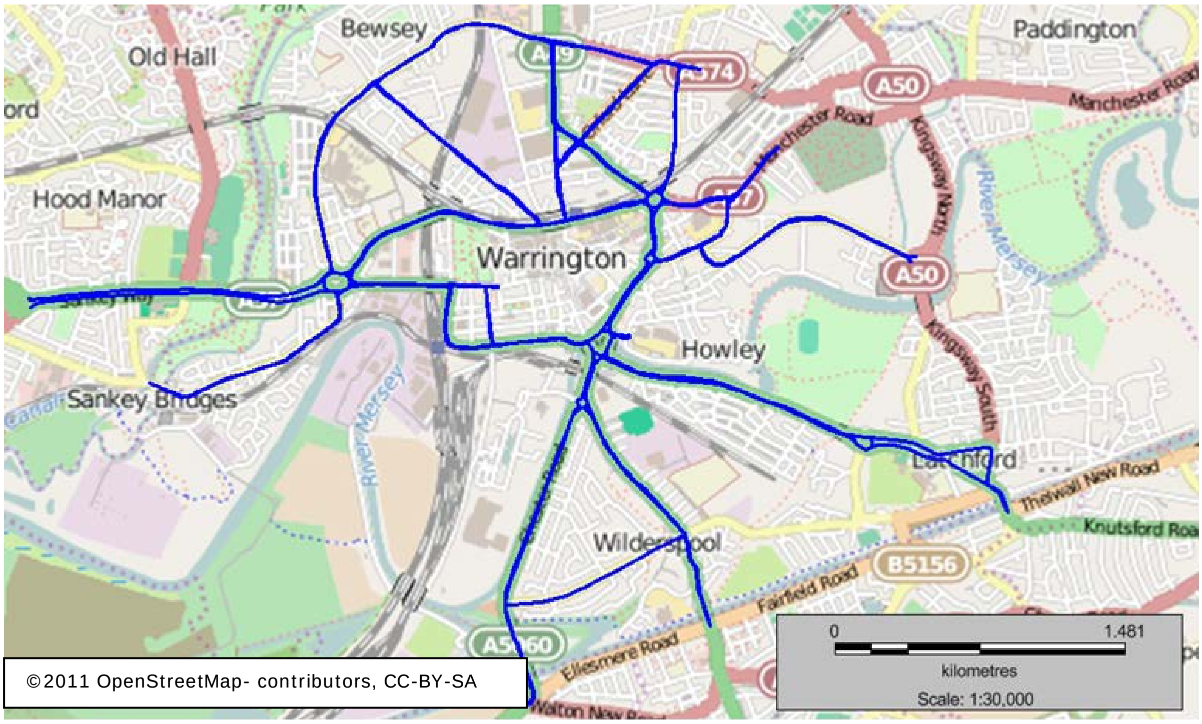


Figure 33: Modelled road network and extent of study area

Road traffic activity

In addition to ANPR data which provided the study with the detailed fleet and journey pattern information the traffic surveying consultants NDC conducted classified automatic traffic counts (ATCs) at the sixteen targeted locations as shown in Figure 34. In total, twenty-two counters (of the pneumatic tube road surface type) were installed across the sixteen locations (in some locations separate counters were required per direction). Counters were installed on Monday 13th May and removed on Tuesday, 27th May 2013. The objective was to capture a minimum of fourteen days' worth of data at each site.

The metrics of interest to this study using ATC data alone included the following;

- Daily traffic flows (vehs/day)
- Average daily traffic speed (km/h)
- Coarse fleet composition (%) (i.e. motorcycles, passenger cars, light goods vehicles (<3.5 tonnes gross), buses, rigid heavy goods vehicles and articulated heavy goods vehicles.
- Diurnal traffic flow profiles (Monday to Sunday) ($Factor_{Flow}$)
- Diurnal speed profiles (Monday to Sunday) ($Factor_{speed}$)

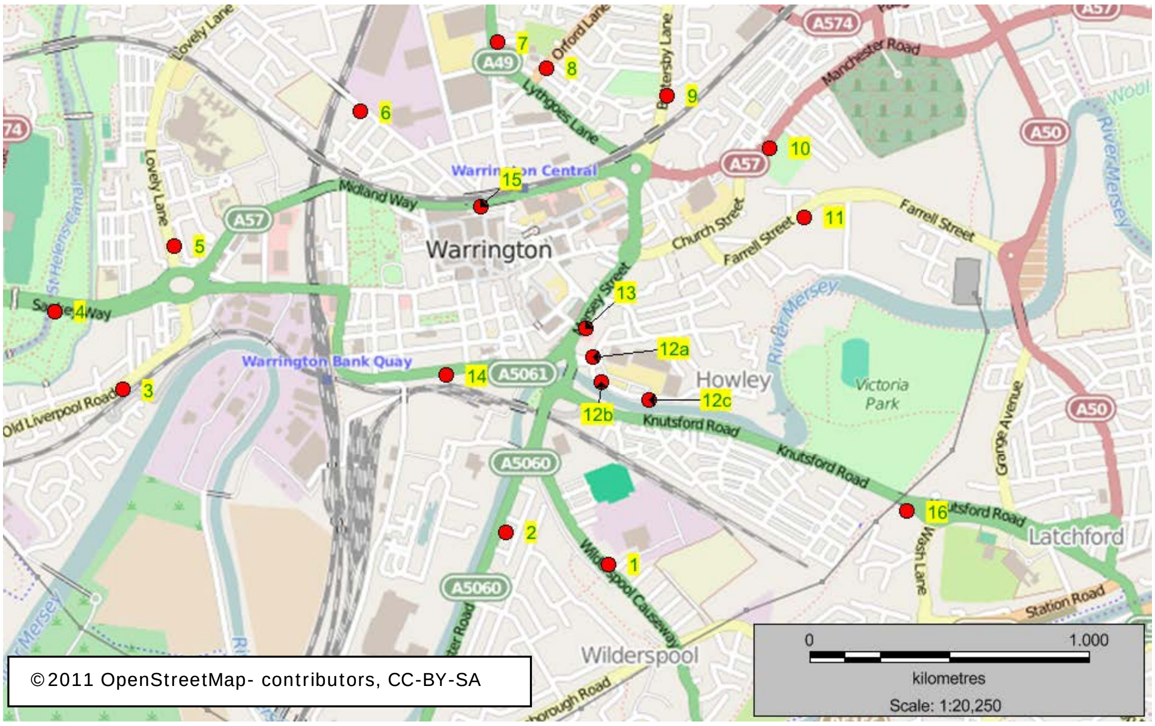


Figure 34: Location of automatic traffic count sites

Traffic flow and speed

Average daily traffic (ADT) was assumed for each of the 111 road links using ATC's. The value was taken as the average over seven day. A full list of traffic data applied for the detailed study assessment is shown in 0 (raw data format from NDC) and processed for application in TEEM (G).

Coarse vehicle composition

The coarse vehicle composition provides the basis of the absolute traffic flows applied in TEEM. It's a hierarchical system whereby the details of emission estimates are based on the corresponding detail of the coarse composition. TEEM models according to the following categories;

Level 0: ADT

Level 1: LDV/HDV/Two Wheelers

Level 2: Motorcycles, mopeds, passenger cars, light goods vehicles (<3.5 tonnes gross), buses, coaches, rigid heavy goods vehicles and articulated heavy goods vehicles.

For this study level two was applied with the expectation of motorcycles and mopeds. This was because a consistent fleet methodology was applied across all vehicle categories using ANPR data from which motorcycles cannot be captured.

A sensitivity analysis was undertaken to proportionally compare vehicles recorded by automatic traffic counters with those recorded using automatic number plate recognition cameras. As shown in Table 70, overall there would appear to be reasonable agreement between light and heavy duty vehicles. Motorcycles are not captured by number plate recognition and hence agreement isn't possible. On a by vehicle category basis the proportion of passenger cars recorded by traffic counters are slightly higher, taxis of course cannot be differentiated from the normal passenger car. It is often the case that traffic counters underestimate light goods vehicles assuming that they are passenger cars. This is probably the reason why the counters have picked up a higher proportion of passenger cars. Buses appear to be fairly similar. A counter cannot differentiate buses from coaches. The camera has identified the proportion of coaches to be around 0.1 percent. The counters have underestimated the number of rigid heavy goods vehicles and overestimated the articulated component if it is to be assumed that the cameras provide a more accurate profile. The standard deviation would appear to show less certainty in the agreement between light and heavy goods vehicles.

From an emissions modelling and air quality management perspective it's important that an accurate characterisation of the fleet is maintained. It allows (a) a greater understanding as to the causes of air-pollution and (b) practitioners to develop more targeted air-pollution mitigation measures.

Table 70: Comparative fleet statistics from automatic count sites and number plate recognition cameras

	ATC				ANPR	
	Average (%)	Max (%)	Min (%)	STDev	Average-inbound camera (%)	Average-outbound camera (%)
LDVS	**96.46**	98.52	93.60	1.30	96.79	**96.79**
HDVS	**2.59**	5.77	0.90	1.30	2.01	**2.11**
TWO WHEELERS	0.96	2.53	0.58	0.40	0.00	0.00
MOTORCYCLES	0.96	2.53	0.58	0.40	0.00	0.00
MOPEDS	0.00	0.00	0.00	0.00	0.00	0.00
CARS	92.95	96.75	88.13	1.63	89.60	89.85
TAXIS	0.00	0.00	0.00	0.00	0.00	0.00
LGVS	3.50	6.85	1.77	0.77	7.19	6.94
BUSES	0.88	1.71	0.44	0.19	1.20	1.10
COACHES	0.00	0.00	0.00	0.00	0.11	0.11
RIGID HGVS	0.80	2.32	0.22	0.49	1.36	1.41
ARTIC HGVS	0.91	3.71	0.07	1.02	0.54	0.60

Detailed Fleet composition

Table 66 shows a comparison of the fleet observed at four locations compared to the NAEI in year 2013. The conclusion was using NAEI fleet projections for Warrington would undoubtedly lead to emission being underestimated. On this basis, a single revised fleet was developed using all available data observed by the ANPR survey (i.e. vehicle details observed for every single recorded journey). In total, 196 origin destination combinations between camera sites were identified. These are exemplified in Table 71. For each of the 196 combinations a comprehensive fleet structure was determined based on the following criteria;

1. Tax class
2. Propulsion Type
3. Body Type
4. Make
5. Model

6. Date of First Registration
7. Gross Weight
8. Number of seats
9. Wheel plan (Axle Configuration)
10. Engine Size
11. Unladen Weight
12. Cat Type
13. Emissions Standard

Table 71: First 10 origin destination combinations used to define a Warrington fleet representing actual journeys made by vehicles.

#	From Camera	To Camera
1	24	31
2	3	23
3	24	0[13]
4	14	17
5	18	0
6	3	4
7	24	8
8	14	2
9	7	0
10	16	15

From the 196 individual fleets a final Warrington fleet profile was developed. The formatting of the fleet profile is commensurate with that applied in the TEEM. Vehicle Emission categories correspond to those developed in COPERT[14] for European assessment and also applied in the Emission Factor Tool Kit[15] in the UK. The entire fleet is sub divided over 420 emission categories and is shown in I. This fleet was appended to every road link included in the modelling assessment.

Diurnal traffic flow and speed profiles

Diurnal profiles allow emissions to be estimated with reference to the variation in traffic flow and speed on an hourly basis. This allows for a more accurate estimate of emissions compared with applying a daily average flow and daily average speed. Profiles vary according to hour and by day. TEEM estimates emissions for each hour over a seven-day week. At present there is no seasonal variability built into TEEM, hence annual emissions are calculated by multiplying the weekly result by fifty-two. For this study flow and speed profiles were matched to all 111 road links. Professional judgement was required to match appropriate profiles to roads using the available count sites. In total, thirty-four profiles were developed this included two from each count site (one in each direction) and a separate one was developed for roundabouts and general

[13] Zero denotes routes terminating in the “central area” rather than passing another camera site.
[14] http://www.eea.europa.eu/publications/copert-4-2014-estimating-emissions
[15] http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

one for Warrington town centre. The generic flow and speed profile for Warrington town centre is shown in Figure 35.

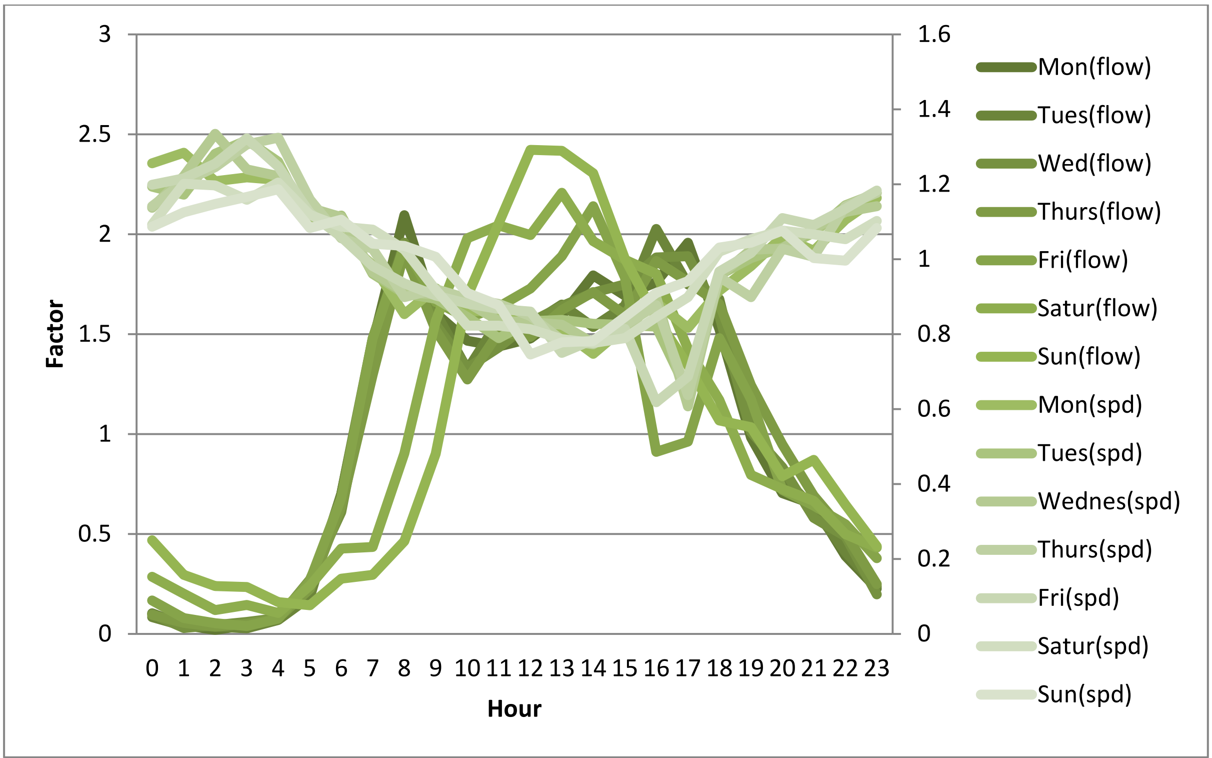


Figure 35: Generic flow and speed profiles for Warrington

In summary, Task 5 to Task 8 involved compiling traffic flows, speeds, fleets and diurnal profiles surveyed by NDC into a format usable by the emissions model, TEEM. The following section includes the baseline emissions modelling results.

Base year emissions for year 2013

The TEEM was set up with all the necessary input data to provide a baseline emissions profile for the Warrington assessment area (i.e. 111 road links). The total emissions per annum are shown in

Table 12. Note that the light duty category includes cars and LGVs whilst the heavy duty includes trucks and buses.

Table 72: Baseline emissions 2013

Pollutant	Sum of LDV (kg/yr)	Sum of HDV (kg/yr)	Total
NOx	117,723	51,639	169,362
PM10 exhaust	3,336	623	3,959
PM25 exhaust	3,169	592	3,761
CO_2	78,899,955	7,353,585	86,253,541

Drilling down still further; Table 73 shows the proportional distribution according to the daily rate of emissions. Apart from NOx light vehicles dominate the profile.

Table 73: Baseline emission 2013a

Pollutant	LDV (g/km/day)	HDV (g/km/day)	LDV %	HDV %
NOx	793,895	374,088	68%	32%
PM10 (Abrasion)	7,248	1,214	86%	14%
PM10 (Brake)	11,746	1,661	88%	12%
PM10 (Tyre)	8,801	846	91%	9%
PM25 (Abrasion)	3,914	656	86%	14%
PM25 (Brake)	4,698	664	88%	12%
PM25 (Tyre)	6,160	592	91%	9%
PM10 (exhaust)	22,313	4,536	83%	17%
PM25 (exhaust)	21,197	4,310	83%	17%
CO_2	528,808,645	51,683,686	91%	9%
HC	66,210	9,107	88%	12%

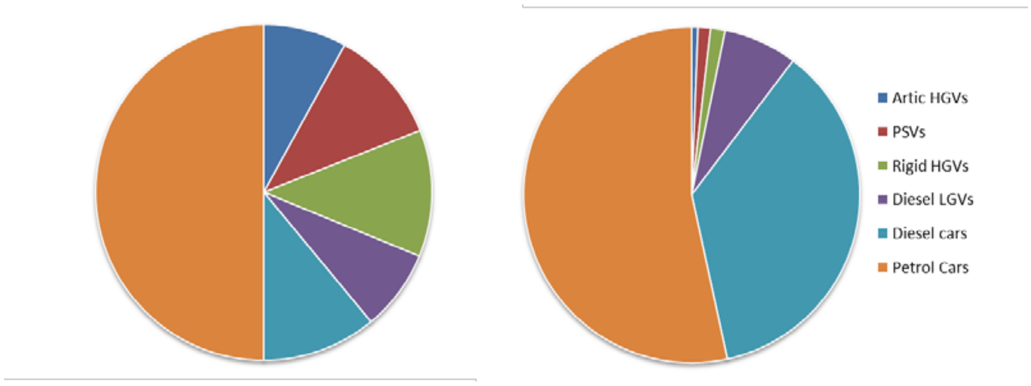
In terms of the source apportionment the baseline results are shown in Table 14. For NOx and exhaust PM the key contributor appears to be diesel passenger cars. Rigid heavy vehicles are second high NOx contributor.

Table 74: Contribution of vehicle types to emissions (source apportionment), 2013

Pollutant	Car Petrol (%)	Car Diesel (%)	LGV Petrol (%)	LGV Diesel (%)	HGV Rigid (%)	HGV Articulated (%)	Buses –PSVs (%)
NOx	11.3%	50.0%	0.0%	7.9%	12.2%	7.5%	11.1%
PM10 exhaust	18.9%	52.1%	0.0%	12.7%	7.5%	3.1%	5.7%
PM25 exhaust	18.9%	52.1%	0.0%	12.7%	7.5%	3.1%	5.7%
CO_2	53.4%	32.4%	0.0%	5.4%	3.3%	2.6%	2.7%
HC	51.0%	27.9%	0.1%	9.2%	5.2%	1.4%	5.1%

With respect to developing air quality mitigation measures it's important that emission quantities are reported alongside the proportion vehicles responsible for the contribution this is shown for NOx in Figure 36.The width of the bars represent the vehicle count proportion (as a percentage) to the overall vehicle count (yearly) for that vehicle category. The heights of the bar represent the quantity of pollutant in unit of tonnes/year. The figure shows that disproportionate NOx contribution from heavy duty vehicles and that over 50% of the annual traffic are petrol cars contributing to only 11%

of the NOx. In other words the figure suggests that measures aimed at tackling diesel engines would be more beneficial to reduce NOx.



a)Vehicle proportions b) NOx emissions

Figure 36: Baseline annual NOx emissions by source category compared to the proportion of vehicles contributing to emissions.

In addition to the presentation of emissions results in tables and charts it is also useful to show spatial representations. Figure 37, Figure 38 and Figure 39 display the results for NOx (as an emission rate) averaged across 24 hours and across seven days of the week for all vehicles, LDVs and HDVs respectively. Whilst the coloured maps look very similar, the legend on each changes accordingly. In Figure 39 for HDVs the results indicate that the main impact on emissions occurs on the ring road.

