Greater Manchester's Outline Business Case to tackle Nitrogen Dioxide Exceedances at the Roadside

Highway Modelling Sensitivity Tests (T4)

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Version Status:	DRAFT FOR APPROVAL	**Prepared by:**	Transport for Greater Manchester on behalf of the 10 Local Authorities of Greater Manchester
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1 Introduction

1.1 Overview

1.1.1 This report presents the results of the highway modelling sensitivity tests for the Greater Manchester Clean Air Plan Project. The report is part of a suite of documents that have been produced to describe the transport modelling deliverables for the study. Other documents in the series include:

- Local Plan Transport Model Validation Report (T2), which explains how the road traffic model was validated against real-world data
- Local Plan Transport Modeling Methodology Report (T3), which describes the approach taken to forecast traffic
- Local Plan Transport Model Forecasting Report (T4), which presents the baseline transport and emissions modelling results for the study
- Local Plan Air Quality Modelling Methodology Report (AQ2), which provides an overview of the air quality modelling process
- Local Plan Air Quality Modelling Report (AQ3), which provides details of modelled NOx and NO2 concentrations for the base and forecast years, including comparisons with measured concentrations for the base year.

1.1.2 The purpose of this report is to assess the extent to which changes to the assumptions made in the CAP analysis could affect the conclusions of the OBC and specifically the delivery of compliance in the shortest possible time. This is particularly important for those assumptions which are subject to consultation (such as charge levels), and for those assumptions that will require refinement as new evidence becomes available at FBC (such as bus and taxi compliance).

1.1.3 The purpose of the analysis is to help understand which aspects of the modelling the results are most sensitive to and ultimately to help answer the questions:

- Is the preferred option the right proposal?
- Is it likely to be sufficient to meet the legal duty?
- Is it excessive, so that the costs outweigh the benefits?

1.1.4 Even where it is shown that the conclusions are insensitive to any given assumption, more work may be required at FBC to meet other analytical objectives. For example, to demonstrate to stakeholders that the scheme is proportionate and necessary.

1.1.5 The sensitivity testing will feed into:

- The development of the FBC data, evidence and modelling work streams, to determine the work required to improve the assumptions; and
- Monitoring and evaluation plans, to ensure that the proposals reflect emerging trends and real-world conditions.

1.2 Sensitivity Tests

1.2.1 The sensitivity tests have been carried out for a forecast year of 2023, focusing on the do-minimum and with scenario forecasts for Option 8. Initially, tests have focused on the following areas of uncertainty:

- Fuel Costs
- Traffic Growth
- Charge Levels
- Fleet Age
- Emissions at Low Speeds
- Electric Vehicle Uptake

1.2.2 Other tests will, however, be included as part of the development of the FBC, to help fill gaps in the analysis and to provide confidence in the results.

1.3 Report Structure

1.3.1 The remainder of the report is structured as follows:

- Section 2 describes the tests that have been carried out
- Section 3 presents the results of the analysis.

2 Test Descriptions

2.1 Fuel Costs (ST01)

2.1.1 JAQU's guidance on sensitivity testing (Reference 1) recommends a review of the elasticities for vehicle km and journey times. This was not possible for the GM CAP study however, due to the lack of a full variable demand model. An alternative approach was therefore used instead, which involved altering the fuel costs in the Saturn highway model by +/-10%, based on guidance provided in WebTAG. This provides high and low growth fuel cost sensitivity measures which allow the re-routing responses of changes to fuel costs to be modelled, and will also provide revised generalised cost skims to feed into the demand sifting tool.

2.1.2 Fuel costs were adjusted for all vehicle types and user classes.

2.1.3 The 8 assignment user classes all have their own generalised cost parameters that reflect the relevant values of time and vehicle operating costs for assignment purposes. For each user class, the new Saturn vehicle operating cost parameter (PPK) is calculated by applying the following factor to the forecast year PPK value for that user class:

(1.1b + c)/ (b + c)

where, b is the fuel operating cost and c is the non-fuel operating cost for the relevant vehicle type.

2.1.4 Note that when following standard WebTAG advice the distance coefficient is made up of fuel and non-fuel components. This means that a 10% increase in fuel cost translates into a smaller increase in the overall distance coefficient of the generalised cost (i.e. less than 10%).

2.1.5 The table below presents the SATURN pence per kilometre (PPK) values used in the forecast year assignment models and the corresponding PPK values that reflect a 10% fuel cost change. It should be noted that the corresponding values of time (PPM, Pence per Minute), do not change.

Table 2- 1 :2023 Generalised Cost Parameters (2010 Prices)

Period	User Class	CAP Saturn Model		Car Fuel Cost Sensitivity Test (ST01)			
		PPM	PPK	High Fuel Cost		Low Fuel Cost	
				PPM	PPK	PPM	PPK
AM Peak Hour	Cars	21.15	7.58	21.15	8.19	21.15	6.96
	LGVs	22.86	14.37	22.86	15.06	22.86	13.67
	OGVs	23.61	55.78	23.61	59.28	23.61	52.38
	Taxis	29.10	14.04	29.10	14.56	29.10	13.51
Inter-Peak Hour	Cars	19.83	6.89	19.83	7.45	19.83	6.33
	LGVs	22.86	13.64	22.86	14.28	22.86	12.99
	OGVs	23.61	49.59	23.61	52.71	23.61	46.47
	Taxis	29.10	12.71	29.10	13.19	29.10	12.23
PM Peak Hour	Cars	20.56	7.03	20.56	7.63	20.56	6.43
	LGVs	22.86	14.18	22.86	14.86	22.86	13.50
	OGVs	23.61	54.40	23.61	57.82	23.61	50.99
	Taxis	29.10	13.70	29.10	14.21	29.10	13.19

Notes:

PPM values are expressed in units of Pence Per Minute

PPK values are expressed in units Pence Per Kilometre

These values are used in SATURN to convert times and distances into generalised costs for assignment purposes

The same PPM/PPK values are used for both compliant and non-compliant vehicle types.