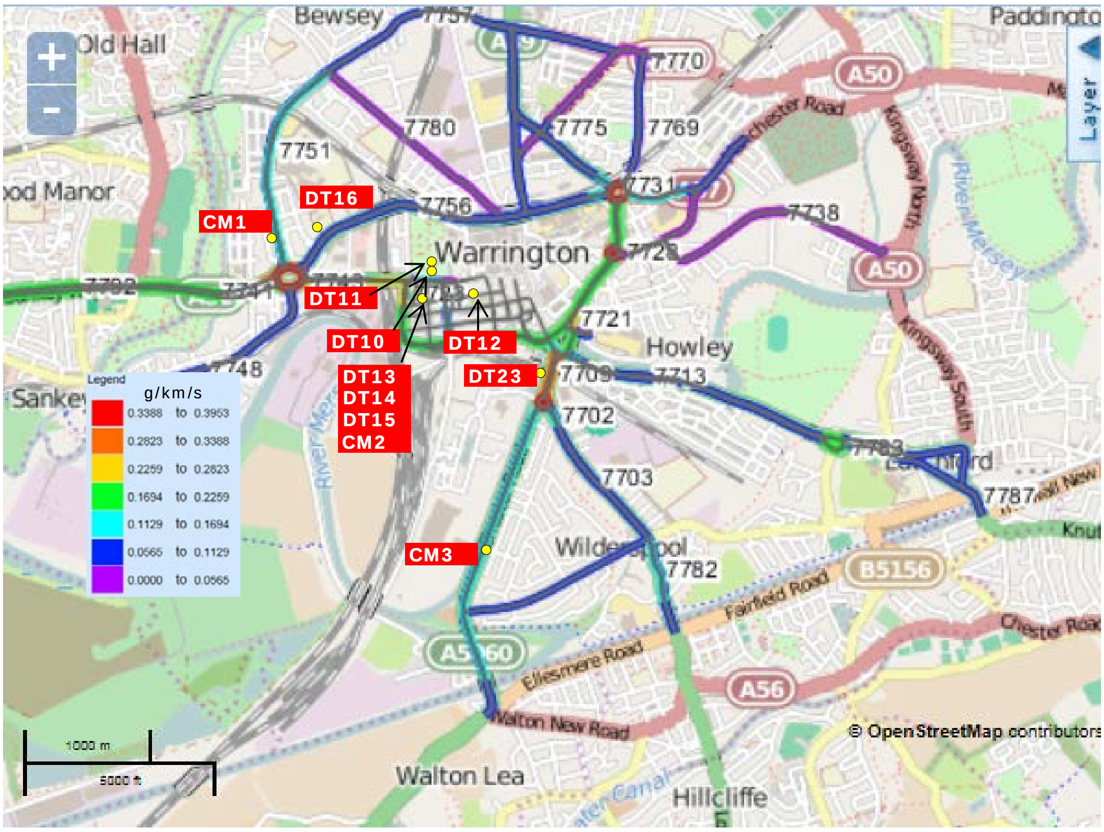


Figure 37: NOx emissions, all vehicles (g/km/s) –111 road links

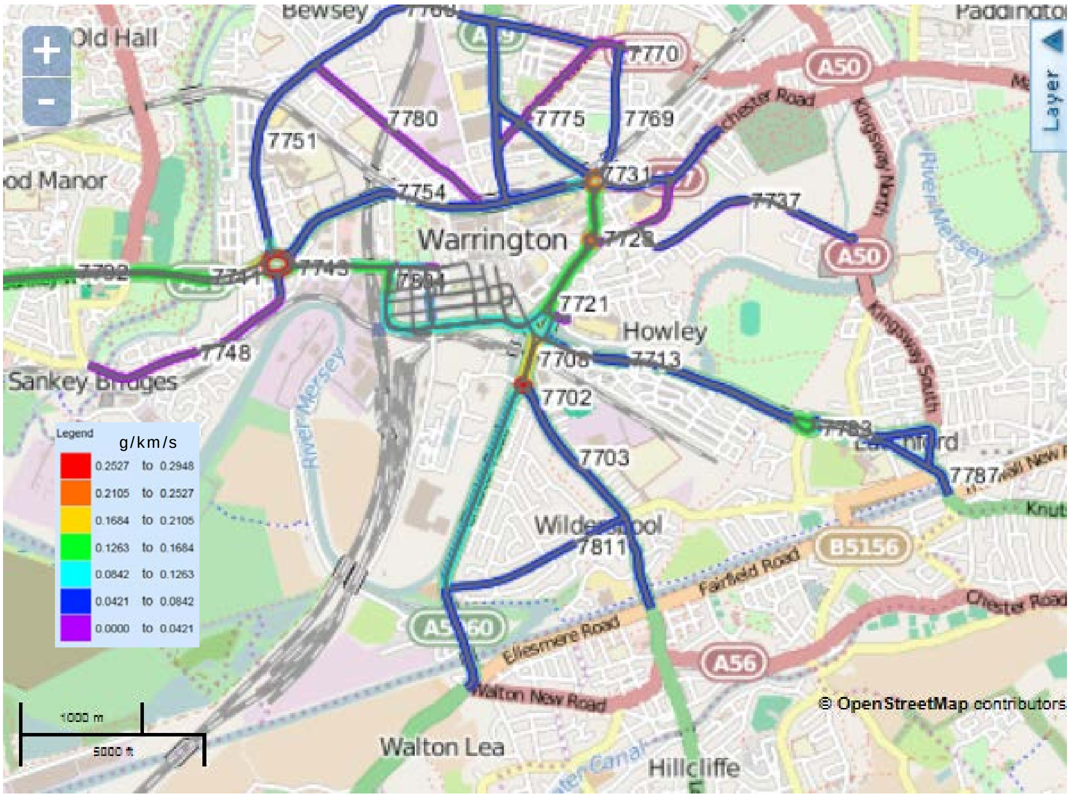


Figure 38: NOx emissions, LDV vehicles (g/km/s) –111 road links

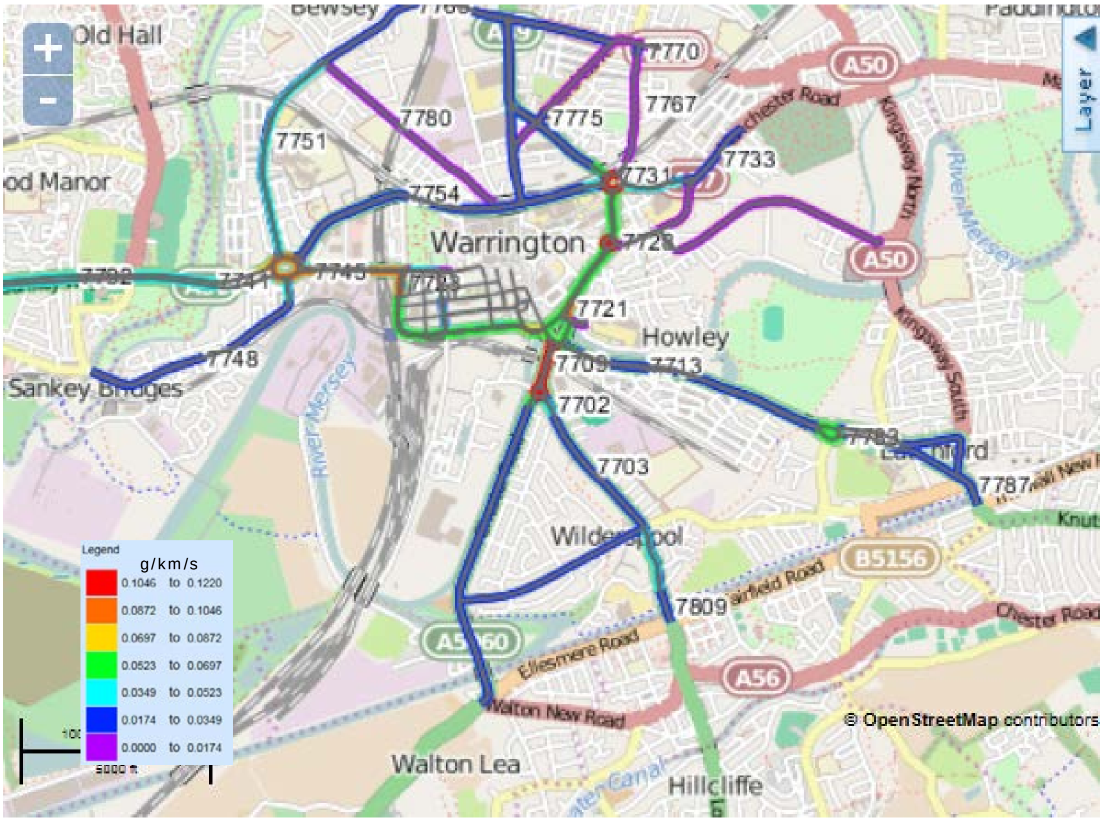


Figure 39: NOx emissions, HDV vehicles (g/km/s) – 111 road links

H.Flow and Speed by link applied in TEEM

Table 75: Daily average flow and speeds for road links in TEEM

TEEM ID	Road Name (ADMS)	Daily average flow (v/day)	Daily average speed (km/h)
7701	WPool_in	7389	48
7702	WPool_in_J	7389	24
7703	WPool_out	7780	45
7704	BBisland	30192	40
7705	Chester_out	9884	45
7706	Chester_in	9189	46
7707	Chester_in_J	9189	24
7708	WPoolCW_S	16969	24
7709	WPoolCW_N	16578	24
7710	Knutsford_in	9817	47
7711	Knutsford_in_J	9817	24
7712	Bridge_Gy_1	13464	40
7713	Knutsford_out	8889	50
7714	Bridge_Gy_2	14283	40
7715	Wharf_in	4341	34
7716	Wharf_out	4110	34
7717	Bridge_Gy_3	6732	40
7718	Bridge_Gy_4	13464	40
7719	Mersey_out	14342	39
7720	Mersey_in	14283	41
7721	Mersey_in_J	14283	24
7722	WPatt_west	14112	42
7723	WPatt_west_J	14112	24
7724	WPatt_east	10771	44
7725	WPatt_east_J	10771	24
7726	Chester1_out	9884	45
7727	Chester1_in	9189	46
7728	Dial_RAB	25763	40
7729	Fennel_nth	14342	39
7730	Fennel_sth	14283	41
7731	Midland_RAB	25763	40
7732	Manchester_out	7325	48
7733	Manchester_in	7452	42
7734	Manchester_in_J	7452	24
7735	Church_east	2442	40
7736	Church_west	2484	42
7737	Farrell_out	5589	53
7738	Farrell_out_in	4908	53
7739	Farrell_out_in_J	4908	24
7740	Sankey_west	18711	61
7741	Sankey_east	18674	57
7742	Sankey_east_J	18674	24
7743	Sankey_RAB	33647	40
7744	Lpool_west	14112	24
7745	Lpool_west_J	14112	24

TEEM ID	Road Name (ADMS)	Daily average flow (v/day)	Daily average speed (km/h)
7746	Lpool_east	10771	44
7747	Old_Lpool_west	4087	47
7748	Old_Lpool_east	4107	46
7749	Old_Lpool_east_J	4107	24
7750	Lov_nth	7370	41
7751	Lov_sth	7746	33
7752	Lov_sth_J	7746	24
7753	Sankey_switch	1000	48
7754	Midland_Way_east	7913	44
7755	Midland_Way_east_J	7913	24
7756	Midland_Way_west	7260	42
7757	Folly_west	7746	33
7758	Folly_west_1	7746	33
7759	Folly_east_1	7370	41
7760	Folly_east	7370	41
7761	Wwick_nth	5478	42
7762	Wwick_sth	6084	42
7763	Lyth_nth	5478	42
7764	Lyth_nt_J	5478	24
7765	Lyth_sth	6084	42
7766	Lyth_sth_J	6084	24
7767	Batt_sth	5625	47
7768	Batt_sth_J	5625	24
7769	Batt_nth	7120	45
7770	Batt_nth_J	7120	24
7771	Pinn_nth_J	500	24
7772	Pinn_sth_J	500	24
7773	Orford_Nth	3704	37
7774	Orford_Sth	3438	30
7775	Orford_Sth_J	3438	24
7776	Bewsey_sth	2284	43
7777	Bewsey_sth_J	2284	43
7778	Bewsey_sth_1	2284	43
7779	Bewsey_nth_1	2519	43
7780	Bewsey_nth	2519	43
7781	WPool_out_1	7780	45
7782	WPool_in_1	7389	24
7783	Wash_RAB	16835	40
7784	Wash_RAB_1	400	40
7785	Knutsford_out1	8889	50
7786	Knutsford_out2	8889	50
7787	Knutsford_out3	8889	50
7788	Knutsford_in_1	9817	47
7789	Knutsford_in_1_J	9817	24
7790	Knutsford_in_2	9817	47
7791	Sankey_west_1	18711	61
7792	Sankey_east_1	18674	57
7793	Sankey_St_east	1293	44
7794	Sankey_St_west	646	44

TEEM ID	Road Name (ADMS)	Daily average flow (v/day)	Daily average speed (km/h)
7795	Winmarleigh_N1	969	44
7796	Winmarleigh_S1	10232	44
7797	Winmarleigh_N2	969	44
7798	Winmarleigh_S2	754	44
7799	Winmarleigh_S3	10232	44
7800	WPatt_West_New	14112	42
7801	WPatt_east_JNew	10232	44
7802	WPatt_east_New	10232	44
7803	WPatt_west_New1	14112	42
7804	WPatt_west_J_New2	13406	24
7805	Wpatt_west_JNew3	706	42
7806	Sankey_St_east_New	11477	42
7807	Chester_In1	9189	22
7808	Chester_Out1	7370	21
7809	WPool_In_2	7389	24
7810	WPool_Out_2	7780	21
7811	GBorough_TW	6000	48

I. Warrington vehicle fleet 2013

Table 76: Applied baseline local vehicle fleet in Warrington

Level	General Fleet	Coarse Fleet	Fuel Pow Tech	VGW Weight	Engin e Size	Emission Standard	Proportion
1	HDVs						0.032922
1	LDVs						0.967078
1	TwoWheelers						0
2	HDVs	Artic_HGVs					0.192067
2	HDVs	Buses					0.378914
2	HDVs	Coaches					0
2	HDVs	Rigid_HGVs					0.429019
2	LDVs	Cars					0.928655
2	LDVs	LGVs					0.071345
2	LDVs	Taxis					0
2	TwoWheelers	Mopeds					0
2	TwoWheelers	Motorcycles					0
3	HDVs	Artic_HGVs	Diesel				1
3	HDVs	Buses	Diesel				1
3	HDVs	Coaches	Diesel				0
3	HDVs	Rigid_HGVs	Diesel				1
3	LDVs	Cars	Diesel				0.405093
3	LDVs	Cars	LPG				0
3	LDVs	Cars	Petrol				0.594907
3	LDVs	LGVs	Diesel				0.996264
3	LDVs	LGVs	Petrol				0.003736
3	LDVs	Taxis	Diesel				0
3	TwoWheelers	Mopeds	Petrol				0
3	TwoWheelers	Motorcycles	Petrol				0
4	HDVs	Artic_HGVs	Diesel	14-20t			0
4	HDVs	Artic_HGVs	Diesel	20-28t			0.014946
4	HDVs	Artic_HGVs	Diesel	28-34t			0.0625
4	HDVs	Artic_HGVs	Diesel	34-40t			0.077446
4	HDVs	Artic_HGVs	Diesel	40-50t			0.845109
4	HDVs	Artic_HGVs	Diesel	50-60t			0
4	HDVs	Buses	Diesel	<=15t			0.795455
4	HDVs	Buses	Diesel	>18t			0.133609
4	HDVs	Buses	Diesel	15-18t			0.070937
4	HDVs	Coaches	Diesel	<=18t			0
4	HDVs	Coaches	Diesel	>18t			0
4	HDVs	Rigid_HGVs	Diesel	<=7.5t			0
4	HDVs	Rigid_HGVs	Diesel	>32t			0.144769
4	HDVs	Rigid_HGVs	Diesel	12-14t			0.314477
4	HDVs	Rigid_HGVs	Diesel	14-20t			0.28163
4	HDVs	Rigid_HGVs	Diesel	20-26t			0.012774
4	HDVs	Rigid_HGVs	Diesel	26-28t			0.159976
4	HDVs	Rigid_HGVs	Diesel	28-32t			0.000608
4	HDVs	Rigid_HGVs	Diesel	7.5-12t			0.085766
4	LDVs	Cars	Diesel	<2.5t			1
4	LDVs	Cars	LPG	<2.5t			0

Level	General Fleet	Coarse Fleet	Fuel Pow Tech	VGW Weight	Engine Size	Emission Standard	Proportion
4	LDVs	Cars	Petrol	<2.5t			1
4	LDVs	LGVs	Diesel	<=1305kg			0.088739
4	LDVs	LGVs	Diesel	1305-1760kg			0.244219
4	LDVs	LGVs	Diesel	1760kg-3.5t			0.667042
4	LDVs	LGVs	Petrol	<=1305kg			0.4
4	LDVs	LGVs	Petrol	1305-1760kg			0.2
4	LDVs	LGVs	Petrol	1760kg-3.5t			0.4
4	LDVs	Taxis	Diesel	<2.5t			0
4	TwoWheelers	Mopeds	Petrol	2-stroke			0
4	TwoWheelers	Mopeds	Petrol	4-stroke			0
4	TwoWheelers	Motorcycles	Petrol	2-stroke			0
4	TwoWheelers	Motorcycles	Petrol	4-stroke			0
5	HDVs	Artic_HGVs	Diesel	14-20t	none		0
5	HDVs	Artic_HGVs	Diesel	20-28t	none		1
5	HDVs	Artic_HGVs	Diesel	28-34t	none		1
5	HDVs	Artic_HGVs	Diesel	34-40t	none		1
5	HDVs	Artic_HGVs	Diesel	40-50t	none		1
5	HDVs	Artic_HGVs	Diesel	50-60t	none		0
5	HDVs	Buses	Diesel	<=15t	none		1
5	HDVs	Buses	Diesel	>18t	none		1
5	HDVs	Buses	Diesel	15-18t	none		1
5	HDVs	Coaches	Diesel	<=18t	none		0
5	HDVs	Coaches	Diesel	>18t	none		0
5	HDVs	Rigid_HGVs	Diesel	<=7.5t	none		0
5	HDVs	Rigid_HGVs	Diesel	>32t	none		1
5	HDVs	Rigid_HGVs	Diesel	12-14t	none		1
5	HDVs	Rigid_HGVs	Diesel	14-20t	none		1
5	HDVs	Rigid_HGVs	Diesel	20-26t	none		1
5	HDVs	Rigid_HGVs	Diesel	26-28t	none		1
5	HDVs	Rigid_HGVs	Diesel	28-32t	none		1
5	HDVs	Rigid_HGVs	Diesel	7.5-12t	none		1
5	LDVs	Cars	Diesel	<2.5t	<1.4l		0.079748
5	LDVs	Cars	Diesel	<2.5t	>2.0l		0.159496
5	LDVs	Cars	Diesel	<2.5t	1.4-2.0l		0.760757
5	LDVs	Cars	LPG	<2.5t	<1.4l		0
5	LDVs	Cars	LPG	<2.5t	>2.0l		0
5	LDVs	Cars	LPG	<2.5t	1.4-2.0l		0
5	LDVs	Cars	Petrol	<2.5t	<1.4l		0.530665
5	LDVs	Cars	Petrol	<2.5t	>2.0l		0.045748
5	LDVs	Cars	Petrol	<2.5t	1.4-2.0l		0.423587
5	LDVs	LGVs	Diesel	<=1305kg	unique		1
5	LDVs	LGVs	Diesel	1305-1760kg	unique		1
5	LDVs	LGVs	Diesel	1760kg-3.5t	unique		1
5	LDVs	LGVs	Petrol	<=1305kg	unique		1
5	LDVs	LGVs	Petrol	1305-1760kg	unique		1

Level	General Fleet	Coarse Fleet	Fuel Pow Tech	VGW Weight	Engine Size	Emission Standard	Proportion
5	LDVs	LGVs	Petrol	1760kg-3.5t	unique		1
5	LDVs	Taxis	Diesel	<2.5t	LTI		0
5	TwoWheelers	Mopeds	Petrol	2-stroke	none		0
5	TwoWheelers	Mopeds	Petrol	4-stroke	none		0
5	TwoWheelers	Motorcycles	Petrol	2-stroke	<150 cc		0
5	TwoWheelers	Motorcycles	Petrol	2-stroke	150-250 cc		0
5	TwoWheelers	Motorcycles	Petrol	4-stroke	<150 cc		0
5	TwoWheelers	Motorcycles	Petrol	4-stroke	>750 cc		0
5	TwoWheelers	Motorcycles	Petrol	4-stroke	150-250 cc		0
5	TwoWheelers	Motorcycles	Petrol	4-stroke	250-750 cc		0
6	HDVs	Artic_HGVs	Diesel	14-20t	none	Euro 0	0
6	HDVs	Artic_HGVs	Diesel	14-20t	none	Euro I	0
6	HDVs	Artic_HGVs	Diesel	14-20t	none	Euro II	0
6	HDVs	Artic_HGVs	Diesel	14-20t	none	Euro III	0
6	HDVs	Artic_HGVs	Diesel	14-20t	none	Euro IV	0
6	HDVs	Artic_HGVs	Diesel	14-20t	none	Euro V EGR	0
6	HDVs	Artic_HGVs	Diesel	14-20t	none	Euro V SCR	0
6	HDVs	Artic_HGVs	Diesel	14-20t	none	Euro VI	0
6	HDVs	Artic_HGVs	Diesel	20-28t	none	Euro 0	0
6	HDVs	Artic_HGVs	Diesel	20-28t	none	Euro I	0
6	HDVs	Artic_HGVs	Diesel	20-28t	none	Euro II	0
6	HDVs	Artic_HGVs	Diesel	20-28t	none	Euro III	0
6	HDVs	Artic_HGVs	Diesel	20-28t	none	Euro IV	0.636364
6	HDVs	Artic_HGVs	Diesel	20-28t	none	Euro V EGR	0
6	HDVs	Artic_HGVs	Diesel	20-28t	none	Euro V SCR	0.363636
6	HDVs	Artic_HGVs	Diesel	20-28t	none	Euro VI	0
6	HDVs	Artic_HGVs	Diesel	28-34t	none	Euro 0	0
6	HDVs	Artic_HGVs	Diesel	28-34t	none	Euro I	0
6	HDVs	Artic_HGVs	Diesel	28-34t	none	Euro II	0
6	HDVs	Artic_HGVs	Diesel	28-34t	none	Euro III	0.217391
6	HDVs	Artic_HGVs	Diesel	28-34t	none	Euro IV	0.304348
6	HDVs	Artic_HGVs	Diesel	28-34t	none	Euro V EGR	0
6	HDVs	Artic_HGVs	Diesel	28-34t	none	Euro V SCR	0.478261
6	HDVs	Artic_HGVs	Diesel	28-34t	none	Euro VI	0
6	HDVs	Artic_HGVs	Diesel	34-40t	none	Euro 0	0
6	HDVs	Artic_HGVs	Diesel	34-40t	none	Euro I	0
6	HDVs	Artic_HGVs	Diesel	34-40t	none	Euro II	0
6	HDVs	Artic_HGVs	Diesel	34-40t	none	Euro III	0.280702
6	HDVs	Artic_HGVs	Diesel	34-40t	none	Euro IV	0.210526
6	HDVs	Artic_HGVs	Diesel	34-40t	none	Euro V EGR	0
6	HDVs	Artic_HGVs	Diesel	34-40t	none	Euro V SCR	0.508772
6	HDVs	Artic_HGVs	Diesel	34-40t	none	Euro VI	0
6	HDVs	Artic_HGVs	Diesel	40-50t	none	Euro 0	0
6	HDVs	Artic_HGVs	Diesel	40-50t	none	Euro I	0.001608
6	HDVs	Artic_HGVs	Diesel	40-50t	none	Euro II	0.006431
6	HDVs	Artic_HGVs	Diesel	40-50t	none	Euro III	0.078778
6	HDVs	Artic_HGVs	Diesel	40-50t	none	Euro IV	0.229904

Level	General Fleet	Coarse Fleet	Fuel Pow Tech	VGW Weight	Engine Size	Emission Standard	Proportion
6	HDVs	Artic_HGVs	Diesel	40-50t	none	Euro V EGR	0
6	HDVs	Artic_HGVs	Diesel	40-50t	none	Euro V SCR	0.68328
6	HDVs	Artic_HGVs	Diesel	40-50t	none	Euro VI	0
6	HDVs	Artic_HGVs	Diesel	50-60t	none	Euro 0	0
6	HDVs	Artic_HGVs	Diesel	50-60t	none	Euro I	0
6	HDVs	Artic_HGVs	Diesel	50-60t	none	Euro II	0
6	HDVs	Artic_HGVs	Diesel	50-60t	none	Euro III	0
6	HDVs	Artic_HGVs	Diesel	50-60t	none	Euro IV	0
6	HDVs	Artic_HGVs	Diesel	50-60t	none	Euro V EGR	0
6	HDVs	Artic_HGVs	Diesel	50-60t	none	Euro V SCR	0
6	HDVs	Artic_HGVs	Diesel	50-60t	none	Euro VI	0
6	HDVs	Buses	Diesel	<=15t	none	Euro 0	0.009524
6	HDVs	Buses	Diesel	<=15t	none	Euro I	0.002597
6	HDVs	Buses	Diesel	<=15t	none	Euro II	0.129004
6	HDVs	Buses	Diesel	<=15t	none	Euro III	0.255411
6	HDVs	Buses	Diesel	<=15t	none	Euro IV	0.4
6	HDVs	Buses	Diesel	<=15t	none	Euro V EGR	0
6	HDVs	Buses	Diesel	<=15t	none	Euro V SCR	0.203463
6	HDVs	Buses	Diesel	<=15t	none	Euro VI	0
6	HDVs	Buses	Diesel	>18t	none	Euro 0	0
6	HDVs	Buses	Diesel	>18t	none	Euro I	0
6	HDVs	Buses	Diesel	>18t	none	Euro II	0.015464
6	HDVs	Buses	Diesel	>18t	none	Euro III	0.015464
6	HDVs	Buses	Diesel	>18t	none	Euro IV	0.092784
6	HDVs	Buses	Diesel	>18t	none	Euro V EGR	0
6	HDVs	Buses	Diesel	>18t	none	Euro V SCR	0.876289
6	HDVs	Buses	Diesel	>18t	none	Euro VI	0
6	HDVs	Buses	Diesel	15-18t	none	Euro 0	0.135922
6	HDVs	Buses	Diesel	15-18t	none	Euro I	0.067961
6	HDVs	Buses	Diesel	15-18t	none	Euro II	0.524272
6	HDVs	Buses	Diesel	15-18t	none	Euro III	0.271845
6	HDVs	Buses	Diesel	15-18t	none	Euro IV	0
6	HDVs	Buses	Diesel	15-18t	none	Euro V EGR	0
6	HDVs	Buses	Diesel	15-18t	none	Euro V SCR	0
6	HDVs	Buses	Diesel	15-18t	none	Euro VI	0
6	HDVs	Coaches	Diesel	<=18t	none	Euro 0	0
6	HDVs	Coaches	Diesel	<=18t	none	Euro I	0
6	HDVs	Coaches	Diesel	<=18t	none	Euro II	0
6	HDVs	Coaches	Diesel	<=18t	none	Euro III	0
6	HDVs	Coaches	Diesel	<=18t	none	Euro IV	0
6	HDVs	Coaches	Diesel	<=18t	none	Euro V EGR	0
6	HDVs	Coaches	Diesel	<=18t	none	Euro V SCR	0
6	HDVs	Coaches	Diesel	<=18t	none	Euro VI	0
6	HDVs	Coaches	Diesel	>18t	none	Euro 0	0
6	HDVs	Coaches	Diesel	>18t	none	Euro I	0
6	HDVs	Coaches	Diesel	>18t	none	Euro II	0
6	HDVs	Coaches	Diesel	>18t	none	Euro III	0
6	HDVs	Coaches	Diesel	>18t	none	Euro IV	0
6	HDVs	Coaches	Diesel	>18t	none	Euro V EGR	0

Level	General Fleet	Coarse Fleet	Fuel Pow Tech	VGW Weight	Engine Size	Emission Standard	Proportion
6	HDVs	Coaches	Diesel	>18t	none	Euro V SCR	0
6	HDVs	Coaches	Diesel	>18t	none	Euro VI	0
6	HDVs	Rigid_HGVs	Diesel	<=7.5t	none	Euro 0	0
6	HDVs	Rigid_HGVs	Diesel	<=7.5t	none	Euro I	0
6	HDVs	Rigid_HGVs	Diesel	<=7.5t	none	Euro II	0
6	HDVs	Rigid_HGVs	Diesel	<=7.5t	none	Euro III	0
6	HDVs	Rigid_HGVs	Diesel	<=7.5t	none	Euro IV	0
6	HDVs	Rigid_HGVs	Diesel	<=7.5t	none	Euro V EGR	0
6	HDVs	Rigid_HGVs	Diesel	<=7.5t	none	Euro V SCR	0
6	HDVs	Rigid_HGVs	Diesel	<=7.5t	none	Euro VI	0
6	HDVs	Rigid_HGVs	Diesel	>32t	none	Euro 0	0
6	HDVs	Rigid_HGVs	Diesel	>32t	none	Euro I	0
6	HDVs	Rigid_HGVs	Diesel	>32t	none	Euro II	0.016807
6	HDVs	Rigid_HGVs	Diesel	>32t	none	Euro III	0.285714
6	HDVs	Rigid_HGVs	Diesel	>32t	none	Euro IV	0.462185
6	HDVs	Rigid_HGVs	Diesel	>32t	none	Euro V EGR	0
6	HDVs	Rigid_HGVs	Diesel	>32t	none	Euro V SCR	0.235294
6	HDVs	Rigid_HGVs	Diesel	>32t	none	Euro VI	0
6	HDVs	Rigid_HGVs	Diesel	12-14t	none	Euro 0	0.001934
6	HDVs	Rigid_HGVs	Diesel	12-14t	none	Euro I	0.009671
6	HDVs	Rigid_HGVs	Diesel	12-14t	none	Euro II	0.065764
6	HDVs	Rigid_HGVs	Diesel	12-14t	none	Euro III	0.226306
6	HDVs	Rigid_HGVs	Diesel	12-14t	none	Euro IV	0.288201
6	HDVs	Rigid_HGVs	Diesel	12-14t	none	Euro V EGR	0
6	HDVs	Rigid_HGVs	Diesel	12-14t	none	Euro V SCR	0.408124
6	HDVs	Rigid_HGVs	Diesel	12-14t	none	Euro VI	0
6	HDVs	Rigid_HGVs	Diesel	14-20t	none	Euro 0	0.00432
6	HDVs	Rigid_HGVs	Diesel	14-20t	none	Euro I	0.017279
6	HDVs	Rigid_HGVs	Diesel	14-20t	none	Euro II	0.049676
6	HDVs	Rigid_HGVs	Diesel	14-20t	none	Euro III	0.282937
6	HDVs	Rigid_HGVs	Diesel	14-20t	none	Euro IV	0.293737
6	HDVs	Rigid_HGVs	Diesel	14-20t	none	Euro V EGR	0
6	HDVs	Rigid_HGVs	Diesel	14-20t	none	Euro V SCR	0.352052
6	HDVs	Rigid_HGVs	Diesel	14-20t	none	Euro VI	0
6	HDVs	Rigid_HGVs	Diesel	20-26t	none	Euro 0	0.095238
6	HDVs	Rigid_HGVs	Diesel	20-26t	none	Euro I	0.047619
6	HDVs	Rigid_HGVs	Diesel	20-26t	none	Euro II	0
6	HDVs	Rigid_HGVs	Diesel	20-26t	none	Euro III	0.333333
6	HDVs	Rigid_HGVs	Diesel	20-26t	none	Euro IV	0.333333
6	HDVs	Rigid_HGVs	Diesel	20-26t	none	Euro V EGR	0
6	HDVs	Rigid_HGVs	Diesel	20-26t	none	Euro V SCR	0.190476
6	HDVs	Rigid_HGVs	Diesel	20-26t	none	Euro VI	0
6	HDVs	Rigid_HGVs	Diesel	26-28t	none	Euro 0	0
6	HDVs	Rigid_HGVs	Diesel	26-28t	none	Euro I	0.011407
6	HDVs	Rigid_HGVs	Diesel	26-28t	none	Euro II	0.034221
6	HDVs	Rigid_HGVs	Diesel	26-28t	none	Euro III	0.231939
6	HDVs	Rigid_HGVs	Diesel	26-28t	none	Euro IV	0.330798
6	HDVs	Rigid_HGVs	Diesel	26-28t	none	Euro V EGR	0
6	HDVs	Rigid_HGVs	Diesel	26-28t	none	Euro V SCR	0.391635

Level	General Fleet	Coarse Fleet	Fuel Pow Tech	VGW Weight	Engine Size	Emission Standard	Proportion
6	HDVs	Rigid_HGVs	Diesel	26-28t	none	Euro VI	0
6	HDVs	Rigid_HGVs	Diesel	28-32t	none	Euro 0	0
6	HDVs	Rigid_HGVs	Diesel	28-32t	none	Euro I	0
6	HDVs	Rigid_HGVs	Diesel	28-32t	none	Euro II	0
6	HDVs	Rigid_HGVs	Diesel	28-32t	none	Euro III	0
6	HDVs	Rigid_HGVs	Diesel	28-32t	none	Euro IV	1
6	HDVs	Rigid_HGVs	Diesel	28-32t	none	Euro V EGR	0
6	HDVs	Rigid_HGVs	Diesel	28-32t	none	Euro V SCR	0
6	HDVs	Rigid_HGVs	Diesel	28-32t	none	Euro VI	0
6	HDVs	Rigid_HGVs	Diesel	7.5-12t	none	Euro 0	0.014184
6	HDVs	Rigid_HGVs	Diesel	7.5-12t	none	Euro I	0
6	HDVs	Rigid_HGVs	Diesel	7.5-12t	none	Euro II	0.106383
6	HDVs	Rigid_HGVs	Diesel	7.5-12t	none	Euro III	0.326241
6	HDVs	Rigid_HGVs	Diesel	7.5-12t	none	Euro IV	0.304965
6	HDVs	Rigid_HGVs	Diesel	7.5-12t	none	Euro V EGR	0
6	HDVs	Rigid_HGVs	Diesel	7.5-12t	none	Euro V SCR	0.248227
6	HDVs	Rigid_HGVs	Diesel	7.5-12t	none	Euro VI	0
6	LDVs	Cars	Diesel	<2.5t	<1.4l	Euro 0	0
6	LDVs	Cars	Diesel	<2.5t	<1.4l	Euro 1	0
6	LDVs	Cars	Diesel	<2.5t	<1.4l	Euro 2	0.001481
6	LDVs	Cars	Diesel	<2.5t	<1.4l	Euro 3	0.147172
6	LDVs	Cars	Diesel	<2.5t	<1.4l	Euro 4	0.567071
6	LDVs	Cars	Diesel	<2.5t	<1.4l	Euro 5	0.284276
6	LDVs	Cars	Diesel	<2.5t	<1.4l	Euro 6	0
6	LDVs	Cars	Diesel	<2.5t	>2.0l	Euro 0	0.001925
6	LDVs	Cars	Diesel	<2.5t	>2.0l	Euro 1	0.01066
6	LDVs	Cars	Diesel	<2.5t	>2.0l	Euro 2	0.035238
6	LDVs	Cars	Diesel	<2.5t	>2.0l	Euro 3	0.224163
6	LDVs	Cars	Diesel	<2.5t	>2.0l	Euro 4	0.447439
6	LDVs	Cars	Diesel	<2.5t	>2.0l	Euro 5	0.280574
6	LDVs	Cars	Diesel	<2.5t	>2.0l	Euro 6	0
6	LDVs	Cars	Diesel	<2.5t	1.4-2.0l	Euro 0	0.000559
6	LDVs	Cars	Diesel	<2.5t	1.4-2.0l	Euro 1	0.003166
6	LDVs	Cars	Diesel	<2.5t	1.4-2.0l	Euro 2	0.021977
6	LDVs	Cars	Diesel	<2.5t	1.4-2.0l	Euro 3	0.235046
6	LDVs	Cars	Diesel	<2.5t	1.4-2.0l	Euro 4	0.402359
6	LDVs	Cars	Diesel	<2.5t	1.4-2.0l	Euro 5	0.336893
6	LDVs	Cars	Diesel	<2.5t	1.4-2.0l	Euro 6	0
6	LDVs	Cars	LPG	<2.5t	<1.4l	Euro 0	0
6	LDVs	Cars	LPG	<2.5t	<1.4l	Euro 1	0
6	LDVs	Cars	LPG	<2.5t	<1.4l	Euro 2	0
6	LDVs	Cars	LPG	<2.5t	<1.4l	Euro 3	0
6	LDVs	Cars	LPG	<2.5t	<1.4l	Euro 4	0
6	LDVs	Cars	LPG	<2.5t	<1.4l	Euro 5	0
6	LDVs	Cars	LPG	<2.5t	<1.4l	Euro 6	0
6	LDVs	Cars	LPG	<2.5t	>2.0l	Euro 0	0

Level	General Fleet	Coarse Fleet	Fuel Pow Tech	VGW Weight	Engine Size	Emission Standard	Proportion
6	LDVs	Cars	LPG	<2.5t	>2.0l	Euro 1	0
6	LDVs	Cars	LPG	<2.5t	>2.0l	Euro 2	0
6	LDVs	Cars	LPG	<2.5t	>2.0l	Euro 3	0
6	LDVs	Cars	LPG	<2.5t	>2.0l	Euro 4	0
6	LDVs	Cars	LPG	<2.5t	>2.0l	Euro 5	0
6	LDVs	Cars	LPG	<2.5t	>2.0l	Euro 6	0
6	LDVs	Cars	LPG	<2.5t	1.4-2.0l	Euro 0	0
6	LDVs	Cars	LPG	<2.5t	1.4-2.0l	Euro 1	0
6	LDVs	Cars	LPG	<2.5t	1.4-2.0l	Euro 2	0
6	LDVs	Cars	LPG	<2.5t	1.4-2.0l	Euro 3	0
6	LDVs	Cars	LPG	<2.5t	1.4-2.0l	Euro 4	0
6	LDVs	Cars	LPG	<2.5t	1.4-2.0l	Euro 5	0
6	LDVs	Cars	LPG	<2.5t	1.4-2.0l	Euro 6	0
6	LDVs	Cars	Petrol	<2.5t	<1.4l	Euro 0	0.002303
6	LDVs	Cars	Petrol	<2.5t	<1.4l	Euro 1	0.007879
6	LDVs	Cars	Petrol	<2.5t	<1.4l	Euro 2	0.073543
6	LDVs	Cars	Petrol	<2.5t	<1.4l	Euro 3	0.31696
6	LDVs	Cars	Petrol	<2.5t	<1.4l	Euro 4	0.368231
6	LDVs	Cars	Petrol	<2.5t	<1.4l	Euro 5	0.231084
6	LDVs	Cars	Petrol	<2.5t	<1.4l	Euro 6	0
6	LDVs	Cars	Petrol	<2.5t	>2.0l	Euro 0	0.014411
6	LDVs	Cars	Petrol	<2.5t	>2.0l	Euro 1	0.029877
6	LDVs	Cars	Petrol	<2.5t	>2.0l	Euro 2	0.147276
6	LDVs	Cars	Petrol	<2.5t	>2.0l	Euro 3	0.453427
6	LDVs	Cars	Petrol	<2.5t	>2.0l	Euro 4	0.286819
6	LDVs	Cars	Petrol	<2.5t	>2.0l	Euro 5	0.06819
6	LDVs	Cars	Petrol	<2.5t	>2.0l	Euro 6	0
6	LDVs	Cars	Petrol	<2.5t	1.4-2.0l	Euro 0	0.003189
6	LDVs	Cars	Petrol	<2.5t	1.4-2.0l	Euro 1	0.010857
6	LDVs	Cars	Petrol	<2.5t	1.4-2.0l	Euro 2	0.093273
6	LDVs	Cars	Petrol	<2.5t	1.4-2.0l	Euro 3	0.394541
6	LDVs	Cars	Petrol	<2.5t	1.4-2.0l	Euro 4	0.360071
6	LDVs	Cars	Petrol	<2.5t	1.4-2.0l	Euro 5	0.138068
6	LDVs	Cars	Petrol	<2.5t	1.4-2.0l	Euro 6	0
6	LDVs	LGVs	Diesel	<=1305kg	unique	Euro 0	0
6	LDVs	LGVs	Diesel	<=1305kg	unique	Euro 1	0.114085
6	LDVs	LGVs	Diesel	<=1305kg	unique	Euro 2	0.183099
6	LDVs	LGVs	Diesel	<=1305kg	unique	Euro 3	0.480282
6	LDVs	LGVs	Diesel	<=1305kg	unique	Euro 4	0.171831
6	LDVs	LGVs	Diesel	<=1305kg	uniqu	Euro 5	0.050704

Level	General Fleet	Coarse Fleet	Fuel Pow Tech	VGW Weight	Engine Size	Emission Standard	Proportion
					e		
6	LDVs	LGVs	Diesel	<=1305kg	unique	Euro 6	0
6	LDVs	LGVs	Diesel	1305-1760kg	unique	Euro 0	0.003071
6	LDVs	LGVs	Diesel	1305-1760kg	unique	Euro 1	0.006141
6	LDVs	LGVs	Diesel	1305-1760kg	unique	Euro 2	0.013306
6	LDVs	LGVs	Diesel	1305-1760kg	unique	Euro 3	0.370522
6	LDVs	LGVs	Diesel	1305-1760kg	unique	Euro 4	0.489253
6	LDVs	LGVs	Diesel	1305-1760kg	unique	Euro 5	0.117707
6	LDVs	LGVs	Diesel	1305-1760kg	unique	Euro 6	0
6	LDVs	LGVs	Diesel	1760kg-3.5t	unique	Euro 0	0.001874
6	LDVs	LGVs	Diesel	1760kg-3.5t	unique	Euro 1	0.005996
6	LDVs	LGVs	Diesel	1760kg-3.5t	unique	Euro 2	0.027169
6	LDVs	LGVs	Diesel	1760kg-3.5t	unique	Euro 3	0.211542
6	LDVs	LGVs	Diesel	1760kg-3.5t	unique	Euro 4	0.427768
6	LDVs	LGVs	Diesel	1760kg-3.5t	unique	Euro 5	0.325651
6	LDVs	LGVs	Diesel	1760kg-3.5t	unique	Euro 6	0
6	LDVs	LGVs	Petrol	<=1305kg	unique	Euro 0	0.083333
6	LDVs	LGVs	Petrol	<=1305kg	unique	Euro 1	0
6	LDVs	LGVs	Petrol	<=1305kg	unique	Euro 2	0
6	LDVs	LGVs	Petrol	<=1305kg	unique	Euro 3	0.083333
6	LDVs	LGVs	Petrol	<=1305kg	unique	Euro 4	0.583333
6	LDVs	LGVs	Petrol	<=1305kg	unique	Euro 5	0.25
6	LDVs	LGVs	Petrol	<=1305kg	unique	Euro 6	0
6	LDVs	LGVs	Petrol	1305-1760kg	unique	Euro 0	0.333333
6	LDVs	LGVs	Petrol	1305-1760kg	unique	Euro 1	0
6	LDVs	LGVs	Petrol	1305-1760kg	unique	Euro 2	0.666667
6	LDVs	LGVs	Petrol	1305-1760kg	unique	Euro 3	0
6	LDVs	LGVs	Petrol	1305-1760kg	unique	Euro 4	0
6	LDVs	LGVs	Petrol	1305-1760kg	unique	Euro 5	0
6	LDVs	LGVs	Petrol	1305-1760kg	unique	Euro 6	0
6	LDVs	LGVs	Petrol	1760kg-3.5t	unique	Euro 0	0
6	LDVs	LGVs	Petrol	1760kg-3.5t	unique	Euro 1	0.166667
6	LDVs	LGVs	Petrol	1760kg-3.5t	unique	Euro 2	0.5

Level	General Fleet	Coarse Fleet	Fuel Pow Tech	VGW Weight	Engine Size	Emission Standard	Proportion
6	LDVs	LGVs	Petrol	1760kg-3.5t	unique	Euro 3	0.25
6	LDVs	LGVs	Petrol	1760kg-3.5t	unique	Euro 4	0.083333
6	LDVs	LGVs	Petrol	1760kg-3.5t	unique	Euro 5	0
6	LDVs	LGVs	Petrol	1760kg-3.5t	unique	Euro 6	0
6	LDVs	Taxis	Diesel	<2.5t	LTI	Euro 0	0
6	LDVs	Taxis	Diesel	<2.5t	LTI	Euro 1	0
6	LDVs	Taxis	Diesel	<2.5t	LTI	Euro 2	0
6	LDVs	Taxis	Diesel	<2.5t	LTI	Euro 3	0
6	LDVs	Taxis	Diesel	<2.5t	LTI	Euro 4	0
6	LDVs	Taxis	Diesel	<2.5t	LTI	Euro 5	0
6	LDVs	Taxis	Diesel	<2.5t	LTI	Euro 6	0
6	TwoWheelers	Mopeds	Petrol	2-stroke	none	Euro 0	0
6	TwoWheelers	Mopeds	Petrol	2-stroke	none	Euro 1	0
6	TwoWheelers	Mopeds	Petrol	2-stroke	none	Euro 2	0
6	TwoWheelers	Mopeds	Petrol	2-stroke	none	Euro 3	0
6	TwoWheelers	Mopeds	Petrol	2-stroke	none	Euro 4	0
6	TwoWheelers	Mopeds	Petrol	2-stroke	none	Euro 5	0
6	TwoWheelers	Mopeds	Petrol	2-stroke	none	Euro 6	0
6	TwoWheelers	Mopeds	Petrol	4-stroke	none	Euro 0	0
6	TwoWheelers	Mopeds	Petrol	4-stroke	none	Euro 1	0
6	TwoWheelers	Mopeds	Petrol	4-stroke	none	Euro 2	0
6	TwoWheelers	Mopeds	Petrol	4-stroke	none	Euro 3	0
6	TwoWheelers	Mopeds	Petrol	4-stroke	none	Euro 4	0
6	TwoWheelers	Mopeds	Petrol	4-stroke	none	Euro 5	0
6	TwoWheelers	Mopeds	Petrol	4-stroke	none	Euro 6	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	<150 cc	Euro 0	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	<150 cc	Euro 1	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	<150 cc	Euro 2	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	<150 cc	Euro 3	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	<150 cc	Euro 4	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	<150 cc	Euro 5	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	<150 cc	Euro 6	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	150-250 cc	Euro 0	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	150-250 cc	Euro 1	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	150-250 cc	Euro 2	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	150-250 cc	Euro 3	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	150-250 cc	Euro 4	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	150-250 cc	Euro 5	0
6	TwoWheelers	Motorcycles	Petrol	2-stroke	150-250 cc	Euro 6	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	<150 cc	Euro 0	0

Level	General Fleet	Coarse Fleet	Fuel Pow Tech	VGW Weight	Engine Size	Emission Standard	Proportion
6	TwoWheelers	Motorcycles	Petrol	4-stroke	<150 cc	Euro 1	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	<150 cc	Euro 2	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	<150 cc	Euro 3	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	<150 cc	Euro 4	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	<150 cc	Euro 5	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	<150 cc	Euro 6	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	>750 cc	Euro 0	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	>750 cc	Euro 1	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	>750 cc	Euro 2	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	>750 cc	Euro 3	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	>750 cc	Euro 4	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	>750 cc	Euro 5	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	>750 cc	Euro 6	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	150-250 cc	Euro 0	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	150-250 cc	Euro 1	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	150-250 cc	Euro 2	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	150-250 cc	Euro 3	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	150-250 cc	Euro 4	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	150-250 cc	Euro 5	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	150-250 cc	Euro 6	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	250-750 cc	Euro 0	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	250-750 cc	Euro 1	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	250-750 cc	Euro 2	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	250-750 cc	Euro 3	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	250-750 cc	Euro 4	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	250-750 cc	Euro 5	0
6	TwoWheelers	Motorcycles	Petrol	4-stroke	250-750 cc	Euro 6	0

J. Air Quality Dispersion Modelling

This section provides detailed information of the air quality dispersion modelling conducted for the detailed assessment using the ADMS-Roads Dispersion Model.

Background concentrations

To represent sources not explicitly included in the modelling, background values of NO_2 for 2013 were included. Concentrations from the four 1km grid squares that covered the entire study area were taken from the Defra background (2013 concentrations based on 2011 data as shown in Table 77). These concentrations were compared with the 2013 concentration of 24.6 µg/m^3 measured at the rural background site in Risley Moss and were found to be similar. The background concentration from Risley Moss was therefore used for this study, along with the PM_{10} background concentration of 17.5 µg/m^3.

Table 77: Background NO_2 concentrations, 2013.

X	y	Annual mean NO_2 concentration (µg/m^3)
359500	388500	26.7
360500	387500	25.1
360500	388500	25.4
360500	386500	19.7

Atmospheric chemistry

The concentration of NO_2 at a specific location is determined by a combination of emissions, meteorology and atmospheric chemistry. Some NO_2 is emitted directly from vehicle exhaust (this is known as primary NO_2), a high proportion of which is from diesel vehicles. Emissions of NO_X from vehicles are primarily in the form of nitrogen oxides (NO + NO_2) (AQEG, 2007). Nitric oxide undergoes a chemical reaction with oxidants such as ozone (O_3) to produce secondary NO_2. At a roadside location, there is routinely an excess of NO, and thus the limit to the formation of NO_2 is usually determined by the availability of O_3. Hence, at heavily trafficked roadside locations, there is not a linear relationship between the transformation of NO_X emissions and NO_2 concentrations.

NO_2 concentrations have been derived from the road NO_X concentrations that were output from the ADMS-Roads model using the Defra calculator (version 4.1)[16] available on the LAQM tools section of the UK Air Quality Archive website.

Meteorological data

The ADMS-Roads model applies hourly sequential meteorological data to calculate atmospheric dispersion. This calculation involves a number of meteorological parameters including wind speed and direction, cloud cover and near surface temperature (the latter two parameters being important for the calculation of atmospheric stability, which affects how pollutants disperse). Warrington Borough Council provided calculated meteorological data specific to Warrington from 2008-2012 and for this study the 2012 was assumed adequate for 2013. Note that these data are preferable to the observed files available from either Manchester and or Liverpool, the

[16] http://www.airquality.co.uk/archive/laqm/tools.php

geographically nearest met sites to Warrington. The wind rose in Figure 40 shows that the wind direction is variable but tends to come from the south to south-west.

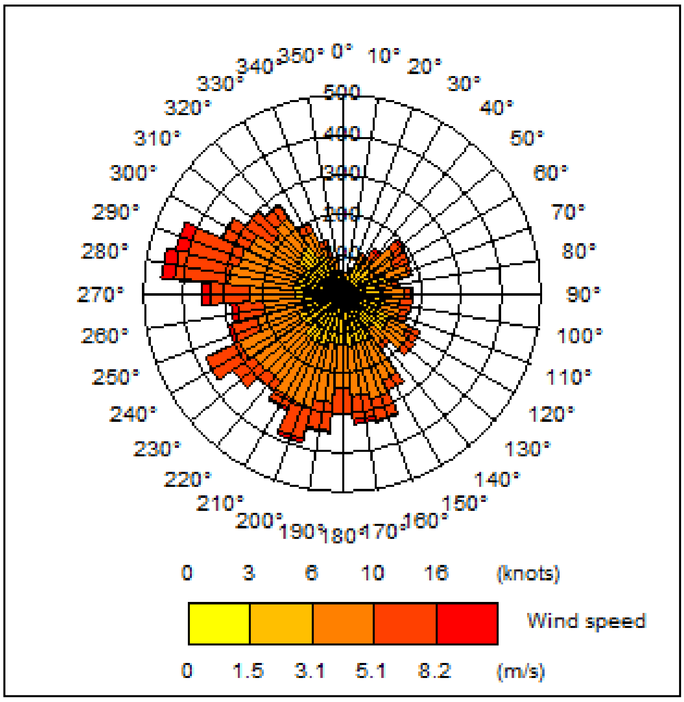


Figure 40: Wind rose for Warrington representative of 2013**.**

Surface roughness

The interaction of wind flow with the ground generates turbulence, influencing pollutant dispersion. The strength of this turbulence is dependent on the land use, with urban areas generating higher turbulence than open countryside. The ADMS-Roads user guide indicates that a surface roughness length of 1 m is suitable for cities and woodland and 0.5 m is suitable for parkland and open suburbia. For this study, a value of 1m was used. The ADMS-Roads model allows the user to specify the surface roughness length of the site where meteorological data has been recorded (used when the surface roughness length at the meteorological site differs from that at the area under assessment). In this way, the ADMS-Roads model modifies the meteorological data to accommodate differences in surface roughness between the modelling domain and the geographical area from which meteorological measurements are obtained. The surface roughness length at the meteorological site used in this study was 0.5 metres.

Model Verification

Model verification has been undertaken in line with LAQM.TG (09) (Defra, 2009). This process allows uncertainties in model results to be investigated and minimised. As part of the verification process, monitored NO_2 concentrations from selected monitoring sites have been converted to road NO_X concentrations using Defra's NO_X – NO_2 calculator available on the LAQM tools section of the UK Air Quality Archive website, using the relevant NO_2 background concentration. The verification process typically requires an adjustment factor to be applied to the modelled road NO_X concentrations to minimise uncertainty in the modelled results. Every effort is made to check and then re-confirm the model set up prior to applying any adjustment to modelled results (e.g. traffic and queuing activity, road link alignment, receptor locations, road widths, background concentrations etc.). If the modelled road NO_X is to be factored, the same adjustment is applied to all subsequent modelled scenarios.

WBC monitors total oxides of nitrogen (NO_X), nitric oxide (NO) and nitrogen dioxide (NO_2) at several locations and also has a large NO_2 diffusion tube network. Those sites that are within or close to the study area are given in Table 78 and Figure 37. Concentrations that were above the annual mean air quality objective of 40 µg/m^3 in 2013 are given in bold.

Table 78: Details of monitoring sites in study area

Site ID	Site name	Site type	Easting	Northing	Site height (m)	2013 NO_2 annual mean concentration (µg/m^3)
CM1	Selby Street	Urban background	359151	388218	2.5	25.6
CM2	Parker Street	Roadside	360015	387907	1.7	**49.4**
CM3	Chester Road	Roadside	360331	386454	1.2	37.7
DT1	Risley Moss	Rural background	366949	392004	2	24.6
DT2	Rostherne Close	Urban background	358667	387755	2	24.9
DT10	Parker Street	Roadside	360044	388048	2.5	**60.7**
DT11	White Street	Roadside	360051	388028	2.5	39.2
DT13/14/15	Parker Street	Roadside	360015	387907	2.5	57.3*
DT16	Crosfield Island	Roadside	359450	388242	2.5	**48.2**
DT23	Brian Bevan	Roadside	360676	387467	2.5	35.1

*Average of 3 diffusion tubes

Of these sites, a selected number of roadside sites were chosen as being appropriate for the model verification process. The results of the model verification process are given in Table 79 in comparison to the measured values at these sites and the adjustment factor calculated from this comparison is given in Figure 41. This adjustment factor was applied to the road NO_x output for the baseline and scenarios and was applied to both the NO_x and PM_{10} model outputs (in the absence of PM_{10} verification sites).

Table 79: Comparison between modelled and monitored road NO_X concentrations

Receptor name	Z(m)	Model road NOx	Monitor road NOx from calculator	bkd	Monitor NO_2	Adj mod NOx	Adj mod NO_2
		($\mu g/m^3$)					
DT16	2.5	35.8	50.0	26.7	**48.2**	31.3	**40.8**
CM2	1.7	79.7	57.1	25.1	**49.4**	69.4	**53.8**
DT11	2.5	32.7	30.4	25.4	39.2	28.6	38.5
DT23	2.5	30.1	21.8	25.1	35.3	26.3	37.2
CM3	1.2	30.8	39.2	19.7	37.7	26.9	32.5

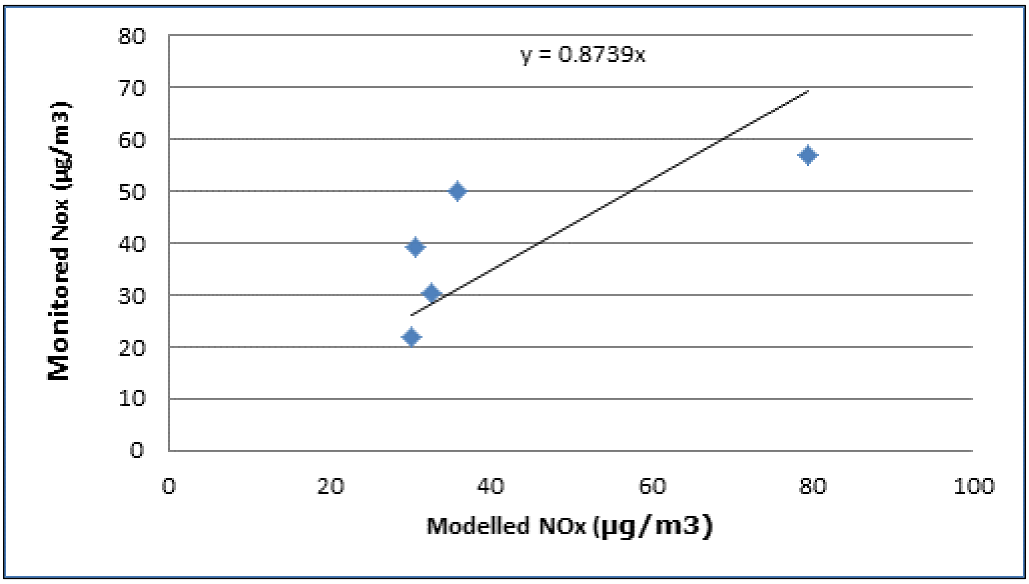


Figure 41: Correlation plot between modelled and measured NOx concentrations

The model was found to over-predict road NO_X concentrations at sites CM2, DT11 and DT23 and under predict at DT16 and CM3 compared to measured concentrations. This gave an overall average over prediction of 7%. This meant that it was appropriate to adjust the modelled road NOX concentrations by a factor of 0.8739 (Figure 41). The next step was for the adjusted road NO_X concentrations to be input into the NO_X-NO_2 calculator with the appropriate background concentration to obtain final modelled NO_2 concentrations. This resulted in an under prediction of 15% at DT16 and an over prediction of 9% at CM2 but overall, the average under prediction was 3%. Overall this agreement was considered to be acceptable and the verification process showed that the model predicted exceedences of the annual mean objective at sites DT16 and CM2, similarly to the monitored values.

The uncertainty of the model to represent the annual mean NO_2 concentration expressed as the standard deviation of the model (SDM) was +-4.9 $\mu g/m^3$.

Receptor and grid modelling

The ADMS-Roads dispersion model was run across a grid to produce a gridded output and contour plot as well as at specific receptors. These receptors were chosen as those located within 200 metres or the road links. To choose the receptors, the study team analysed the address point file by extracting all those points considered not to be residential[17]. The total number of receptors across the study area applied (including eight monitoring sites) totalled 2,898. All residential receptors were assumed to be at 1.5m above ground level. In other words no account was taken of exposure experienced at 1st or 2nd floor levels typically associated with flats above shops. A map that indicates the location of the receptors is given in Figure 42 and a table of receptors with modelled concentrations close to or above the annual mean NO_2 objective is given in Table 80.

Figure 42: Location of modelled receptors in relation to modelled road link, study zone A

[17] In accordance with Defra guidance inhabitants of residential properties are more likely to be subject to the NO_2 exposure risk factor associated with the health based annual mean metric of 40µg/m^3.

Table 80: Relevant receptors with modelled annual mean NO_2 concentrations above 35 µg/m^3, baseline

x	y	Address	Postcode	Annual mean NO_2 concentration µg/m^3
359455	388104	BAXTER STREET 40	WA5 1AN	37.67
359450	388105	BAXTER STREET 42	WA5 1AN	37.28
359445	388103	BAXTER STREET 44	WA5 1AN	36.16
359442	388103	BAXTER STREET 46	WA5 1AN	35.76
359439	388103	BAXTER STREET 48	WA5 1AN	35.25
360082	388108	DIXON STREET 5	WA1 1NW	35.06
361116	388310	FENNEL STREET	WA1 2PA	36.71
359492	388240	GREEN STREET 41	WA5 1TR	35.8
359483	388243	GREEN STREET 43	WA5 1TR	35.49
359474	388246	GREEN STREET 45	WA5 1TR	35.37
359467	388247	GREEN STREET 47	WA5 1TR	35.72
359453	388252	LOVELY LANE 1	WA5 1LX	36.68
359452	388257	LOVELY LANE 3	WA5 1LX	36.14
359450	388263	LOVELY LANE 5	WA5 1LX	35.93
359449	388266	LOVELY LANE 7	WA5 1LX	35.67
359448	388271	LOVELY LANE 9	WA5 1LX	35.25
359518	388235	MANLEY GARDENS 19	WA5 1SS	36.16
360969	388090	MERSEY STREET	WA1 2BP	35.63
359745	388166	OLD LIVERPOOL ROAD 5	WA5 1AE	39.8
360044	388013	PARKER STREET	WA1 1LT	41.19
359976	388135	PARKER STREET 1	WA1 1LT	37.98
360058	388093	PARKER STREET 10	WA1 1LT	41.14
360056	388088	PARKER STREET 12	WA1 1LT	41.26
360056	388084	PARKER STREET 14	WA1 1LT	41.08
360054	388079	PARKER STREET 16	WA1 1LT	41.42
360053	388075	PARKER STREET 18	WA1 1LT	41.6
360053	388070	PARKER STREET 20	WA1 1LT	41.32
360052	388065	PARKER STREET 22	WA1 1LT	41.07
360051	388060	PARKER STREET 24	WA1 1LT	41.31
360051	388055	PARKER STREET 26	WA1 1LT	41.07
360050	388050	PARKER STREET 28	WA1 1LT	40.95
360049	388045	PARKER STREET 30	WA1 1LT	40.86
360049	388040	PARKER STREET 32	WA1 1LT	40.77
360047	388035	PARKER STREET 34	WA1 1LT	41.13
360042	388007	PARKER STREET 38	WA1 1LT	41.68
360040	388003	PARKER STREET 40	WA1 1LT	43.03
360042	387997	PARKER STREET 42	WA1 1LT	40.83
360041	387993	PARKER STREET 44	WA1 1LT	40.84
360040	387988	PARKER STREET 46	WA1 1LT	41.31
360039	387985	PARKER STREET 48	WA1 1LT	41.22
360035	387963	PARKER STREET 52	WA1 1LT	42.47
360035	387959	PARKER STREET 54	WA1 1LT	42.57
360035	387954	PARKER STREET 56	WA1 1LT	42
360060	388098	PARKER STREET 8	WA1 1LT	40.64
360076	388136	SANKEY STREET	WA1 1NN	40.9
360105	388134	SANKEY STREET 139	WA1 1NN	37.55
360105	388134	SANKEY STREET 139	WA1 1NN	37.55
360510	387887	STANLEY STREET	WA1 1EZ	37.25

		29		
360047	388030	WHITE STREET 1	WA1 1NR	40.74
360421	387872	WILSON PATTEN STREET	WA1 1PG	39.85
360075	387854	WILSON PATTEN STREET	WA1 1PG	39.8
360404	387869	WILSON PATTEN STREET 15	WA1 1PG	40.79
360399	387868	WILSON PATTEN STREET 17	WA1 1PG	40.92
360393	387867	WILSON PATTEN STREET 19	WA1 1PG	41.17
360368	387863	WILSON PATTEN STREET 25	WA1 1PG	42.37
360368	387863	WILSON PATTEN STREET 25	WA1 1PG	42.37
360362	387862	WILSON PATTEN STREET 27	WA1 1PG	42.77
360354	387861	WILSON PATTEN STREET 29	WA1 1PG	42.91
360345	387861	WILSON PATTEN STREET 31	WA1 1PG	41.92
360338	387861	WILSON PATTEN STREET 33	WA1 1PG	41.96
360304	387857	WILSON PATTEN STREET 43	WA1 1PG	42.1
360299	387857	WILSON PATTEN STREET 45	WA1 1PG	42.08
360289	387858	WILSON PATTEN STREET 47	WA1 1PG	41.2

Other issues

The study team considered whether air pollution (in the study area) might be influenced by street canyon effects (i.e. typically where building height exceeds the building façade to façade distance). Close inspection could not identify any clear circumstances where this might be an issue.

K. Goods vehicle re-routing measure: Traffic data

Table 81: Traffic data applied for the goods vehicle re-routing measure

Baseline																		
Road Name	Traffic Direction	TEEM_ID	Link Length (km)	Speed (km/h)	AADT	LDVs	HDVs	Two Wheelers	Motor cycles	Mopeds	Cars	Taxis	LGVs	Buses	Coaches	Rigid HGVs	Artic HGVs	Data source
Bridge Foot	WB	7819	0.91	32	16862	15081	1781	0	0	0	15081	0	0	0	0	1203	578	2
Bridge Foot	EB	7818	0.12	32	14157	13427	730	0	0	0	13427	0	0	83	0	437	210	2
Wilson Patton Street(a)	EB	7870	0.53	40	11640	11163	477	0	0	0	11163	0	0	0	0	322	155	2
Wilson Patton Street(b)	EB	7817	0.37	43	10814	10300	514	0	0	0	10300	0	0	42	0	319	153	2
Parker Street Junction	NB	7820	0.13	32	15020	13365	1655	0	0	0	13365	0	0	0	0	1118	537	2
Parker Street Junction	SB	7870	0.53	40	11640	11163	477	0	0	0	11163	0	0	0	0	322	155	2
Sankey Way	WB	7744	0.46	24	14112	13573	539	0	0	0	12540	0	1033	196	33	187	123	2
Sankey Way	EB	7746	0.54	44	10771	10360	411	0	0	0	9571	0	789	150	25	142	94	2
Sankey Way RR	RR	7743	0.38	40	33645	32791	854	0	0	0	30974	0	1817	281	17	425	131	2
Froghall Lane	EB	7754	1.58	44	7913	7659	254	0	0	0	7100	0	559	91	9	109	45	2
Froghall Lane(a)	WB	7753	0.06	48	1000	976	24	0	0	0	917	0	59	8	0	13	3	2
Froghall Lane(b)	WB	7756	1.63	42	7260	7027	233	0	0	0	6514	0	513	84	8	100	41	2
Midland Way	EB	7755	0.11	24	7913	7659	254	0	0	0	7100	0	559	91	9	109	45	2
Cockhedge Green RR	RR	7731	0.26	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2
Brick Street	NB	7729	0.25	39	14341	13794	547	0	0	0	12744	0	1050	199	33	190	125	2
Brick Street	SB	7730	0.25	41	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2
Dial Street RR	RR	7728	0.16	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2
Mersey Street	NB	7719	0.42	39	14341	13794	547	0	0	0	12744	0	1050	199	33	190	125	2
Mersey Street	SB	7720	0.31	41	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2
Mersey Street	SB	7721	0.11	24	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2
Bridg Foot RR	RR	7714	0.03	40	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2

Bridge Foot RR	RR	7712	0.12	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2
Bridge Foot RR	RR	7717	0.05	40	6733	6475	258	0	0	0	5982	0	493	94	16	89	59	2
Bridge Foot RR	RR	7718	0.09	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2
Clockwise																		
	Traffic Direction	TEEM_ID	Link Length (km)	Speed (km/h)	AADT	LDVs	HDVs	Two Wheelers	Motor cycles	Mopeds	Cars	Taxis	LGVs	Buses	Coaches	Rigid HGVs	Artic HGVs	Data source
Bridge Foot	WB	7819	0.91	32	17158	15081	2077	0	0	0	15081	0	0	0	0	1381	696	2
Bridge Foot	EB	7818	0.12	32	13510	13427	83	0	0	0	13427	0	0	83	0	0	0	2
Wilson Patton Street(a)	EB	7870	0.53	40	11163	11163	0	0	0	0	11163	0	0	0	0	0	0	2
Wilson Patton Street(b)	EB	7817	0.37	43	10342	10300	42	0	0	0	10300	0	0	42	0	0	0	2
Parker Street Junction	NB	7820	0.13	32	15316	13365	1951	0	0	0	13365	0	0	0	0	1296	655	2
Parker Street Junction	SB	7870	0.53	40	11163	11163	0	0	0	0	11163	0	0	0	0	0	0	2
Sankey Way	WB	7744	0.46	24	14408	13573	835	0	0	0	12540	0	1033	196	33	365	241	2
Sankey Way	EB	7746	0.54	44	10535	10360	175	0	0	0	9571	0	789	150	25	0	0	2
Sankey Way RR	RR	7743	0.38	40	33941	32791	1150	0	0	0	30974	0	1817	281	17	603	249	2
Froghall Lane	EB	7754	1.58	44	8445	7659	786	0	0	0	7100	0	559	91	9	429	257	2
Froghall Lane(a)	WB	7753	0.06	48	984	976	8	0	0	0	917	0	59	8	0	0	0	2
Froghall Lane(b)	WB	7756	1.63	42	7119	7027	92	0	0	0	6514	0	513	84	8	0	0	2
Midland Way	EB	7755	0.11	24	8445	7659	786	0	0	0	7100	0	559	91	9	429	257	2
Cockhedge Green RR	RR	7731	0.26	40	25886.38	24779	1107.38	0	0	0	22893	0	1886	358	60	390	299	2
Brick Street	NB	7729	0.25	39	14026	13794	232	0	0	0	12744	0	1050	199	33	0	0	2
Brick Street	SB	7730	0.25	41	14702.38	13738	964.38	0	0	0	12692	0	1046	198	33	416	317	2
Dial Street RR	RR	7728	0.16	40	25629.16	24779	850.16	0	0	0	22893	0	1886	358	60	231	201	2
Mersey Street	NB	7719	0.42	39	14026	13794	232	0	0	0	12744	0	1050	199	33	0	0	2
Mersey Street	SB	7720	0.31	41	14702.38	13738	964.38	0	0	0	12692	0	1046	198	33	416	317	2
Mersey Street	SB	7721	0.11	24	14425	13738	687	0	0	0	12692	0	1046	198	33	331	125	2
Bridge Foot RR	RR	7714	0.03	40	14519	13738	781	0	0	0	12692	0	1046	198	33	331	219	2
Bridge Foot RR	RR	7712	0.12	40	13511.2	12950	561.2	0	0	0	11964	0	986	187	31	206	137	2
Bridge Foot RR	RR	7717	0.05	40	6585	6475	110	0	0	0	5982	0	493	94	16	0	0	2

Bridge Foot RR	RR	7718	0.09	40	13168	12950	218	0	0	0	11964	0	986	187	31	0	0	2
Anticlockwise																		
	Traffic Direction	TEEM_ID	Link Length (km)	Speed (km/h)	AADT	LDVs	HDVs	Two Wheelers	Motor cycles	Mopeds	Cars	Taxis	LGVs	Buses	Coaches	Rigid HGVs	Artic HGVs	Data source
Bridge Foot	WB	7819	0.91	32	15081	15081	0	0	0	0	15081	0	0	0	0	0	0	2
Bridge Foot	EB	7818	0.12	32	14625	13427	1198	0	0	0	13427	0	0	83	0	735	380	2
Wilson Patton Street(a)	EB	7870	0.53	40	12108	11163	945	0	0	0	11163	0	0	0	0	620	325	2
Wilson Patton Street(b)	EB	7817	0.37	43	11282	10300	982	0	0	0	10300	0	0	42	0	617	323	2
Parker Street Junction	NB	7820	0.13	32	13365	13365	0	0	0	0	13365	0	0	0	0	0	0	2
Parker Street Junction	SB	7870	0.53	40	12108	11163	945	0	0	0	11163	0	0	0	0	620	325	2
Sankey Way	WB	7744	0.46	24	13802	13573	229	0	0	0	12540	0	1033	196	33	0	0	2
Sankey Way	EB	7746	0.54	44	11239	10360	879	0	0	0	9571	0	789	150	25	440	264	2
Sankey Way RR	RR	7743	0.38	40	33959	32791	1168	0	0	0	30974	0	1817	281	17	614	256	2
Froghall Lane	EB	7754	1.58	44	7759	7659	100	0	0	0	7100	0	559	91	9	0	0	2
Froghall Lane(a)	WB	7753	0.06	48	1314	976	338	0	0	0	917	0	59	8	0	202	128	2
Froghall Lane(b)	WB	7756	1.63	42	7574	7027	547	0	0	0	6514	0	513	84	8	289	166	2
Midland Way	EB	7755	0.11	24	7759	7659	100	0	0	0	7100	0	559	91	9	0	0	2
Cockhedge Green RR	RR	7731	0.26	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2
Brick Street	NB	7729	0.25	39	15651.8	13794	1857.8	0	0	0	12744	0	1050	199	33	1469	157	2
Brick Street	SB	7730	0.25	41	13969	13738	231	0	0	0	12692	0	1046	198	33	0	0	2
Dial Street RR	RR	7728	0.16	40	27544	24779	2765	0	0	0	22893	0	1886	358	60	1544	803	2
Mersey Street	NB	7719	0.42	39	16229.8	13794	2435.8	0	0	0	12744	0	1050	199	33	1469	735	2
Mersey Street	SB	7720	0.31	41	13969	13738	231	0	0	0	12692	0	1046	198	33	0	0	2
Mersey Street	SB	7721	0.11	24	13969	13738	231	0	0	0	12692	0	1046	198	33	0	0	2
Bridge Foot RR	RR	7714	0.03	40	13969	13738	231	0	0	0	12692	0	1046	198	33	0	0	2
Bridge Foot RR	RR	7712	0.12	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2
Bridge Foot RR	RR	7717	0.05	40	6779.2	6475	304.2	0	0	0	5982	0	493	94	16	122	73	2
Bridge Foot RR	RR	7718	0.09	40	15399	12950	2449	0	0	0	11964	0	986	187	31	1490	741	2

L. Detailed testing of the oneway option(s): Traffic data

Table 82: Baseline (links across entire study area)

TEEM_ID	Road_Class	Road_type	Location	Link_Length_KM	Speed_KMH	AADT	LDVs	HDVs	TwoWheelers	Motorcycles	Mopeds	Cars	Taxis	LGVs	Buses	Coaches	Rigid_HGVs	Artic_HGVs	Datasource	Comments
7701	A1	Urban	Warrington	0.72	48	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7702	A1	Urban	Warrington	0.11	24	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7703	A1	Urban	Warrington	0.83	45	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7704	A1	Urban	Warrington	0.17	40	30192	29150	1042	0	0	0	26959	0	2191	394	24	467	156	2	NDC2013
7705	A1	Urban	Warrington	1.09	45	9884	9617	267	0	0	0	8917	0	700	47	8	125	88	2	NDC2013
7706	A1	Urban	Warrington	1.03	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7707	A1	Urban	Warrington	0.06	24	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7708	A1	Urban	Warrington	0.24	24	16969	16383	586	0	0	0	15152	0	1231	222	14	263	88	2	NDC2013
7709	A1	Urban	Warrington	0.25	24	16578	15984	594	0	0	0	14867	0	1117	264	12	229	89	2	NDC2013
7710	A1	Urban	Warrington	1.24	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7711	A1	Urban	Warrington	0.21	24	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7712	A1	Urban	Warrington	0.12	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2	NDC2013
7713	A1	Urban	Warrington	1.34	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7714	A1	Urban	Warrington	0.03	40	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7715	A1	Urban	Warrington	0.1	34	4341	4230	111	0	0	0	3940	0	290	8	7	74	21	2	NDC2013
7716	A1	Urban	Warrington	0.09	34	4110	4009	101	0	0	0	3757	0	252	7	7	65	22	2	NDC2013
7717	A1	Urban	Warrington	0.05	40	6732	6475	257	0	0	0	5982	0	493	94	16	89	59	2	NDC2013
7718	A1	Urban	Warrington	0.09	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2	NDC2013
7719	A1	Urban	Warrington	0.42	39	14342	13794	548	0	0	0	12744	0	1050	199	33	190	125	2	NDC2013
7720	A1	Urban	Warrington	0.31	41	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7721	A1	Urban	Warrington	0.11	24	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7722	A1	Urban	Warrington	0.91	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013

7723	A1	Urban	Warrington	0.13	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7724	A1	Urban	Warrington	0.9	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7725	A1	Urban	Warrington	0.12	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7726	A1	Urban	Warrington	0.36	45	9884	9617	267	0	0	0	8917	0	700	47	8	125	88	2	NDC2013
7727	A1	Urban	Warrington	0.36	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7728	A1	Urban	Warrington	0.16	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2	NDC2013
7729	A1	Urban	Warrington	0.25	39	14342	13794	548	0	0	0	12744	0	1050	199	33	190	125	2	NDC2013
7730	A1	Urban	Warrington	0.25	41	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7731	A1	Urban	Warrington	0.26	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2	NDC2013
7732	A1	Urban	Warrington	0.71	48	7325	7040	284	0	0	0	6534	0	506	93	6	130	56	2	NDC2013
7733	A1	Urban	Warrington	0.41	42	7452	7174	278	0	0	0	6651	0	523	86	8	106	79	2	NDC2013
7734	A1	Urban	Warrington	0.31	24	7452	7174	278	0	0	0	6651	0	523	86	8	106	79	2	NDC2013
7735	A1	Urban	Warrington	0.56	40	2442	2347	95	0	0	0	2178	0	169	31	2	43	19	2	NDC2013
7736	A1	Urban	Warrington	0.59	42	2484	2391	93	0	0	0	2217	0	174	29	3	35	26	2	NDC2013
7737	A1	Urban	Warrington	1.26	53	5589	5496	93	0	0	0	5062	0	434	6	2	65	20	2	NDC2013
7738	A1	Urban	Warrington	1.14	53	4908	4819	89	0	0	0	4413	0	406	7	3	61	17	2	NDC2013
7739	A1	Urban	Warrington	0.12	24	4908	4819	89	0	0	0	4413	0	406	7	3	61	17	2	NDC2013
7740	A1	Urban	Warrington	0.57	61	18711	18236	475	0	0	0	17225	0	1011	156	10	237	73	2	NDC2013
7741	A1	Urban	Warrington	0.37	57	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7742	A1	Urban	Warrington	0.15	24	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7743	A1	Urban	Warrington	0.38	40	33647	32792	855	0	0	0	30974	0	1817	281	17	425	131	2	NDC2013
7744	A1	Urban	Warrington	0.46	24	14112	13573	539	0	0	0	12540	0	1033	196	33	187	123	2	NDC2013
7745	A1	Urban	Warrington	0.08	24	14112	13573	539	0	0	0	12540	0	1033	196	33	187	123	2	NDC2013
7746	A1	Urban	Warrington	0.54	44	10771	10360	411	0	0	0	9571	0	789	150	25	142	94	2	NDC2013
7747	A1	Urban	Warrington	1.25	47	4087	3796	291	0	0	0	3326	0	469	152	1	110	28	2	NDC2013
7748	A1	Urban	Warrington	1.11	46	4107	3828	279	0	0	0	3379	0	449	149	5	97	28	2	NDC2013
7749	A1	Urban	Warrington	0.13	24	4107	3828	279	0	0	0	3379	0	449	149	5	97	28	2	NDC2013
7750	A1	Urban	Warrington	1.11	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7751	A1	Urban	Warrington	1.01	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7752	A1	Urban	Warrington	0.09	24	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7753	A1	Urban	Warrington	0.06	48	1000	976	24	0	0	0	917	0	59	8	0	13	3	2	NDC2013
7754	A1	Urban	Warrington	1.58	44	7913	7659	254	0	0	0	7100	0	559	91	9	109	45	2	NDC2013
7755	A1	Urban	Warrington	0.11	24	7913	7659	254	0	0	0	7100	0	559	91	9	109	45	2	NDC2013

7756	A1	Urban	Warrington	1.63	42	7260	7027	233	0	0	0	6514	0	513	84	8	100	41	2	NDC2013
7757	A1	Urban	Warrington	1.02	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7758	A1	Urban	Warrington	0.52	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7759	A1	Urban	Warrington	0.52	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7760	A1	Urban	Warrington	1.03	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7761	A1	Urban	Warrington	0.91	42	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7762	A1	Urban	Warrington	0.92	42	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7763	A1	Urban	Warrington	0.57	42	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7764	A1	Urban	Warrington	0.04	24	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7765	A1	Urban	Warrington	0.51	42	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7766	A1	Urban	Warrington	0.1	24	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7767	A1	Urban	Warrington	0.61	47	5625	5518	107	0	0	0	5208	0	310	67	15	24	2	2	NDC2013
7768	A1	Urban	Warrington	0.06	24	5625	5518	107	0	0	0	5208	0	310	67	15	24	2	2	NDC2013
7769	A1	Urban	Warrington	0.62	45	7120	7004	116	0	0	0	6618	0	386	70	9	32	5	2	NDC2013
7770	A1	Urban	Warrington	0.06	24	7120	7004	116	0	0	0	6618	0	386	70	9	32	5	2	NDC2013
7771	A1	Urban	Warrington	0.14	24	500	492	8	0	0	0	465	0	27	5	1	2	0	2	NDC2013
7772	A1	Urban	Warrington	0.15	24	500	492	8	0	0	0	465	0	27	5	1	2	0	2	NDC2013
7773	A1	Urban	Warrington	0.8	37	3704	3593	111	0	0	0	3397	0	196	90	0	18	2	2	NDC2013
7774	A1	Urban	Warrington	0.73	30	3438	3330	108	0	0	0	3161	0	169	76	1	26	5	2	NDC2013
7775	A1	Urban	Warrington	0.07	24	3438	3330	108	0	0	0	3161	0	169	76	1	26	5	2	NDC2013
7776	A1	Urban	Warrington	0.82	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7777	A1	Urban	Warrington	0.04	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7778	A1	Urban	Warrington	0.24	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7779	A1	Urban	Warrington	0.23	43	2519	2473	46	0	0	0	2276	0	197	16	2	24	4	2	NDC2013
7780	A1	Urban	Warrington	0.86	43	2519	2473	46	0	0	0	2276	0	197	16	2	24	4	2	NDC2013
7781	A1	Urban	Warrington	0.32	45	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7782	A1	Urban	Warrington	0.33	24	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7783	A1	Urban	Warrington	0.27	40	16835	16304	531	0	0	0	15123	0	1181	157	32	221	121	2	NDC2013
7784	A1	Urban	Warrington	0.02	40	400	387	13	0	0	0	359	0	28	4	1	5	3	2	NDC2013
7785	A1	Urban	Warrington	0.03	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7786	A1	Urban	Warrington	0.79	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7787	A1	Urban	Warrington	0.22	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7788	A1	Urban	Warrington	0.8	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013

7789	A1	Urban	Warrington	0.03	24	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7790	A1	Urban	Warrington	0.05	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7791	A1	Urban	Warrington	0.97	61	18711	18236	475	0	0	0	17225	0	1011	156	10	237	73	2	NDC2013
7792	A1	Urban	Warrington	1.02	57	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7793	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7794	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7795	A1	Urban	Warrington	0.08	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7796	A1	Urban	Warrington	0.08	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7797	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7798	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7799	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7800	A1	Urban	Warrington	0.5	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7801	A1	Urban	Warrington	0.12	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7802	A1	Urban	Warrington	0.12	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7803	A1	Urban	Warrington	0.4	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7804	A1	Urban	Warrington	0.13	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7805	A1	Urban	Warrington	0.16	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7806	A1	Urban	Warrington	0.14	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7807	A1	Urban	Warrington	0.19	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7808	A1	Urban	Warrington	0.19	45	7370	7171	199	0	0	0	6649	0	522	35	6	93	65	2	NDC2013
7809	A1	Urban	Warrington	0.16	48	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7810	A1	Urban	Warrington	0.12	44	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7811	A1	Urban	Warrington	0.99	48	6000	5785	215	0	0	0	5381	0	404	95	4	83	32	2	NDC2013
7812	A1	Urban	Warrington	0.23	30	9987	8851	1136	0	0	0	8851	0	0	473	0	448	215	2	WBC2014TM
7813	A1	Urban	Warrington	0.23	35	3239	2667	572	0	0	0	2667	0	0	361	0	142	68	2	WBC2014TM
7814	A1	Urban	Warrington	0.08	31	9317	8764	553	0	0	0	8764	0	0	0	0	373	179	2	WBC2014TM
7815	A1	Urban	Warrington	0.23	31	8140	7661	480	0	0	0	7661	0	0	0	0	324	156	2	WBC2014TM
7816	A1	Urban	Warrington	0.23	32	433	419	14	0	0	0	419	0	0	0	0	9	5	2	WBC2014TM
7817	A1	Urban	Warrington	0.37	43	10814	10300	514	0	0	0	10300	0	0	42	0	319	153	2	WBC2014TM
7818	A1	Urban	Warrington	0.12	32	14157	13427	730	0	0	0	13427	0	0	83	0	437	210	2	WBC2014TM
7819	A1	Urban	Warrington	0.91	32	16862	15081	1781	0	0	0	15081	0	0	0	0	1203	578	2	WBC2014TM
7820	A1	Urban	Warrington	0.13	32	15019	13365	1654	0	0	0	13365	0	0	0	0	1118	537	2	WBC2014TM
7821	A1	Urban	Warrington	0.13	32	139	132	7	0	0	0	132	0	0	0	0	5	2	2	WBC2014TM

7822	A1	Urban	Warrington	0.09	32	1095	1015	80	0	0	0	1015	0	0	0	0	54	26	2	WBC2014TM
7823	A1	Urban	Warrington	0.07	35	612	556	56	0	0	0	556	0	0	0	0	38	18	2	WBC2014TM
7824	A1	Urban	Warrington	0.05	32	667	612	56	0	0	0	612	0	0	0	0	38	18	2	WBC2014TM
7825	A1	Urban	Warrington	0.23	32	4096	3730	366	0	0	0	3730	0	0	0	0	247	119	2	WBC2014TM
7826	A1	Urban	Warrington	0.16	32	427	396	31	0	0	0	396	0	0	0	0	21	10	2	WBC2014TM
7827	A1	Urban	Warrington	0.08	32	619	580	38	0	0	0	580	0	0	0	0	26	12	2	WBC2014TM
7828	A1	Urban	Warrington	0.06	32	160	149	10	0	0	0	149	0	0	0	0	7	3	2	WBC2014TM
7829	A1	Urban	Warrington	0.06	32	160	146	14	0	0	0	146	0	0	0	0	9	5	2	WBC2014TM
7830	A1	Urban	Warrington	0.06	31	3621	3079	542	0	0	0	3079	0	0	375	0	113	54	2	WBC2014TM
7831	A1	Urban	Warrington	0.07	31	2846	2658	188	0	0	0	2658	0	0	83	0	70	34	2	WBC2014TM
7832	A1	Urban	Warrington	0.09	31	3009	2752	257	0	0	0	2752	0	0	83	0	117	56	2	WBC2014TM
7833	A1	Urban	Warrington	0.09	32	520	485	35	0	0	0	485	0	0	0	0	23	11	2	WBC2014TM
7834	A1	Urban	Warrington	0.11	32	768	723	45	0	0	0	723	0	0	0	0	31	15	2	WBC2014TM
7835	A1	Urban	Warrington	0.08	32	73	66	7	0	0	0	66	0	0	0	0	5	2	2	WBC2014TM
7836	A1	Urban	Warrington	0.12	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7837	A1	Urban	Warrington	0.06	32	375	361	14	0	0	0	361	0	0	0	0	9	5	2	WBC2014TM
7838	A1	Urban	Warrington	0.07	32	441	414	28	0	0	0	414	0	0	0	0	19	9	2	WBC2014TM
7839	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7840	A1	Urban	Warrington	0.13	35	73	70	3	0	0	0	70	0	0	0	0	2	1	2	WBC2014TM
7841	A1	Urban	Warrington	0.1	35	195	188	7	0	0	0	188	0	0	0	0	5	2	2	WBC2014TM
7842	A1	Urban	Warrington	0.06	32	2161	2071	90	0	0	0	2071	0	0	0	0	61	29	2	WBC2014TM
7843	A1	Urban	Warrington	0.08	32	2182	2092	90	0	0	0	2092	0	0	0	0	61	29	2	WBC2014TM
7844	A1	Urban	Warrington	0.11	35	3746	3562	184	0	0	0	3562	0	0	0	0	124	60	2	WBC2014TM
7845	A1	Urban	Warrington	0.07	35	799	445	354	0	0	0	445	0	0	292	0	42	20	2	WBC2014TM
7846	A1	Urban	Warrington	0.06	35	1334	952	382	0	0	0	952	0	0	292	0	61	29	2	WBC2014TM
7847	A1	Urban	Warrington	0.03	34	6130	5609	521	0	0	0	5609	0	0	0	0	352	169	2	WBC2014TM
7848	A1	Urban	Warrington	0.07	34	5755	5247	507	0	0	0	5247	0	0	0	0	343	165	2	WBC2014TM
7849	A1	Urban	Warrington	0.15	32	76	0	76	0	0	0	0	0	0	76	0	0	0	2	WBC2014TM
7850	A1	Urban	Warrington	0.07	35	1265	883	382	0	0	0	883	0	0	292	0	61	29	2	WBC2014TM
7851	A1	Urban	Warrington	0.07	32	35	31	3	0	0	0	31	0	0	0	0	2	1	2	WBC2014TM
7852	A1	Urban	Warrington	0.05	35	1265	883	382	0	0	0	883	0	0	292	0	61	29	2	WBC2014TM
7853	A1	Urban	Warrington	0.05	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7854	A1	Urban	Warrington	0.08	32	1161	1105	56	0	0	0	1105	0	0	0	0	38	18	2	WBC2014TM

7855	A1	Urban	Warrington	0.03	31	3614	3072	542	0	0	0	3072	0	0	375	0	113	54	2	WBC2014TM
7856	A1	Urban	Warrington	0.09	27	13511	12163	1348	0	0	0	12163	0	0	473	0	592	284	2	WBC2014TM
7857	A1	Urban	Warrington	0.09	35	910	473	438	0	0	0	473	0	0	361	0	52	25	2	WBC2014TM
7858	A1	Urban	Warrington	0.05	16	177	167	10	0	0	0	167	0	0	0	0	7	3	2	WBC2014TM
7859	A1	Urban	Warrington	0.06	35	3072	2558	514	0	0	0	2558	0	0	375	0	94	45	2	WBC2014TM
7860	A1	Urban	Warrington	0.23	32	524	491	32	0	0	0	491	0	0	0	0	22	11	2	WBC2014TM
7861	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7862	A1	Urban	Warrington	0.1	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7863	A1	Urban	Warrington	0.04	16	104	90	14	0	0	0	90	0	0	0	0	9	5	2	WBC2014TM
7864	A1	Urban	Warrington	0.06	32	202	174	28	0	0	0	174	0	0	0	0	19	9	2	WBC2014TM
7865	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7866	A1	Urban	Warrington	0.07	16	63	63	0	0	0	0	63	0	0	0	0	0	0	2	WBC2014TM
7867	A1	Urban	Warrington	0.09	15	650	612	38	0	0	0	612	0	0	0	0	26	12	2	WBC2014TM
7868	A1	Urban	Warrington	0.11	40	2829	2815	14	0	0	0	2815	0	0	0	0	9	5	2	WBC2014TM
7869	A1	Urban	Warrington	0.11	40	3433	3399	35	0	0	0	3399	0	0	0	0	23	11	2	WBC2014TM
7870	A1	Urban	Warrington	0.53	40	11640	11163	477	0	0	0	11163	0	0	0	0	322	155	2	WBC2014TM
7871	A1	Urban	Warrington	0.04	16	459	445	14	0	0	0	445	0	0	0	0	9	5	2	WBC2014TM
7872	A1	Urban	Warrington	0.1	35	348	327	21	0	0	0	327	0	0	0	0	14	7	2	WBC2014TM
7873	A1	Urban	Warrington	0.07	31	3072	2558	514	0	0	0	2558	0	0	375	0	94	45	2	WBC2014TM
7874	A1	Urban	Warrington	0.07	32	6102	5577	525	0	0	0	5577	0	0	0	0	355	170	2	WBC2014TM
7875	A1	Urban	Warrington	0.06	31	6213	5678	535	0	0	0	5678	0	0	0	0	362	174	2	WBC2014TM
7876	A1	Urban	Warrington	0.11	35	2071	1943	129	0	0	0	1943	0	0	0	0	87	42	2	WBC2014TM
7877	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7878	A1	Urban	Warrington	0.09	32	243	226	17	0	0	0	226	0	0	0	0	12	6	2	WBC2014TM
7879	A1	Urban	Warrington	0.07	32	66	66	0	0	0	0	66	0	0	0	0	0	0	2	WBC2014TM
7880	A1	Urban	Warrington	0.07	31	181	160	21	0	0	0	160	0	0	0	0	14	7	2	WBC2014TM
7881	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM

Table 83: Scenario A (all links)

TEEM_ID	Road_Class	Road_type	Location	Link_Length_KM	Speed_KMH	AADT	LDVs	HDVs	TwoWheelers	Motorcycles	Mopeds	Cars	Taxis	LGVs	Buses	Coaches	Rigid_HGVs	Artic_HGVs	Datasource	Comments
7701	A1	Urban	Warrington	0.72	48	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7702	A1	Urban	Warrington	0.11	24	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7703	A1	Urban	Warrington	0.83	45	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7704	A1	Urban	Warrington	0.17	40	30192	29150	1042	0	0	0	26959	0	2191	394	24	467	156	2	NDC2013
7705	A1	Urban	Warrington	1.09	45	9884	9617	267	0	0	0	8917	0	700	47	8	125	88	2	NDC2013
7706	A1	Urban	Warrington	1.03	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7707	A1	Urban	Warrington	0.06	24	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7708	A1	Urban	Warrington	0.24	24	16969	16383	586	0	0	0	15152	0	1231	222	14	263	88	2	NDC2013
7709	A1	Urban	Warrington	0.25	24	16578	15984	594	0	0	0	14867	0	1117	264	12	229	89	2	NDC2013
7710	A1	Urban	Warrington	1.24	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7711	A1	Urban	Warrington	0.21	24	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7712	A1	Urban	Warrington	0.12	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2	NDC2013
7713	A1	Urban	Warrington	1.34	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7714	A1	Urban	Warrington	0.03	40	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7715	A1	Urban	Warrington	0.1	34	4341	4230	111	0	0	0	3940	0	290	8	7	74	21	2	NDC2013
7716	A1	Urban	Warrington	0.09	34	4110	4009	101	0	0	0	3757	0	252	7	7	65	22	2	NDC2013
7717	A1	Urban	Warrington	0.05	40	6732	6475	257	0	0	0	5982	0	493	94	16	89	59	2	NDC2013
7718	A1	Urban	Warrington	0.09	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2	NDC2013
7719	A1	Urban	Warrington	0.42	39	14342	13794	548	0	0	0	12744	0	1050	199	33	190	125	2	NDC2013
7720	A1	Urban	Warrington	0.31	41	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7721	A1	Urban	Warrington	0.11	24	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7722	A1	Urban	Warrington	0.91	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7723	A1	Urban	Warrington	0.13	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7724	A1	Urban	Warrington	0.9	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7725	A1	Urban	Warrington	0.12	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013

7726	A1	Urban	Warrington	0.36	45	9884	9617	267	0	0	0	8917	0	700	47	8	125	88	2	NDC2013
7727	A1	Urban	Warrington	0.36	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7728	A1	Urban	Warrington	0.16	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2	NDC2013
7729	A1	Urban	Warrington	0.25	39	14342	13794	548	0	0	0	12744	0	1050	199	33	190	125	2	NDC2013
7730	A1	Urban	Warrington	0.25	41	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7731	A1	Urban	Warrington	0.26	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2	NDC2013
7732	A1	Urban	Warrington	0.71	48	7325	7040	284	0	0	0	6534	0	506	93	6	130	56	2	NDC2013
7733	A1	Urban	Warrington	0.41	42	7452	7174	278	0	0	0	6651	0	523	86	8	106	79	2	NDC2013
7734	A1	Urban	Warrington	0.31	24	7452	7174	278	0	0	0	6651	0	523	86	8	106	79	2	NDC2013
7735	A1	Urban	Warrington	0.56	40	2442	2347	95	0	0	0	2178	0	169	31	2	43	19	2	NDC2013
7736	A1	Urban	Warrington	0.59	42	2484	2391	93	0	0	0	2217	0	174	29	3	35	26	2	NDC2013
7737	A1	Urban	Warrington	1.26	53	5589	5496	93	0	0	0	5062	0	434	6	2	65	20	2	NDC2013
7738	A1	Urban	Warrington	1.14	53	4908	4819	89	0	0	0	4413	0	406	7	3	61	17	2	NDC2013
7739	A1	Urban	Warrington	0.12	24	4908	4819	89	0	0	0	4413	0	406	7	3	61	17	2	NDC2013
7740	A1	Urban	Warrington	0.57	61	18711	18236	475	0	0	0	17225	0	1011	156	10	237	73	2	NDC2013
7741	A1	Urban	Warrington	0.37	57	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7742	A1	Urban	Warrington	0.15	24	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7743	A1	Urban	Warrington	0.38	40	33647	32792	855	0	0	0	30974	0	1817	281	17	425	131	2	NDC2013
7744	A1	Urban	Warrington	0.46	24	14112	13573	539	0	0	0	12540	0	1033	196	33	187	123	2	NDC2013
7745	A1	Urban	Warrington	0.08	24	14112	13573	539	0	0	0	12540	0	1033	196	33	187	123	2	NDC2013
7746	A1	Urban	Warrington	0.54	44	10771	10360	411	0	0	0	9571	0	789	150	25	142	94	2	NDC2013
7747	A1	Urban	Warrington	1.25	47	4087	3796	291	0	0	0	3326	0	469	152	1	110	28	2	NDC2013
7748	A1	Urban	Warrington	1.11	46	4107	3828	279	0	0	0	3379	0	449	149	5	97	28	2	NDC2013
7749	A1	Urban	Warrington	0.13	24	4107	3828	279	0	0	0	3379	0	449	149	5	97	28	2	NDC2013
7750	A1	Urban	Warrington	1.11	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7751	A1	Urban	Warrington	1.01	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7752	A1	Urban	Warrington	0.09	24	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7753	A1	Urban	Warrington	0.06	48	1000	976	24	0	0	0	917	0	59	8	0	13	3	2	NDC2013
7754	A1	Urban	Warrington	1.58	44	7913	7659	254	0	0	0	7100	0	559	91	9	109	45	2	NDC2013
7755	A1	Urban	Warrington	0.11	24	7913	7659	254	0	0	0	7100	0	559	91	9	109	45	2	NDC2013
7756	A1	Urban	Warrington	1.63	42	7260	7027	233	0	0	0	6514	0	513	84	8	100	41	2	NDC2013
7757	A1	Urban	Warrington	1.02	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7758	A1	Urban	Warrington	0.52	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013

7759	A1	Urban	Warrington	0.52	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7760	A1	Urban	Warrington	1.03	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7761	A1	Urban	Warrington	0.91	42	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7762	A1	Urban	Warrington	0.92	42	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7763	A1	Urban	Warrington	0.57	42	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7764	A1	Urban	Warrington	0.04	24	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7765	A1	Urban	Warrington	0.51	42	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7766	A1	Urban	Warrington	0.1	24	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7767	A1	Urban	Warrington	0.61	47	5625	5518	107	0	0	0	5208	0	310	67	15	24	2	2	NDC2013
7768	A1	Urban	Warrington	0.06	24	5625	5518	107	0	0	0	5208	0	310	67	15	24	2	2	NDC2013
7769	A1	Urban	Warrington	0.62	45	7120	7004	116	0	0	0	6618	0	386	70	9	32	5	2	NDC2013
7770	A1	Urban	Warrington	0.06	24	7120	7004	116	0	0	0	6618	0	386	70	9	32	5	2	NDC2013
7771	A1	Urban	Warrington	0.14	24	500	492	8	0	0	0	465	0	27	5	1	2	0	2	NDC2013
7772	A1	Urban	Warrington	0.15	24	500	492	8	0	0	0	465	0	27	5	1	2	0	2	NDC2013
7773	A1	Urban	Warrington	0.8	37	3704	3593	111	0	0	0	3397	0	196	90	0	18	2	2	NDC2013
7774	A1	Urban	Warrington	0.73	30	3438	3330	108	0	0	0	3161	0	169	76	1	26	5	2	NDC2013
7775	A1	Urban	Warrington	0.07	24	3438	3330	108	0	0	0	3161	0	169	76	1	26	5	2	NDC2013
7776	A1	Urban	Warrington	0.82	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7777	A1	Urban	Warrington	0.04	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7778	A1	Urban	Warrington	0.24	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7779	A1	Urban	Warrington	0.23	43	2519	2473	46	0	0	0	2276	0	197	16	2	24	4	2	NDC2013
7780	A1	Urban	Warrington	0.86	43	2519	2473	46	0	0	0	2276	0	197	16	2	24	4	2	NDC2013
7781	A1	Urban	Warrington	0.32	45	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7782	A1	Urban	Warrington	0.33	24	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7783	A1	Urban	Warrington	0.27	40	16835	16304	531	0	0	0	15123	0	1181	157	32	221	121	2	NDC2013
7784	A1	Urban	Warrington	0.02	40	400	387	13	0	0	0	359	0	28	4	1	5	3	2	NDC2013
7785	A1	Urban	Warrington	0.03	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7786	A1	Urban	Warrington	0.79	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7787	A1	Urban	Warrington	0.22	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7788	A1	Urban	Warrington	0.8	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7789	A1	Urban	Warrington	0.03	24	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7790	A1	Urban	Warrington	0.05	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7791	A1	Urban	Warrington	0.97	61	18711	18236	475	0	0	0	17225	0	1011	156	10	237	73	2	NDC2013

7792	A1	Urban	Warrington	1.02	57	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7793	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7794	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7795	A1	Urban	Warrington	0.08	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7796	A1	Urban	Warrington	0.08	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7797	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7798	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7799	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7800	A1	Urban	Warrington	0.5	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7801	A1	Urban	Warrington	0.12	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7802	A1	Urban	Warrington	0.12	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7803	A1	Urban	Warrington	0.4	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7804	A1	Urban	Warrington	0.13	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7805	A1	Urban	Warrington	0.16	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7806	A1	Urban	Warrington	0.14	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7807	A1	Urban	Warrington	0.19	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7808	A1	Urban	Warrington	0.19	45	7370	7171	199	0	0	0	6649	0	522	35	6	93	65	2	NDC2013
7809	A1	Urban	Warrington	0.16	48	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7810	A1	Urban	Warrington	0.12	44	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7811	A1	Urban	Warrington	0.99	48	6000	5785	215	0	0	0	5381	0	404	95	4	83	32	2	NDC2013
7812	A1	Urban	Warrington	0.23	30	12884	11765	1119	0	0	0	11765	0	0	473	0	437	210	2	WBC2014TM
7813	A1	Urban	Warrington	0.23	35	455	0	455	0	0	0	0	0	0	455	0	0	0	2	WBC2014TM
7814	A1	Urban	Warrington	0.08	31	7499	6846	653	0	0	0	6846	0	0	375	0	188	90	2	WBC2014TM
7815	A1	Urban	Warrington	0.23	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7816	A1	Urban	Warrington	0.23	32	8606	7947	659	0	0	0	7947	0	0	281	0	255	122	2	WBC2014TM
7817	A1	Urban	Warrington	0.37	43	9101	8656	445	0	0	0	8656	0	0	0	0	301	144	2	WBC2014TM
7818	A1	Urban	Warrington	0.12	32	10508	10008	500	0	0	0	10008	0	0	0	0	338	162	2	WBC2014TM
7819	A1	Urban	Warrington	0.91	32	10301	9245	1056	0	0	0	9245	0	0	0	0	713	342	2	WBC2014TM
7820	A1	Urban	Warrington	0.13	32	16249	14644	1605	0	0	0	14644	0	0	0	0	1085	521	2	WBC2014TM
7821	A1	Urban	Warrington	0.13	32	104	104	0	0	0	0	104	0	0	0	0	0	0	2	WBC2014TM
7822	A1	Urban	Warrington	0.09	32	782	698	83	0	0	0	698	0	0	0	0	56	27	2	WBC2014TM
7823	A1	Urban	Warrington	0.07	35	1237	1119	118	0	0	0	1119	0	0	0	0	80	38	2	WBC2014TM
7824	A1	Urban	Warrington	0.05	32	382	354	28	0	0	0	354	0	0	0	0	19	9	2	WBC2014TM

7825	A1	Urban	Warrington	0.23	32	2363	2155	209	0	0	0	2155	0	0	0	0	141	68	2	WBC2014TM
7826	A1	Urban	Warrington	0.16	32	1456	1376	80	0	0	0	1376	0	0	0	0	54	26	2	WBC2014TM
7827	A1	Urban	Warrington	0.08	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7828	A1	Urban	Warrington	0.06	32	2509	2377	132	0	0	0	2377	0	0	0	0	89	43	2	WBC2014TM
7829	A1	Urban	Warrington	0.06	32	2495	2363	132	0	0	0	2363	0	0	0	0	89	43	2	WBC2014TM
7830	A1	Urban	Warrington	0.06	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7831	A1	Urban	Warrington	0.07	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7832	A1	Urban	Warrington	0.09	31	5504	5178	327	0	0	0	5178	0	0	0	0	221	106	2	WBC2014TM
7833	A1	Urban	Warrington	0.09	32	688	655	33	0	0	0	655	0	0	0	0	22	11	2	WBC2014TM
7834	A1	Urban	Warrington	0.11	32	730	685	45	0	0	0	685	0	0	0	0	31	15	2	WBC2014TM
7835	A1	Urban	Warrington	0.08	32	570	532	38	0	0	0	532	0	0	0	0	26	12	2	WBC2014TM
7836	A1	Urban	Warrington	0.12	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7837	A1	Urban	Warrington	0.06	32	229	219	10	0	0	0	219	0	0	0	0	7	3	2	WBC2014TM
7838	A1	Urban	Warrington	0.07	32	414	386	28	0	0	0	386	0	0	0	0	19	9	2	WBC2014TM
7839	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7840	A1	Urban	Warrington	0.13	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7841	A1	Urban	Warrington	0.1	35	431	417	14	0	0	0	417	0	0	0	0	9	5	2	WBC2014TM
7842	A1	Urban	Warrington	0.06	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7843	A1	Urban	Warrington	0.08	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7844	A1	Urban	Warrington	0.11	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7845	A1	Urban	Warrington	0.07	35	431	417	14	0	0	0	417	0	0	0	0	9	5	2	WBC2014TM
7846	A1	Urban	Warrington	0.06	35	570	507	63	0	0	0	507	0	0	0	0	42	20	2	WBC2014TM
7847	A1	Urban	Warrington	0.03	34	5247	4809	438	0	0	0	4809	0	0	0	0	296	142	2	WBC2014TM
7848	A1	Urban	Warrington	0.07	34	4869	4451	417	0	0	0	4451	0	0	0	0	282	135	2	WBC2014TM
7849	A1	Urban	Warrington	0.15	32	118	0	118	0	0	0	0	0	0	118	0	0	0	2	WBC2014TM
7850	A1	Urban	Warrington	0.07	35	403	348	56	0	0	0	348	0	0	0	0	38	18	2	WBC2014TM
7851	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7852	A1	Urban	Warrington	0.05	35	403	348	56	0	0	0	348	0	0	0	0	38	18	2	WBC2014TM
7853	A1	Urban	Warrington	0.05	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7854	A1	Urban	Warrington	0.08	32	1682	1592	90	0	0	0	1592	0	0	0	0	61	29	2	WBC2014TM
7855	A1	Urban	Warrington	0.03	31	1036	994	42	0	0	0	994	0	0	0	0	28	14	2	WBC2014TM
7856	A1	Urban	Warrington	0.09	27	5873	5060	813	0	0	0	5060	0	0	473	0	230	110	2	WBC2014TM
7857	A1	Urban	Warrington	0.09	35	737	0	737	0	0	0	0	0	0	737	0	0	0	2	WBC2014TM

7858	A1	Urban	Warrington	0.05	16	167	156	10	0	0	0	156	0	0	0	0	7	3	2	WBC2014TM
7859	A1	Urban	Warrington	0.06	35	480	466	14	0	0	0	466	0	0	0	0	9	5	2	WBC2014TM
7860	A1	Urban	Warrington	0.23	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7861	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7862	A1	Urban	Warrington	0.1	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7863	A1	Urban	Warrington	0.04	16	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7864	A1	Urban	Warrington	0.06	32	209	188	21	0	0	0	188	0	0	0	0	14	7	2	WBC2014TM
7865	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7866	A1	Urban	Warrington	0.07	16	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7867	A1	Urban	Warrington	0.09	15	587	549	38	0	0	0	549	0	0	0	0	26	12	2	WBC2014TM
7868	A1	Urban	Warrington	0.11	40	7666	6867	799	0	0	0	6867	0	0	0	0	540	259	2	WBC2014TM
7869	A1	Urban	Warrington	0.11	40	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7870	A1	Urban	Warrington	0.53	40	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7871	A1	Urban	Warrington	0.04	16	222	209	14	0	0	0	209	0	0	0	0	9	5	2	WBC2014TM
7872	A1	Urban	Warrington	0.1	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7873	A1	Urban	Warrington	0.07	31	480	466	14	0	0	0	466	0	0	0	0	9	5	2	WBC2014TM
7874	A1	Urban	Warrington	0.07	32	8559	7933	626	0	0	0	7933	0	0	0	0	423	203	2	WBC2014TM
7875	A1	Urban	Warrington	0.06	31	5609	5101	507	0	0	0	5101	0	0	0	0	343	165	2	WBC2014TM
7876	A1	Urban	Warrington	0.11	35	928	813	115	0	0	0	813	0	0	0	0	77	37	2	WBC2014TM
7877	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7878	A1	Urban	Warrington	0.09	32	2398	2314	83	0	0	0	2314	0	0	0	0	56	27	2	WBC2014TM
7879	A1	Urban	Warrington	0.07	32	45	45	0	0	0	0	45	0	0	0	0	0	0	2	WBC2014TM
7880	A1	Urban	Warrington	0.07	31	215	195	21	0	0	0	195	0	0	0	0	14	7	2	WBC2014TM
7881	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM

Table 84: Scenario B (all links)

TEEM_ID	Road_Class	Road_type	Location	Link_Length_KM	Speed_KMH	AADT	LDVs	HDVs	TwoWheelers	Motorcycles	Mopeds	Cars	Taxis	LGVs	Buses	Coaches	Rigid_HGVs	Artic_HGVs	Datasource	Comments
7701	A1	Urban	Warrington	0.72	48	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7702	A1	Urban	Warrington	0.11	24	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7703	A1	Urban	Warrington	0.83	45	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7704	A1	Urban	Warrington	0.17	40	30192	29150	1042	0	0	0	26959	0	2191	394	24	467	156	2	NDC2013
7705	A1	Urban	Warrington	1.09	45	9884	9617	267	0	0	0	8917	0	700	47	8	125	88	2	NDC2013
7706	A1	Urban	Warrington	1.03	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7707	A1	Urban	Warrington	0.06	24	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7708	A1	Urban	Warrington	0.24	24	16969	16383	586	0	0	0	15152	0	1231	222	14	263	88	2	NDC2013
7709	A1	Urban	Warrington	0.25	24	16578	15984	594	0	0	0	14867	0	1117	264	12	229	89	2	NDC2013
7710	A1	Urban	Warrington	1.24	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7711	A1	Urban	Warrington	0.21	24	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7712	A1	Urban	Warrington	0.12	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2	NDC2013
7713	A1	Urban	Warrington	1.34	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7714	A1	Urban	Warrington	0.03	40	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7715	A1	Urban	Warrington	0.1	34	4341	4230	111	0	0	0	3940	0	290	8	7	74	21	2	NDC2013
7716	A1	Urban	Warrington	0.09	34	4110	4009	101	0	0	0	3757	0	252	7	7	65	22	2	NDC2013
7717	A1	Urban	Warrington	0.05	40	6732	6475	257	0	0	0	5982	0	493	94	16	89	59	2	NDC2013
7718	A1	Urban	Warrington	0.09	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2	NDC2013
7719	A1	Urban	Warrington	0.42	39	14342	13794	548	0	0	0	12744	0	1050	199	33	190	125	2	NDC2013
7720	A1	Urban	Warrington	0.31	41	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7721	A1	Urban	Warrington	0.11	24	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7722	A1	Urban	Warrington	0.91	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7723	A1	Urban	Warrington	0.13	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7724	A1	Urban	Warrington	0.9	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013

7725	A1	Urban	Warrington	0.12	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7726	A1	Urban	Warrington	0.36	45	9884	9617	267	0	0	0	8917	0	700	47	8	125	88	2	NDC2013
7727	A1	Urban	Warrington	0.36	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7728	A1	Urban	Warrington	0.16	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2	NDC2013
7729	A1	Urban	Warrington	0.25	39	14342	13794	548	0	0	0	12744	0	1050	199	33	190	125	2	NDC2013
7730	A1	Urban	Warrington	0.25	41	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7731	A1	Urban	Warrington	0.26	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2	NDC2013
7732	A1	Urban	Warrington	0.71	48	7325	7040	284	0	0	0	6534	0	506	93	6	130	56	2	NDC2013
7733	A1	Urban	Warrington	0.41	42	7452	7174	278	0	0	0	6651	0	523	86	8	106	79	2	NDC2013
7734	A1	Urban	Warrington	0.31	24	7452	7174	278	0	0	0	6651	0	523	86	8	106	79	2	NDC2013
7735	A1	Urban	Warrington	0.56	40	2442	2347	95	0	0	0	2178	0	169	31	2	43	19	2	NDC2013
7736	A1	Urban	Warrington	0.59	42	2484	2391	93	0	0	0	2217	0	174	29	3	35	26	2	NDC2013
7737	A1	Urban	Warrington	1.26	53	5589	5496	93	0	0	0	5062	0	434	6	2	65	20	2	NDC2013
7738	A1	Urban	Warrington	1.14	53	4908	4819	89	0	0	0	4413	0	406	7	3	61	17	2	NDC2013
7739	A1	Urban	Warrington	0.12	24	4908	4819	89	0	0	0	4413	0	406	7	3	61	17	2	NDC2013
7740	A1	Urban	Warrington	0.57	61	18711	18236	475	0	0	0	17225	0	1011	156	10	237	73	2	NDC2013
7741	A1	Urban	Warrington	0.37	57	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7742	A1	Urban	Warrington	0.15	24	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7743	A1	Urban	Warrington	0.38	40	33647	32792	855	0	0	0	30974	0	1817	281	17	425	131	2	NDC2013
7744	A1	Urban	Warrington	0.46	24	14112	13573	539	0	0	0	12540	0	1033	196	33	187	123	2	NDC2013
7745	A1	Urban	Warrington	0.08	24	14112	13573	539	0	0	0	12540	0	1033	196	33	187	123	2	NDC2013
7746	A1	Urban	Warrington	0.54	44	10771	10360	411	0	0	0	9571	0	789	150	25	142	94	2	NDC2013
7747	A1	Urban	Warrington	1.25	47	4087	3796	291	0	0	0	3326	0	469	152	1	110	28	2	NDC2013
7748	A1	Urban	Warrington	1.11	46	4107	3828	279	0	0	0	3379	0	449	149	5	97	28	2	NDC2013
7749	A1	Urban	Warrington	0.13	24	4107	3828	279	0	0	0	3379	0	449	149	5	97	28	2	NDC2013
7750	A1	Urban	Warrington	1.11	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7751	A1	Urban	Warrington	1.01	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7752	A1	Urban	Warrington	0.09	24	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7753	A1	Urban	Warrington	0.06	48	1000	976	24	0	0	0	917	0	59	8	0	13	3	2	NDC2013
7754	A1	Urban	Warrington	1.58	44	7913	7659	254	0	0	0	7100	0	559	91	9	109	45	2	NDC2013
7755	A1	Urban	Warrington	0.11	24	7913	7659	254	0	0	0	7100	0	559	91	9	109	45	2	NDC2013
7756	A1	Urban	Warrington	1.63	42	7260	7027	233	0	0	0	6514	0	513	84	8	100	41	2	NDC2013
7757	A1	Urban	Warrington	1.02	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013

7758	A1	Urban	Warrington	0.52	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7759	A1	Urban	Warrington	0.52	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7760	A1	Urban	Warrington	1.03	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7761	A1	Urban	Warrington	0.91	42	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7762	A1	Urban	Warrington	0.92	42	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7763	A1	Urban	Warrington	0.57	42	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7764	A1	Urban	Warrington	0.04	24	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7765	A1	Urban	Warrington	0.51	42	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7766	A1	Urban	Warrington	0.1	24	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7767	A1	Urban	Warrington	0.61	47	5625	5518	107	0	0	0	5208	0	310	67	15	24	2	2	NDC2013
7768	A1	Urban	Warrington	0.06	24	5625	5518	107	0	0	0	5208	0	310	67	15	24	2	2	NDC2013
7769	A1	Urban	Warrington	0.62	45	7120	7004	116	0	0	0	6618	0	386	70	9	32	5	2	NDC2013
7770	A1	Urban	Warrington	0.06	24	7120	7004	116	0	0	0	6618	0	386	70	9	32	5	2	NDC2013
7771	A1	Urban	Warrington	0.14	24	500	492	8	0	0	0	465	0	27	5	1	2	0	2	NDC2013
7772	A1	Urban	Warrington	0.15	24	500	492	8	0	0	0	465	0	27	5	1	2	0	2	NDC2013
7773	A1	Urban	Warrington	0.8	37	3704	3593	111	0	0	0	3397	0	196	90	0	18	2	2	NDC2013
7774	A1	Urban	Warrington	0.73	30	3438	3330	108	0	0	0	3161	0	169	76	1	26	5	2	NDC2013
7775	A1	Urban	Warrington	0.07	24	3438	3330	108	0	0	0	3161	0	169	76	1	26	5	2	NDC2013
7776	A1	Urban	Warrington	0.82	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7777	A1	Urban	Warrington	0.04	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7778	A1	Urban	Warrington	0.24	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7779	A1	Urban	Warrington	0.23	43	2519	2473	46	0	0	0	2276	0	197	16	2	24	4	2	NDC2013
7780	A1	Urban	Warrington	0.86	43	2519	2473	46	0	0	0	2276	0	197	16	2	24	4	2	NDC2013
7781	A1	Urban	Warrington	0.32	45	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7782	A1	Urban	Warrington	0.33	24	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7783	A1	Urban	Warrington	0.27	40	16835	16304	531	0	0	0	15123	0	1181	157	32	221	121	2	NDC2013
7784	A1	Urban	Warrington	0.02	40	400	387	13	0	0	0	359	0	28	4	1	5	3	2	NDC2013
7785	A1	Urban	Warrington	0.03	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7786	A1	Urban	Warrington	0.79	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7787	A1	Urban	Warrington	0.22	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7788	A1	Urban	Warrington	0.8	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7789	A1	Urban	Warrington	0.03	24	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7790	A1	Urban	Warrington	0.05	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013

7791	A1	Urban	Warrington	0.97	61	18711	18236	475	0	0	0	17225	0	1011	156	10	237	73	2	NDC2013
7792	A1	Urban	Warrington	1.02	57	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7793	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7794	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7795	A1	Urban	Warrington	0.08	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7796	A1	Urban	Warrington	0.08	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7797	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7798	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7799	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7800	A1	Urban	Warrington	0.5	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7801	A1	Urban	Warrington	0.12	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7802	A1	Urban	Warrington	0.12	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7803	A1	Urban	Warrington	0.4	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7804	A1	Urban	Warrington	0.13	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7805	A1	Urban	Warrington	0.16	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7806	A1	Urban	Warrington	0.14	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7807	A1	Urban	Warrington	0.19	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7808	A1	Urban	Warrington	0.19	45	7370	7171	199	0	0	0	6649	0	522	35	6	93	65	2	NDC2013
7809	A1	Urban	Warrington	0.16	48	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7810	A1	Urban	Warrington	0.12	44	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7811	A1	Urban	Warrington	0.99	48	6000	5785	215	0	0	0	5381	0	404	95	4	83	32	2	NDC2013
7812	A1	Urban	Warrington	0.23	30	12931	11789	1142	0	0	0	11789	0	0	473	0	452	217	2	WBC2014TM
7813	A1	Urban	Warrington	0.23	35	455	0	455	0	0	0	0	0	0	455	0	0	0	2	WBC2014TM
7814	A1	Urban	Warrington	0.08	31	7277	6630	646	0	0	0	6630	0	0	375	0	183	88	2	WBC2014TM
7815	A1	Urban	Warrington	0.23	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7816	A1	Urban	Warrington	0.23	32	9247	8566	681	0	0	0	8566	0	0	281	0	270	130	2	WBC2014TM
7817	A1	Urban	Warrington	0.37	43	9226	8750	476	0	0	0	8750	0	0	0	0	322	154	2	WBC2014TM
7818	A1	Urban	Warrington	0.12	32	9383	8917	466	0	0	0	8917	0	0	0	0	315	151	2	WBC2014TM
7819	A1	Urban	Warrington	0.91	32	8989	8075	914	0	0	0	8075	0	0	0	0	618	297	2	WBC2014TM
7820	A1	Urban	Warrington	0.13	32	12746	11412	1334	0	0	0	11412	0	0	0	0	902	433	2	WBC2014TM
7821	A1	Urban	Warrington	0.13	32	111	111	0	0	0	0	111	0	0	0	0	0	0	2	WBC2014TM
7822	A1	Urban	Warrington	0.09	32	577	514	63	0	0	0	514	0	0	0	0	42	20	2	WBC2014TM

7823	A1	Urban	Warrington	0.07	35	1654	1550	104	0	0	0	1550	0	0	0	0	70	34	2	WBC2014TM
7824	A1	Urban	Warrington	0.05	32	389	361	28	0	0	0	361	0	0	0	0	19	9	2	WBC2014TM
7825	A1	Urban	Warrington	0.23	32	5356	4972	385	0	0	0	4972	0	0	0	0	260	125	2	WBC2014TM
7826	A1	Urban	Warrington	0.16	32	1397	1317	80	0	0	0	1317	0	0	0	0	54	26	2	WBC2014TM
7827	A1	Urban	Warrington	0.08	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7828	A1	Urban	Warrington	0.06	32	1998	1887	111	0	0	0	1887	0	0	0	0	75	36	2	WBC2014TM
7829	A1	Urban	Warrington	0.06	32	1988	1877	111	0	0	0	1877	0	0	0	0	75	36	2	WBC2014TM
7830	A1	Urban	Warrington	0.06	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7831	A1	Urban	Warrington	0.07	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7832	A1	Urban	Warrington	0.09	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7833	A1	Urban	Warrington	0.09	32	664	619	45	0	0	0	619	0	0	0	0	31	15	2	WBC2014TM
7834	A1	Urban	Warrington	0.11	32	730	685	45	0	0	0	685	0	0	0	0	31	15	2	WBC2014TM
7835	A1	Urban	Warrington	0.08	32	775	740	35	0	0	0	740	0	0	0	0	23	11	2	WBC2014TM
7836	A1	Urban	Warrington	0.12	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7837	A1	Urban	Warrington	0.06	32	188	181	7	0	0	0	181	0	0	0	0	5	2	2	WBC2014TM
7838	A1	Urban	Warrington	0.07	32	431	403	28	0	0	0	403	0	0	0	0	19	9	2	WBC2014TM
7839	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7840	A1	Urban	Warrington	0.13	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7841	A1	Urban	Warrington	0.1	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7842	A1	Urban	Warrington	0.06	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7843	A1	Urban	Warrington	0.08	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7844	A1	Urban	Warrington	0.11	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7845	A1	Urban	Warrington	0.07	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7846	A1	Urban	Warrington	0.06	35	438	382	56	0	0	0	382	0	0	0	0	38	18	2	WBC2014TM
7847	A1	Urban	Warrington	0.03	34	2884	2599	285	0	0	0	2599	0	0	0	0	193	92	2	WBC2014TM
7848	A1	Urban	Warrington	0.07	34	2686	2408	278	0	0	0	2408	0	0	0	0	188	90	2	WBC2014TM
7849	A1	Urban	Warrington	0.15	32	118	0	118	0	0	0	0	0	0	118	0	0	0	2	WBC2014TM
7850	A1	Urban	Warrington	0.07	35	445	389	56	0	0	0	389	0	0	0	0	38	18	2	WBC2014TM
7851	A1	Urban	Warrington	0.07	32	118	111	7	0	0	0	111	0	0	0	0	5	2	2	WBC2014TM
7852	A1	Urban	Warrington	0.05	35	445	389	56	0	0	0	389	0	0	0	0	38	18	2	WBC2014TM

7853	A1	Urban	Warrington	0.05	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7854	A1	Urban	Warrington	0.08	32	1599	1508	90	0	0	0	1508	0	0	0	0	61	29	2	WBC2014TM
7855	A1	Urban	Warrington	0.03	31	709	674	35	0	0	0	674	0	0	0	0	23	11	2	WBC2014TM
7856	A1	Urban	Warrington	0.09	27	6179	5331	848	0	0	0	5331	0	0	473	0	254	122	2	WBC2014TM
7857	A1	Urban	Warrington	0.09	35	737	0	737	0	0	0	0	0	0	737	0	0	0	2	WBC2014TM
7858	A1	Urban	Warrington	0.05	16	167	156	10	0	0	0	156	0	0	0	0	7	3	2	WBC2014TM
7859	A1	Urban	Warrington	0.06	35	160	153	7	0	0	0	153	0	0	0	0	5	2	2	WBC2014TM
7860	A1	Urban	Warrington	0.23	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7861	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7862	A1	Urban	Warrington	0.1	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7863	A1	Urban	Warrington	0.04	16	76	76	0	0	0	0	76	0	0	0	0	0	0	2	WBC2014TM
7864	A1	Urban	Warrington	0.06	32	215	195	21	0	0	0	195	0	0	0	0	14	7	2	WBC2014TM
7865	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7866	A1	Urban	Warrington	0.07	16	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7867	A1	Urban	Warrington	0.09	15	726	678	49	0	0	0	678	0	0	0	0	33	16	2	WBC2014TM
7868	A1	Urban	Warrington	0.11	40	5358	4643	716	0	0	0	4643	0	0	0	0	484	232	2	WBC2014TM
7869	A1	Urban	Warrington	0.11	40	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7870	A1	Urban	Warrington	0.53	40	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7871	A1	Urban	Warrington	0.04	16	222	209	14	0	0	0	209	0	0	0	0	9	5	2	WBC2014TM
7872	A1	Urban	Warrington	0.1	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7873	A1	Urban	Warrington	0.07	31	160	153	7	0	0	0	153	0	0	0	0	5	2	2	WBC2014TM
7874	A1	Urban	Warrington	0.07	32	5835	5397	438	0	0	0	5397	0	0	0	0	296	142	2	WBC2014TM
7875	A1	Urban	Warrington	0.06	31	3628	3287	341	0	0	0	3287	0	0	0	0	230	110	2	WBC2014TM
7876	A1	Urban	Warrington	0.11	35	1338	1230	108	0	0	0	1230	0	0	0	0	73	35	2	WBC2014TM
7877	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7878	A1	Urban	Warrington	0.09	32	1661	1602	59	0	0	0	1602	0	0	0	0	40	19	2	WBC2014TM
7879	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7880	A1	Urban	Warrington	0.07	31	90	76	14	0	0	0	76	0	0	0	0	9	5	2	WBC2014TM
7881	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM

Table 85: Scenario C (all links)

TEEM_ID	Road_Class	Road_type	Location	Link_Length_KM	Speed_KMH	AADT	LDVs	HDVs	TwoWheelers	Motorcycles	Mopeds	Cars	Taxis	LGVs	Buses	Coaches	Rigid_HGVs	Artic_HGVs	Datasource	Comments
7701	A1	Urban	Warrington	0.72	48	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7702	A1	Urban	Warrington	0.11	24	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7703	A1	Urban	Warrington	0.83	45	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7704	A1	Urban	Warrington	0.17	40	30192	29150	1042	0	0	0	26959	0	2191	394	24	467	156	2	NDC2013
7705	A1	Urban	Warrington	1.09	45	9884	9617	267	0	0	0	8917	0	700	47	8	125	88	2	NDC2013
7706	A1	Urban	Warrington	1.03	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7707	A1	Urban	Warrington	0.06	24	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7708	A1	Urban	Warrington	0.24	24	16969	16383	586	0	0	0	15152	0	1231	222	14	263	88	2	NDC2013
7709	A1	Urban	Warrington	0.25	24	16578	15984	594	0	0	0	14867	0	1117	264	12	229	89	2	NDC2013
7710	A1	Urban	Warrington	1.24	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7711	A1	Urban	Warrington	0.21	24	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7712	A1	Urban	Warrington	0.12	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2	NDC2013
7713	A1	Urban	Warrington	1.34	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7714	A1	Urban	Warrington	0.03	40	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7715	A1	Urban	Warrington	0.1	34	4341	4230	111	0	0	0	3940	0	290	8	7	74	21	2	NDC2013
7716	A1	Urban	Warrington	0.09	34	4110	4009	101	0	0	0	3757	0	252	7	7	65	22	2	NDC2013
7717	A1	Urban	Warrington	0.05	40	6732	6475	257	0	0	0	5982	0	493	94	16	89	59	2	NDC2013
7718	A1	Urban	Warrington	0.09	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2	NDC2013
7719	A1	Urban	Warrington	0.42	39	14342	13794	548	0	0	0	12744	0	1050	199	33	190	125	2	NDC2013
7720	A1	Urban	Warrington	0.31	41	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7721	A1	Urban	Warrington	0.11	24	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7722	A1	Urban	Warrington	0.91	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7723	A1	Urban	Warrington	0.13	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7724	A1	Urban	Warrington	0.9	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7725	A1	Urban	Warrington	0.12	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013

7726	A1	Urban	Warrington	0.36	45	9884	9617	267	0	0	0	8917	0	700	47	8	125	88	2	NDC2013
7727	A1	Urban	Warrington	0.36	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7728	A1	Urban	Warrington	0.16	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2	NDC2013
7729	A1	Urban	Warrington	0.25	39	14342	13794	548	0	0	0	12744	0	1050	199	33	190	125	2	NDC2013
7730	A1	Urban	Warrington	0.25	41	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7731	A1	Urban	Warrington	0.26	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2	NDC2013
7732	A1	Urban	Warrington	0.71	48	7325	7040	284	0	0	0	6534	0	506	93	6	130	56	2	NDC2013
7733	A1	Urban	Warrington	0.41	42	7452	7174	278	0	0	0	6651	0	523	86	8	106	79	2	NDC2013
7734	A1	Urban	Warrington	0.31	24	7452	7174	278	0	0	0	6651	0	523	86	8	106	79	2	NDC2013
7735	A1	Urban	Warrington	0.56	40	2442	2347	95	0	0	0	2178	0	169	31	2	43	19	2	NDC2013
7736	A1	Urban	Warrington	0.59	42	2484	2391	93	0	0	0	2217	0	174	29	3	35	26	2	NDC2013
7737	A1	Urban	Warrington	1.26	53	5589	5496	93	0	0	0	5062	0	434	6	2	65	20	2	NDC2013
7738	A1	Urban	Warrington	1.14	53	4908	4819	89	0	0	0	4413	0	406	7	3	61	17	2	NDC2013
7739	A1	Urban	Warrington	0.12	24	4908	4819	89	0	0	0	4413	0	406	7	3	61	17	2	NDC2013
7740	A1	Urban	Warrington	0.57	61	18711	18236	475	0	0	0	17225	0	1011	156	10	237	73	2	NDC2013
7741	A1	Urban	Warrington	0.37	57	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7742	A1	Urban	Warrington	0.15	24	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7743	A1	Urban	Warrington	0.38	40	33647	32792	855	0	0	0	30974	0	1817	281	17	425	131	2	NDC2013
7744	A1	Urban	Warrington	0.46	24	14112	13573	539	0	0	0	12540	0	1033	196	33	187	123	2	NDC2013
7745	A1	Urban	Warrington	0.08	24	14112	13573	539	0	0	0	12540	0	1033	196	33	187	123	2	NDC2013
7746	A1	Urban	Warrington	0.54	44	10771	10360	411	0	0	0	9571	0	789	150	25	142	94	2	NDC2013
7747	A1	Urban	Warrington	1.25	47	4087	3796	291	0	0	0	3326	0	469	152	1	110	28	2	NDC2013
7748	A1	Urban	Warrington	1.11	46	4107	3828	279	0	0	0	3379	0	449	149	5	97	28	2	NDC2013
7749	A1	Urban	Warrington	0.13	24	4107	3828	279	0	0	0	3379	0	449	149	5	97	28	2	NDC2013
7750	A1	Urban	Warrington	1.11	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7751	A1	Urban	Warrington	1.01	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7752	A1	Urban	Warrington	0.09	24	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7753	A1	Urban	Warrington	0.06	48	1000	976	24	0	0	0	917	0	59	8	0	13	3	2	NDC2013
7754	A1	Urban	Warrington	1.58	44	7913	7659	254	0	0	0	7100	0	559	91	9	109	45	2	NDC2013
7755	A1	Urban	Warrington	0.11	24	7913	7659	254	0	0	0	7100	0	559	91	9	109	45	2	NDC2013
7756	A1	Urban	Warrington	1.63	42	7260	7027	233	0	0	0	6514	0	513	84	8	100	41	2	NDC2013
7757	A1	Urban	Warrington	1.02	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7758	A1	Urban	Warrington	0.52	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013

7759	A1	Urban	Warrington	0.52	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7760	A1	Urban	Warrington	1.03	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7761	A1	Urban	Warrington	0.91	42	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7762	A1	Urban	Warrington	0.92	42	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7763	A1	Urban	Warrington	0.57	42	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7764	A1	Urban	Warrington	0.04	24	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7765	A1	Urban	Warrington	0.51	42	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7766	A1	Urban	Warrington	0.1	24	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7767	A1	Urban	Warrington	0.61	47	5625	5518	107	0	0	0	5208	0	310	67	15	24	2	2	NDC2013
7768	A1	Urban	Warrington	0.06	24	5625	5518	107	0	0	0	5208	0	310	67	15	24	2	2	NDC2013
7769	A1	Urban	Warrington	0.62	45	7120	7004	116	0	0	0	6618	0	386	70	9	32	5	2	NDC2013
7770	A1	Urban	Warrington	0.06	24	7120	7004	116	0	0	0	6618	0	386	70	9	32	5	2	NDC2013
7771	A1	Urban	Warrington	0.14	24	500	492	8	0	0	0	465	0	27	5	1	2	0	2	NDC2013
7772	A1	Urban	Warrington	0.15	24	500	492	8	0	0	0	465	0	27	5	1	2	0	2	NDC2013
7773	A1	Urban	Warrington	0.8	37	3704	3593	111	0	0	0	3397	0	196	90	0	18	2	2	NDC2013
7774	A1	Urban	Warrington	0.73	30	3438	3330	108	0	0	0	3161	0	169	76	1	26	5	2	NDC2013
7775	A1	Urban	Warrington	0.07	24	3438	3330	108	0	0	0	3161	0	169	76	1	26	5	2	NDC2013
7776	A1	Urban	Warrington	0.82	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7777	A1	Urban	Warrington	0.04	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7778	A1	Urban	Warrington	0.24	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7779	A1	Urban	Warrington	0.23	43	2519	2473	46	0	0	0	2276	0	197	16	2	24	4	2	NDC2013
7780	A1	Urban	Warrington	0.86	43	2519	2473	46	0	0	0	2276	0	197	16	2	24	4	2	NDC2013
7781	A1	Urban	Warrington	0.32	45	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7782	A1	Urban	Warrington	0.33	24	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7783	A1	Urban	Warrington	0.27	40	16835	16304	531	0	0	0	15123	0	1181	157	32	221	121	2	NDC2013
7784	A1	Urban	Warrington	0.02	40	400	387	13	0	0	0	359	0	28	4	1	5	3	2	NDC2013
7785	A1	Urban	Warrington	0.03	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7786	A1	Urban	Warrington	0.79	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7787	A1	Urban	Warrington	0.22	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7788	A1	Urban	Warrington	0.8	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7789	A1	Urban	Warrington	0.03	24	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7790	A1	Urban	Warrington	0.05	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7791	A1	Urban	Warrington	0.97	61	18711	18236	475	0	0	0	17225	0	1011	156	10	237	73	2	NDC2013

7792	A1	Urban	Warrington	1.02	57	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7793	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7794	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7795	A1	Urban	Warrington	0.08	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7796	A1	Urban	Warrington	0.08	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7797	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7798	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7799	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7800	A1	Urban	Warrington	0.5	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7801	A1	Urban	Warrington	0.12	44	10232	9842	391	0	0	0	9093	0	749	142	24	135	89	2	NDC2013
7802	A1	Urban	Warrington	0.12	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7803	A1	Urban	Warrington	0.4	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7804	A1	Urban	Warrington	0.13	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7805	A1	Urban	Warrington	0.16	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7806	A1	Urban	Warrington	0.14	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7807	A1	Urban	Warrington	0.19	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7808	A1	Urban	Warrington	0.19	45	7370	7171	199	0	0	0	6649	0	522	35	6	93	65	2	NDC2013
7809	A1	Urban	Warrington	0.16	48	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7810	A1	Urban	Warrington	0.12	44	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7811	A1	Urban	Warrington	0.99	48	6000	5785	215	0	0	0	5381	0	404	95	4	83	32	2	NDC2013
7812	A1	Urban	Warrington	0.23	30	12357	11245	1112	0	0	0	11245	0	0	473	0	432	207	2	WBC2014TM
7813	A1	Urban	Warrington	0.23	35	455	0	455	0	0	0	0	0	0	455	0	0	0	2	WBC2014TM
7814	A1	Urban	Warrington	0.08	31	9591	8861	730	0	0	0	8861	0	0	375	0	239	115	2	WBC2014TM
7815	A1	Urban	Warrington	0.23	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7816	A1	Urban	Warrington	0.23	32	9808	9146	662	0	0	0	9146	0	0	281	0	257	123	2	WBC2014TM
7817	A1	Urban	Warrington	0.37	43	8604	8225	379	0	0	0	8225	0	0	0	0	256	123	2	WBC2014TM
7818	A1	Urban	Warrington	0.12	32	8013	7666	348	0	0	0	7666	0	0	0	0	235	113	2	WBC2014TM
7819	A1	Urban	Warrington	0.91	32	13346	12045	1301	0	0	0	12045	0	0	0	0	879	422	2	WBC2014TM
7820	A1	Urban	Warrington	0.13	32	17577	15846	1731	0	0	0	15846	0	0	0	0	1169	561	2	WBC2014TM
7821	A1	Urban	Warrington	0.13	32	181	181	0	0	0	0	181	0	0	0	0	0	0	2	WBC2014TM
7822	A1	Urban	Warrington	0.09	32	2405	2189	215	0	0	0	2189	0	0	0	0	146	70	2	WBC2014TM
7823	A1	Urban	Warrington	0.07	35	1293	1209	83	0	0	0	1209	0	0	0	0	56	27	2	WBC2014TM

7824	A1	Urban	Warrington	0.05	32	1056	1001	56	0	0	0	1001	0	0	0	0	38	18	2	WBC2014TM
7825	A1	Urban	Warrington	0.23	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7826	A1	Urban	Warrington	0.16	32	799	733	66	0	0	0	733	0	0	0	0	45	21	2	WBC2014TM
7827	A1	Urban	Warrington	0.08	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7828	A1	Urban	Warrington	0.06	32	445	431	14	0	0	0	431	0	0	0	0	9	5	2	WBC2014TM
7829	A1	Urban	Warrington	0.06	32	431	417	14	0	0	0	417	0	0	0	0	9	5	2	WBC2014TM
7830	A1	Urban	Warrington	0.06	31	723	653	70	0	0	0	653	0	0	0	0	47	23	2	WBC2014TM
7831	A1	Urban	Warrington	0.07	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7832	A1	Urban	Warrington	0.09	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7833	A1	Urban	Warrington	0.09	32	1114	1041	73	0	0	0	1041	0	0	0	0	49	24	2	WBC2014TM
7834	A1	Urban	Warrington	0.11	32	737	692	45	0	0	0	692	0	0	0	0	31	15	2	WBC2014TM
7835	A1	Urban	Warrington	0.08	32	275	264	10	0	0	0	264	0	0	0	0	7	3	2	WBC2014TM
7836	A1	Urban	Warrington	0.12	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7837	A1	Urban	Warrington	0.06	32	170	163	7	0	0	0	163	0	0	0	0	5	2	2	WBC2014TM
7838	A1	Urban	Warrington	0.07	32	434	407	28	0	0	0	407	0	0	0	0	19	9	2	WBC2014TM
7839	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7840	A1	Urban	Warrington	0.13	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7841	A1	Urban	Warrington	0.1	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7842	A1	Urban	Warrington	0.06	32	375	0	375	0	0	0	0	0	0	375	0	0	0	2	WBC2014TM
7843	A1	Urban	Warrington	0.08	32	375	0	375	0	0	0	0	0	0	375	0	0	0	2	WBC2014TM
7844	A1	Urban	Warrington	0.11	35	146	142	3	0	0	0	142	0	0	0	0	2	1	2	WBC2014TM
7845	A1	Urban	Warrington	0.07	35	3009	2815	195	0	0	0	2815	0	0	0	0	131	63	2	WBC2014TM
7846	A1	Urban	Warrington	0.06	35	3555	3336	219	0	0	0	3336	0	0	0	0	148	71	2	WBC2014TM
7847	A1	Urban	Warrington	0.03	34	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7848	A1	Urban	Warrington	0.07	34	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7849	A1	Urban	Warrington	0.15	32	118	0	118	0	0	0	0	0	0	118	0	0	0	2	WBC2014TM
7850	A1	Urban	Warrington	0.07	35	3635	3412	222	0	0	0	3412	0	0	0	0	150	72	2	WBC2014TM
7851	A1	Urban	Warrington	0.07	32	139	125	14	0	0	0	125	0	0	0	0	9	5	2	WBC2014TM
7852	A1	Urban	Warrington	0.05	35	3635	3412	222	0	0	0	3412	0	0	0	0	150	72	2	WBC2014TM
7853	A1	Urban	Warrington	0.05	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM

7854	A1	Urban	Warrington	0.08	32	1188	1098	90	0	0	0	1098	0	0	0	0	61	29	2	WBC2014TM
7855	A1	Urban	Warrington	0.03	31	570	542	28	0	0	0	542	0	0	0	0	19	9	2	WBC2014TM
7856	A1	Urban	Warrington	0.09	27	4288	3538	751	0	0	0	3538	0	0	473	0	188	90	2	WBC2014TM
7857	A1	Urban	Warrington	0.09	35	737	0	737	0	0	0	0	0	0	737	0	0	0	2	WBC2014TM
7858	A1	Urban	Warrington	0.05	16	170	160	10	0	0	0	160	0	0	0	0	7	3	2	WBC2014TM
7859	A1	Urban	Warrington	0.06	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7860	A1	Urban	Warrington	0.23	32	2236	1747	489	0	0	0	1747	0	0	375	0	77	37	2	WBC2014TM
7861	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7862	A1	Urban	Warrington	0.1	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7863	A1	Urban	Warrington	0.04	16	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7864	A1	Urban	Warrington	0.06	32	243	215	28	0	0	0	215	0	0	0	0	19	9	2	WBC2014TM
7865	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7866	A1	Urban	Warrington	0.07	16	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7867	A1	Urban	Warrington	0.09	15	570	539	31	0	0	0	539	0	0	0	0	21	10	2	WBC2014TM
7868	A1	Urban	Warrington	0.11	40	7687	6811	876	0	0	0	6811	0	0	0	0	592	284	2	WBC2014TM
7869	A1	Urban	Warrington	0.11	40	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7870	A1	Urban	Warrington	0.53	40	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7871	A1	Urban	Warrington	0.04	16	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7872	A1	Urban	Warrington	0.1	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7873	A1	Urban	Warrington	0.07	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7874	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7875	A1	Urban	Warrington	0.06	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7876	A1	Urban	Warrington	0.11	35	2234	2109	125	0	0	0	2109	0	0	0	0	85	41	2	WBC2014TM
7877	A1	Urban	Warrington	0.03	32	2231	1758	473	0	0	0	1758	0	0	375	0	66	32	2	WBC2014TM
7878	A1	Urban	Warrington	0.09	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7879	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7880	A1	Urban	Warrington	0.07	31	2276	2148	129	0	0	0	2148	0	0	0	0	87	42	2	WBC2014TM
7881	A1	Urban	Warrington	0.07	32	2346	1873	473	0	0	0	1873	0	0	375	0	66	32	2	WBC2014TM

Table 86: Scenario D (all links)

TEEM_ID	Road_Class	Road_type	Location	Link_Length_KM	Speed_KMH	AADT	LDVs	HDVs	TwoWheelers	Motorcycles	Mopeds	Cars	Taxis	LGVs	Buses	Coaches	Rigid_HGVs	Artic_HGVs	Datasource	Comments
7701	A1	Urban	Warrington	0.72	48	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7702	A1	Urban	Warrington	0.11	24	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7703	A1	Urban	Warrington	0.83	45	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7704	A1	Urban	Warrington	0.17	40	30192	29150	1042	0	0	0	26959	0	2191	394	24	467	156	2	NDC2013
7705	A1	Urban	Warrington	1.09	45	9884	9617	267	0	0	0	8917	0	700	47	8	125	88	2	NDC2013
7706	A1	Urban	Warrington	1.03	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7707	A1	Urban	Warrington	0.06	24	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7708	A1	Urban	Warrington	0.24	24	16969	16383	586	0	0	0	15152	0	1231	222	14	263	88	2	NDC2013
7709	A1	Urban	Warrington	0.25	24	16578	15984	594	0	0	0	14867	0	1117	264	12	229	89	2	NDC2013
7710	A1	Urban	Warrington	1.24	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7711	A1	Urban	Warrington	0.21	24	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7712	A1	Urban	Warrington	0.12	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2	NDC2013
7713	A1	Urban	Warrington	1.34	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7714	A1	Urban	Warrington	0.03	40	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7715	A1	Urban	Warrington	0.1	34	4341	4230	111	0	0	0	3940	0	290	8	7	74	21	2	NDC2013
7716	A1	Urban	Warrington	0.09	34	4110	4009	101	0	0	0	3757	0	252	7	7	65	22	2	NDC2013
7717	A1	Urban	Warrington	0.05	40	6732	6475	257	0	0	0	5982	0	493	94	16	89	59	2	NDC2013
7718	A1	Urban	Warrington	0.09	40	13464	12950	514	0	0	0	11964	0	986	187	31	178	118	2	NDC2013
7719	A1	Urban	Warrington	0.42	39	14342	13794	548	0	0	0	12744	0	1050	199	33	190	125	2	NDC2013
7720	A1	Urban	Warrington	0.31	41	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7721	A1	Urban	Warrington	0.11	24	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7722	A1	Urban	Warrington	0.91	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7723	A1	Urban	Warrington	0.13	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7724	A1	Urban	Warrington	0.9	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7725	A1	Urban	Warrington	0.12	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013

7726	A1	Urban	Warrington	0.36	45	9884	9617	267	0	0	0	8917	0	700	47	8	125	88	2	NDC2013
7727	A1	Urban	Warrington	0.36	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7728	A1	Urban	Warrington	0.16	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2	NDC2013
7729	A1	Urban	Warrington	0.25	39	14342	13794	548	0	0	0	12744	0	1050	199	33	190	125	2	NDC2013
7730	A1	Urban	Warrington	0.25	41	14283	13738	545	0	0	0	12692	0	1046	198	33	189	125	2	NDC2013
7731	A1	Urban	Warrington	0.26	40	25763	24779	984	0	0	0	22893	0	1886	358	60	341	225	2	NDC2013
7732	A1	Urban	Warrington	0.71	48	7325	7040	284	0	0	0	6534	0	506	93	6	130	56	2	NDC2013
7733	A1	Urban	Warrington	0.41	42	7452	7174	278	0	0	0	6651	0	523	86	8	106	79	2	NDC2013
7734	A1	Urban	Warrington	0.31	24	7452	7174	278	0	0	0	6651	0	523	86	8	106	79	2	NDC2013
7735	A1	Urban	Warrington	0.56	40	2442	2347	95	0	0	0	2178	0	169	31	2	43	19	2	NDC2013
7736	A1	Urban	Warrington	0.59	42	2484	2391	93	0	0	0	2217	0	174	29	3	35	26	2	NDC2013
7737	A1	Urban	Warrington	1.26	53	5589	5496	93	0	0	0	5062	0	434	6	2	65	20	2	NDC2013
7738	A1	Urban	Warrington	1.14	53	4908	4819	89	0	0	0	4413	0	406	7	3	61	17	2	NDC2013
7739	A1	Urban	Warrington	0.12	24	4908	4819	89	0	0	0	4413	0	406	7	3	61	17	2	NDC2013
7740	A1	Urban	Warrington	0.57	61	18711	18236	475	0	0	0	17225	0	1011	156	10	237	73	2	NDC2013
7741	A1	Urban	Warrington	0.37	57	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7742	A1	Urban	Warrington	0.15	24	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7743	A1	Urban	Warrington	0.38	40	33647	32792	855	0	0	0	30974	0	1817	281	17	425	131	2	NDC2013
7744	A1	Urban	Warrington	0.46	24	14112	13573	539	0	0	0	12540	0	1033	196	33	187	123	2	NDC2013
7745	A1	Urban	Warrington	0.08	24	14112	13573	539	0	0	0	12540	0	1033	196	33	187	123	2	NDC2013
7746	A1	Urban	Warrington	0.54	44	10771	10360	411	0	0	0	9571	0	789	150	25	142	94	2	NDC2013
7747	A1	Urban	Warrington	1.25	47	4087	3796	291	0	0	0	3326	0	469	152	1	110	28	2	NDC2013
7748	A1	Urban	Warrington	1.11	46	4107	3828	279	0	0	0	3379	0	449	149	5	97	28	2	NDC2013
7749	A1	Urban	Warrington	0.13	24	4107	3828	279	0	0	0	3379	0	449	149	5	97	28	2	NDC2013
7750	A1	Urban	Warrington	1.11	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7751	A1	Urban	Warrington	1.01	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7752	A1	Urban	Warrington	0.09	24	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7753	A1	Urban	Warrington	0.06	48	1000	976	24	0	0	0	917	0	59	8	0	13	3	2	NDC2013
7754	A1	Urban	Warrington	1.58	44	7913	7659	254	0	0	0	7100	0	559	91	9	109	45	2	NDC2013
7755	A1	Urban	Warrington	0.11	24	7913	7659	254	0	0	0	7100	0	559	91	9	109	45	2	NDC2013
7756	A1	Urban	Warrington	1.63	42	7260	7027	233	0	0	0	6514	0	513	84	8	100	41	2	NDC2013
7757	A1	Urban	Warrington	1.02	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013
7758	A1	Urban	Warrington	0.52	33	7746	7510	236	0	0	0	6928	0	582	102	17	92	25	2	NDC2013

7759	A1	Urban	Warrington	0.52	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7760	A1	Urban	Warrington	1.03	41	7370	7184	186	0	0	0	6562	0	622	67	17	79	23	2	NDC2013
7761	A1	Urban	Warrington	0.91	42	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7762	A1	Urban	Warrington	0.92	42	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7763	A1	Urban	Warrington	0.57	42	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7764	A1	Urban	Warrington	0.04	24	5478	5205	273	0	0	0	4801	0	403	77	2	128	67	2	NDC2013
7765	A1	Urban	Warrington	0.51	42	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7766	A1	Urban	Warrington	0.1	24	6084	5806	277	0	0	0	5354	0	452	78	3	119	77	2	NDC2013
7767	A1	Urban	Warrington	0.61	47	5625	5518	107	0	0	0	5208	0	310	67	15	24	2	2	NDC2013
7768	A1	Urban	Warrington	0.06	24	5625	5518	107	0	0	0	5208	0	310	67	15	24	2	2	NDC2013
7769	A1	Urban	Warrington	0.62	45	7120	7004	116	0	0	0	6618	0	386	70	9	32	5	2	NDC2013
7770	A1	Urban	Warrington	0.06	24	7120	7004	116	0	0	0	6618	0	386	70	9	32	5	2	NDC2013
7771	A1	Urban	Warrington	0.14	24	500	492	8	0	0	0	465	0	27	5	1	2	0	2	NDC2013
7772	A1	Urban	Warrington	0.15	24	500	492	8	0	0	0	465	0	27	5	1	2	0	2	NDC2013
7773	A1	Urban	Warrington	0.8	37	3704	3593	111	0	0	0	3397	0	196	90	0	18	2	2	NDC2013
7774	A1	Urban	Warrington	0.73	30	3438	3330	108	0	0	0	3161	0	169	76	1	26	5	2	NDC2013
7775	A1	Urban	Warrington	0.07	24	3438	3330	108	0	0	0	3161	0	169	76	1	26	5	2	NDC2013
7776	A1	Urban	Warrington	0.82	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7777	A1	Urban	Warrington	0.04	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7778	A1	Urban	Warrington	0.24	43	2284	2240	44	0	0	0	2045	0	195	12	1	24	7	2	NDC2013
7779	A1	Urban	Warrington	0.23	43	2519	2473	46	0	0	0	2276	0	197	16	2	24	4	2	NDC2013
7780	A1	Urban	Warrington	0.86	43	2519	2473	46	0	0	0	2276	0	197	16	2	24	4	2	NDC2013
7781	A1	Urban	Warrington	0.32	45	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7782	A1	Urban	Warrington	0.33	24	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7783	A1	Urban	Warrington	0.27	40	16835	16304	531	0	0	0	15123	0	1181	157	32	221	121	2	NDC2013
7784	A1	Urban	Warrington	0.02	40	400	387	13	0	0	0	359	0	28	4	1	5	3	2	NDC2013
7785	A1	Urban	Warrington	0.03	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7786	A1	Urban	Warrington	0.79	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7787	A1	Urban	Warrington	0.22	50	8889	8634	255	0	0	0	8038	0	596	82	14	112	46	2	NDC2013
7788	A1	Urban	Warrington	0.8	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7789	A1	Urban	Warrington	0.03	24	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7790	A1	Urban	Warrington	0.05	47	9817	9507	310	0	0	0	8818	0	689	91	19	129	71	2	NDC2013
7791	A1	Urban	Warrington	0.97	61	18711	18236	475	0	0	0	17225	0	1011	156	10	237	73	2	NDC2013

7792	A1	Urban	Warrington	1.02	57	18674	18228	446	0	0	0	17130	0	1097	144	6	247	48	2	NDC2013
7793	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7794	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7795	A1	Urban	Warrington	0.08	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7796	A1	Urban	Warrington	0.08	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7797	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7798	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7799	A1	Urban	Warrington	0.23	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7800	A1	Urban	Warrington	0.5	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7801	A1	Urban	Warrington	0.12	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7802	A1	Urban	Warrington	0.12	44	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7803	A1	Urban	Warrington	0.4	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7804	A1	Urban	Warrington	0.13	24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7805	A1	Urban	Warrington	0.16	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7806	A1	Urban	Warrington	0.14	42	0	0	0	0	0	0	0	0	0	0	0	0	0	2	NDC2013
7807	A1	Urban	Warrington	0.19	46	9189	8901	288	0	0	0	8252	0	649	58	11	141	78	2	NDC2013
7808	A1	Urban	Warrington	0.19	45	7370	7171	199	0	0	0	6649	0	522	35	6	93	65	2	NDC2013
7809	A1	Urban	Warrington	0.16	48	7389	7124	265	0	0	0	6626	0	498	118	5	102	40	2	NDC2013
7810	A1	Urban	Warrington	0.12	44	7780	7512	268	0	0	0	6947	0	565	102	6	120	40	2	NDC2013
7811	A1	Urban	Warrington	0.99	48	6000	5785	215	0	0	0	5381	0	404	95	4	83	32	2	NDC2013
7812	A1	Urban	Warrington	0.23	30	12895	11772	1124	0	0	0	11772	0	0	473	0	441	210	2	WBC2014TM
7813	A1	Urban	Warrington	0.23	35	455	0	455	0	0	0	0	0	0	455	0	0	0	2	WBC2014TM
7814	A1	Urban	Warrington	0.08	31	7452	6794	658	0	0	0	6794	0	0	375	0	193	90	2	WBC2014TM
7815	A1	Urban	Warrington	0.23	31	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7816	A1	Urban	Warrington	0.23	32	8667	8017	650	0	0	0	8017	0	0	281	0	247	122	2	WBC2014TM
7817	A1	Urban	Warrington	0.37	43	8165	7739	426	0	0	0	7739	0	0	0	0	282	144	2	WBC2014TM
7818	A1	Urban	Warrington	0.12	32	11192	10654	538	0	0	0	10654	0	0	0	0	376	162	2	WBC2014TM
7819	A1	Urban	Warrington	0.91	32	12132	11000	1132	0	0	0	11000	0	0	0	0	790	342	2	WBC2014TM
7820	A1	Urban	Warrington	0.13	32	17647	15943	1704	0	0	0	15943	0	0	0	0	1183	521	2	WBC2014TM
7821	A1	Urban	Warrington	0.13	32	139	139	0	0	0	0	139	0	0	0	0	0	0	2	WBC2014TM
7822	A1	Urban	Warrington	0.09	32	1220	1115	105	0	0	0	1115	0	0	0	0	77	27	2	WBC2014TM
7823	A1	Urban	Warrington	0.07	35	1232	1133	99	0	0	0	1133	0	0	0	0	61	38	2	WBC2014TM

7824	A1	Urban	Warrington	0.05	32	463	431	32	0	0	0	431	0	0	0	0	23	9	2	WBC2014TM
7825	A1	Urban	Warrington	0.23	32	1961	1802	158	0	0	0	1802	0	0	0	0	91	68	2	WBC2014TM
7826	A1	Urban	Warrington	0.16	32	1640	1553	87	0	0	0	1553	0	0	0	0	61	26	2	WBC2014TM
7827	A1	Urban	Warrington	0.08	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7828	A1	Urban	Warrington	0.06	32	1546	1449	97	0	0	0	1449	0	0	0	0	54	43	2	WBC2014TM
7829	A1	Urban	Warrington	0.06	32	1526	1432	94	0	0	0	1432	0	0	0	0	52	43	2	WBC2014TM
7830	A1	Urban	Warrington	0.06	31	0	1209	0	0	0	0	1209	0	0	0	0	38	0	2	WBC2014TM
7831	A1	Urban	Warrington	0.07	31	0	118	0	0	0	0	118	0	0	0	0	5	0	2	WBC2014TM
7832	A1	Urban	Warrington	0.09	31	0	0	0	0	0	0	0	0	0	0	0	0	106	2	WBC2014TM
7833	A1	Urban	Warrington	0.09	32	710	679	31	0	0	0	679	0	0	0	0	20	11	2	WBC2014TM
7834	A1	Urban	Warrington	0.11	32	737	692	45	0	0	0	692	0	0	0	0	31	15	2	WBC2014TM
7835	A1	Urban	Warrington	0.08	32	387	358	29	0	0	0	358	0	0	0	0	16	12	2	WBC2014TM
7836	A1	Urban	Warrington	0.12	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7837	A1	Urban	Warrington	0.06	32	222	212	10	0	0	0	212	0	0	0	0	7	3	2	WBC2014TM
7838	A1	Urban	Warrington	0.07	32	417	389	28	0	0	0	389	0	0	0	0	19	9	2	WBC2014TM
7839	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7840	A1	Urban	Warrington	0.13	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7841	A1	Urban	Warrington	0.1	35	190	181	9	0	0	0	181	0	0	0	0	5	5	2	WBC2014TM
7842	A1	Urban	Warrington	0.06	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7843	A1	Urban	Warrington	0.08	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7844	A1	Urban	Warrington	0.11	35	0	4379	0	0	0	0	4379	0	0	0	0	176	0	2	WBC2014TM
7845	A1	Urban	Warrington	0.07	35	1307	1265	42	0	0	0	1265	0	0	0	0	38	5	2	WBC2014TM
7846	A1	Urban	Warrington	0.06	35	2053	1953	100	0	0	0	1953	0	0	0	0	80	20	2	WBC2014TM
7847	A1	Urban	Warrington	0.03	34	5409	5032	377	0	0	0	5032	0	0	0	0	235	142	2	WBC2014TM
7848	A1	Urban	Warrington	0.07	34	3689	3371	318	0	0	0	3371	0	0	0	0	183	135	2	WBC2014TM
7849	A1	Urban	Warrington	0.15	32	118	0	118	0	0	0	0	0	0	118	0	0	0	2	WBC2014TM
7850	A1	Urban	Warrington	0.07	35	1279	1195	84	0	0	0	1195	0	0	0	0	66	18	2	WBC2014TM
7851	A1	Urban	Warrington	0.07	32	0	598	0	0	0	0	598	0	0	0	0	21	0	2	WBC2014TM
7852	A1	Urban	Warrington	0.05	35	1279	1195	84	0	0	0	1195	0	0	0	0	66	18	2	WBC2014TM
7853	A1	Urban	Warrington	0.05	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM

7854	A1	Urban	Warrington	0.08	32	1939	1835	104	0	0	0	1835	0	0	0	0	75	29	2	WBC2014TM
7855	A1	Urban	Warrington	0.03	31	1330	1279	51	0	0	0	1279	0	0	0	0	38	14	2	WBC2014TM
7856	A1	Urban	Warrington	0.09	27	5673	4865	808	0	0	0	4865	0	0	473	0	225	110	2	WBC2014TM
7857	A1	Urban	Warrington	0.09	35	737	0	737	0	0	0	0	0	0	737	0	0	0	2	WBC2014TM
7858	A1	Urban	Warrington	0.05	16	167	156	10	0	0	0	156	0	0	0	0	7	3	2	WBC2014TM
7859	A1	Urban	Warrington	0.06	35	781	758	23	0	0	0	758	0	0	0	0	19	5	2	WBC2014TM
7860	A1	Urban	Warrington	0.23	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7861	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7862	A1	Urban	Warrington	0.1	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7863	A1	Urban	Warrington	0.04	16	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7864	A1	Urban	Warrington	0.06	32	229	209	21	0	0	0	209	0	0	0	0	14	7	2	WBC2014TM
7865	A1	Urban	Warrington	0.03	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7866	A1	Urban	Warrington	0.07	16	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7867	A1	Urban	Warrington	0.09	15	572	539	34	0	0	0	539	0	0	0	0	21	12	2	WBC2014TM
7868	A1	Urban	Warrington	0.11	40	7878	6999	879	0	0	0	6999	0	0	0	0	620	259	2	WBC2014TM
7869	A1	Urban	Warrington	0.11	40	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7870	A1	Urban	Warrington	0.53	40	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7871	A1	Urban	Warrington	0.04	16	222	209	14	0	0	0	209	0	0	0	0	9	5	2	WBC2014TM
7872	A1	Urban	Warrington	0.1	35	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM
7873	A1	Urban	Warrington	0.07	31	781	758	23	0	0	0	758	0	0	0	0	19	5	2	WBC2014TM
7874	A1	Urban	Warrington	0.07	32	2264	1953	311	0	0	0	1953	0	0	0	0	108	203	2	WBC2014TM
7875	A1	Urban	Warrington	0.06	31	1570	1307	263	0	0	0	1307	0	0	0	0	99	165	2	WBC2014TM
7876	A1	Urban	Warrington	0.11	35	1527	1407	119	0	0	0	1407	0	0	0	0	82	37	2	WBC2014TM
7877	A1	Urban	Warrington	0.03	32	0	626	0	0	0	0	626	0	0	375	0	28	0	2	WBC2014TM
7878	A1	Urban	Warrington	0.09	32	818	782	36	0	0	0	782	0	0	0	0	9	27	2	WBC2014TM
7879	A1	Urban	Warrington	0.07	32	1350	1310	40	0	0	0	1310	0	0	0	0	40	0	2	WBC2014TM
7880	A1	Urban	Warrington	0.07	31	0	0	0	0	0	0	0	0	0	0	0	0	7	2	WBC2014TM
7881	A1	Urban	Warrington	0.07	32	0	0	0	0	0	0	0	0	0	0	0	0	0	2	WBC2014TM

M. Response to Client Comments

Comments received on 7/10/2015 on version 2

#	Comment	Response
MR1	Details should be in introduction. Main details in our USA. If needed to pt maps of AQMAS in an appendix. Graphs are already shown in our USA needed plus data used is 'correct'	Reference to USA report. RM to decide whether to put additional information in an appendix.
MR2	Highlight areas with red line for consistency	The maps have been altered accordingly
MR3	Give full description of what each measure is	This has been done.
MR4	Remove table and replace with text. Table is unclear.	This has been done.
MR5	Which one was used for the results?	Text amended to state EFT 5.1
MR6	But results are presented??	Text amended. PM10 was modelled.
MR7	Require these receptors to be described with x and y. Why were these 3 only chosen?	3 worst case receptors chosen as indicative of zone impacts. Co-ordinates provided.
MR8	What does this table actually show? Refers to tests not yet mentioned? Says PM but says this was not modelled??	Table modified.
MR9	Labelling not clear	Figure has been modified
MR10	Use of test 2a etc. is confusing. Table not required, information should be within each test description	The table has been removed and details of test numbering in descriptions. Model setup information has been moved to the appendix.
MR11	Having blank cells looks like data missing. Would use table to show total t/a for each pollutant for each study area. Then have pie chart to show %age split. How have these figures changed under the detailed assessment?? If have significantly shows initial assumption were incorrect, although best at time	Table modified. % vehicle split applies to all areas. Table moved to Appendix.
MR12	Have these figures changed after detailed assessment?	This has been re-calculated and new table inserted into the report (**Table 13**)
MR13	Show AQ impact and then costs only	This will be provided.
MR14	Description, implementation, boundary assumptions need to be added to the descriptions on page 19 for each scenario. – to simply reporting of results	These have been moved to the appendix.
MR15	This shows average improvement over the study area? What about improvement at receptors? Have concern now that this has vastly reported the potential improvement for worse case receptors.	This is the result at the worst case roadside receptor.
MR16	Why was 5.1 not used?	This was used. The text has been amended.
MR17	May be clearer for comparison between measures if shows t/a reduced i.e. 0.8 – same for other pollutants	Table format kept. Table moved to appendix.
MR18	Take out test numbers	This has been done
MR19	Red cells don't seem to add anything?	Table has been reformatted.
MR20	Are the impacts not simply averaged out over a wider area therefore lower?? If exposure to NO2 already below the objective, reducing it further	The impacts are shown at a roadside receptor. There would be a net benefit across the area.

	has no impact. What is highest level? I.e. roadside?	
MR21	Analysis of data to be removed from main body of report and included within an appendix. Tables do not show all routes????	This has been moved to the appendix.
MR22	What is the East – West Zone split referring to?	This was added by the traffic survey contractors for screenline purposes. It has been removed in the final report.
MR23	Move into an appendix	This has been done
MR24	This is unclear. Is this talking about trips that stop ion town centre? Assume 2 types – 1. Trips for town centre, 2 through traffic. What are the key routes for these separately? Is this based on percentage or vehicles numbers?	We don't understand the comment. The text has been modified slightly. This is based on numbers of vehicles.
MR25	Does this not complicate things?	The team considers that the conditional formatting makes the variation clearer to see.
MR26	High percentage but what are the numbers? Percentages can appear higher if numbers are low, can be misleading. Are they high compared to other roads?	For LGV the actual numbers have been inserted and text modified.
MR27	Table not the clearest. Coaches should be included within buses.	Table modified and coaches included with buses
MR28	Due to not being a major road – was included in camera survey to capture traffic mainly cars that would rat-run across town to avoid centre.	Understood
MR29	Simplify to conclusions, remainder to go in appendix – conclusions are 'lost' by containing within text	Details included in appendix.
MR30	Are these figures AADT or percentage? Includes routes not of concern?	
MR31	State conclusions clearly, remainder to go in appendix	This has been changed and details in appendix.
MR32	Table required?	
MR33	Table details within new table – make conclusions clear	Conclusions are clearer
MR34	Key findings – need to make them clear and stand out – bit lost amongst the text	This has been done
MR35	Put section in appendix. Main report needs to only state TEEM was used to calculate emissions to be used in ADMS	This has been done
MR36	Does this lead to any specific conclusions?? And is this the same for all major link roads??	This was just one example, a generic flow and speed profile is now provided
MR37	Keep within main text.	Accepted.
MR38	Is there not a further split to separate cars etc.? Assume this is total for study area A? Can this be reported for each of the major link roads?	This is provided in the subsequent table.
MR39	Not required	OK
MR40	Not the clearest diagram. Show as pie charts/and in table?	This has been amended to provide the information in 2 separate pie charts
MR41	The report should not be used to 'promote' TEEM	This sentence is removed. This section is now in the Appendix.
MR42	Blank	
MR43	Due to scale and background colour very unclear. Are there any 'red' areas? If not scale needs adjusting – highest value appears to be	This is a TEEM output so background map can't be changed. The figures have been

	green?	moved to the appendix.
MR44	Is this for the Sankey Green AQMA area? Lower than measured background at Selby St site in area – care should be taken whether to use	This background values are for the 1km grids across the study area to compare with the monitored value. The text has been modified to confirm the monitored value was used.
MR45	Is 1m used for the modelling?	Yes. Text amended.
MR46	Confusing section. Simply needs to be presented as Option 1 HGV routing results and Option 2 Parker Street.	Sections re-ordered. Details moved to appendix.
MR47	Details already included earlier in report	Sections reordered and reworded.
MR48	Having 2 verifications processes is confusing. Where are the additional 70 links? Why does this increase significantly change the verification?	Moved to appendix.
MR49	Study area B??	Whole area (A)
MR50	Poor map – arrows??	Map improved.
MR51	Should already be included in earlier section in description of options to be taken to DA. HGV option needs to be presented first	The sections have been re-ordered
MR52	Does this extend to this area?	Yes, the whole area (A)
MR53	Map is not very clear to show routing plan	The map has been improved.
MR54	With Option is this?? There were 4 to model	This was the pre-feasibility study and has been moved to the appendix. Conducted before we were provided with the 4 options. This has been removed from the report.
MR55	What was this test?	As above
MR56	This is confusing over the previous reported baselines?	Noted. One baseline is provided.
MR57	If additional links are all town centre then is this not skewing the previous reported data? The situation seems to be changing within the report	Noted as above.
MR58	This seems to significantly affect the ANPR traffic data? How does this change all previous conclusions? Appear to be using 2 data sets within this study??	The dataset within the town centre was provided by the traffic model as the ANPR survey did not include these road links.
MR59	Not reporting HC?	Deleted
MR60	As previous diagram really unclear- study is now reporting on 2 datasets??	Noted. This has been reworded and one set provided.
MR61	But has changed – this does not make the study clear. The study needs to use one dataset throughout not be amending and changing it so reporting different levels	Noted and reworded as above.
MR62	Re-verification has now changed significantly the factor preciously reported and used?? The model is now over predicting when was under predicting before??	As above. Two verifications conducted as different traffic networks (with and without 70 town centre links). 2nd verification as used for the detailed modelling of the two options. Details of 2nd verification provided only
MR63	Appear to have run 2 models????	Noted, as above.

Comments received 30/11/2015 on version 3

Comment No	Comment	Response
[MR1]	Double check that it was linked to Chester Road for the assessment?	Amended to read Chester Road
[MR2]	Sounds misleading? Not sure what this means? Leads to thinking that Farrell Street is busiest route at this time?	Sentence re-worded as requested by client.
[MR3]	Sounds misleading? Not sure what this means? Leads to thinking that Farrell Street is busiest route at this time?	As above
[MR4]	Old Liverpool Rd is not a key route? Chester Rd, Manchester Rd, Wilderspool Causeway and Knutsford Road are	Sentence amended to remove reference to key routes
[MR5]	Camera location was called river road for some reason but is Wilderspool Causeway. River Road runs parallel to it.	Refernece to River Road deleted
[MR6]	?Does this mean that more diesel cars than petrol expected? What is the proportion compared to the predictions? Is this due to the national growth in diesel cars not accounted for in national fleet or just our data?	The bullet point has been reworded. A comparison to diesel and petrol cars against the national model has been provided.
[MR7]	Wharf st leads to retial and industrial area only which explains it	This has been added.
[MR8]	As a percentage?	This is correct and has been added.
[MR9]	But what are the highest numbers? Proportion could be high if total vehicle numbers low.	The text has been amended.
[MR10]	Retail and Industrial estate no through road.	The text has been added.
[MR11]	Is this the same as highest numbers?	The text has been amended
[MR12]	But what routes have highest numbers?	The text has been amended
[MR13]	Wharf st is not through traffic as is Retail/Indstrial area. It is a destination not a route.	This is noted.
[MR14]	Have added numbers in brackets	This is accepted
[MR15]	Some of the figures do not seem to match up with data in appendix table 69?	These have been corrected
[MR16]	Is this correct? Major route would expect similar to Sankey Way volumes	This has been amended
[MR17]	As before	As above
[MR18]	Does this mean for Wilderspool causeway that of the total number of cars that travel to Chester Rd, 27% are through traffic and 73% stop in town centre? Can the actual number be added in brackets?	The table has been amended.
[MR19]	Is this Sankey Way? If AQMA should include the Old Liverpool Rd and Loverlt Lane data	Reworded to say Sankey Way
[MR20]	What is the definition of these	Amended to say car derived van
[MR21]	What about cars and buses?	These are included. Note that LDV includes cars and LGVs and HDV includes HGV and buses
[MR22]	Where is this figure from?	This has been amended
[MR23]	What about Receptors on Mersey Street? Is there a list of all receptor locations above 35 ug/m3 for baseline?`	A list of receptors with concentrations above 35 ug/m3 has been added in Appendix J
[MR24]	What about car and bus emissions? Same for tables 20 and 21	As for comment MR21
[MR25]	Agree, but under LAQM we have to assess AQ at the facade	This has been added to the text
[MR26]	On Wilson Patten/Parker St?	The text has been reworded.

Comments received on 22/12/2015 on version 4 (via email)

Comment No	Comment	Response
[1]	Page 15, Study Zone B Figure 2 is the map listed as Study Zone C figure 3 and vice versa. Just need the maps swapping over.	Modified