2.2 Traffic Growth (ST02/ST04)

2.2.1 This test modelled high plus low traffic growth defined by modelling the do-minimum demand plus or minus a proportion of the base year matrix, to test sensitivity around the level of development in GM.

2.2.2 TAG sets out the recommended approach for modelling high and low growth scenarios in Section 4.2 of Unit M4, stating that scenarios should be formed by adding and subtracting a proportion of the base year demand to the demand from the core scenario.

2.2.3 In the TAG methodology, the proportion of the base year matrix is set to equal the square root of the number of years between the model base year and the forecast future year, multiplied by a factor p, which has been set equal to 2.5%. The proportions used for the test are set out in Table 2- 2 below.

2.2.4 The test has been carried out in four stages:

- First, updated do-minimum matrices were created for use with the Saturn model;
- Next, these matrices were assigned to create high and low growth cost skims for input to the demand sifting tool;
- Next, the demand sifting tool was used to create high and low growth do-something demand matrices for Option 8, which models a category C Clean Air Zone (CAZ) across the whole of Greater Manchester; and
- Finally, the high and low growth do-something matrices created above were assigned to the Saturn model to create new inputs for EMIGMA.

2.2.5 Separate EMIGMA runs have been carried out using the Saturn outputs from stages 1 and 4, so that impacts of the high and low growth tests could be assessed for the with and without scheme scenarios.

Table 2- 2: Proportion of Base Demand Matrix Added and Subtracted for High and Low traffic Growth Sensitivity Tests

Forecast Year	Years From Base (2016)	Square Root of Years for Base	High and Low Growth Forecast with p=2.5
2023	7	2.65	6.61%

2.3 Charge Levels (ST03)

2.3.1 JAQU's guidance on sensitivity testing does not include a test for the level of CAZ charges. We consider this to be an important assumption however.

2.3.2 The with scheme model runs for Option 8 were undertaken based on daily charge levels of £7.50 for non-compliant LGVs and Taxis and £100 for non-compliant HGVs and buses. The impacts of the CAZ charge levels have been investigated by running a high and low charge test for Car, LGV, OGV, Taxi and Bus trips. The test was carried out by coding the new charges into the demand sifting tool for Option 8 and using the output change matrices to create new do-something inputs for the Saturn model. The assumed charges are shown below in Table 2- 3.

Table 2- 3: Charge Level Sensitivity Test Non-Compliant Vehicle Charges (£'s, 2010 Prices)

Model/Test	Car	LGV	OGV	Bus	Taxi
Option 8 Do-Something	NA	£7.50	£100.00	£100.0	£7.50
High Charge Test	NA	£12.50	£200.00	£200.00	£12.50
Low Charge Test	NA	£2.50	£50.00	£50.00	£2.50
Notes: Non-compliant cars are not charged for Option 8					

2.4 Fleet Age (ST05)

2.4.1 The impacts of assumptions around the change in fleet age over time have been investigated by re-running the 2023 do-minimum Saturn and EMIGMA models using the 2021 and 2025 fleet age profiles. This provided a simple test of plausible alternative scenarios where the fleet is 'older' and 'younger' in the projected year, reflecting the impacts of vehicle owners choosing to either to hold onto vehicles for longer or replace them more frequently than has been forecast in the core test.

2.5 Emissions at Low Speeds (ST06)

2.5.1 JAQU's guidance on sensitivity testing notes that road traffic emission estimates on roads with low speeds are likely to be much more uncertain than roads with higher speeds. This is partly due to a lack of available data around emissions at low speeds, but is also due to greater variability in traffic behaviour, with more stop-start-driving and uncertainty about emissions estimated using emission rates based on average speeds. There will also be greater uncertainty around average speeds from the traffic model for roads with stop starting driving, as this is difficult to represent in conventional assignment models such as Saturn.

2.5.2 Uncertainty surrounding emissions at low speeds has been investigated by running a 'low emissions' sensitivity test which involved re-running the 2023 do-minimum EMIGMA model with a minimum speed cut-off of 10kph. (The core model runs have assumed that the EFT emission factors can be used for modelled speeds down to 5kph, so they effectively represent 'high emission' forecasts for roads with low modelled speeds).

2.6 Electric Vehicle Uptake (ST07)

2.6.1 The air quality impacts of measures to promote the increased take up of electric vehicles have been modelled post assignment in the CAP study by adjusting the non-compliant vehicle flows that are output from the Saturn model and that are input to EMIGMA assuming that electric vehicles generate zero emissions at the exhaust.

2.6.2 The impacts of the uptake of electric vehicles have been included in the appraisal of the CAP options by assuming that measures to promote electric vehicles could deliver an additional 68,000 electric cars and 7,000 electric LGVs within the county, with a combined annual vehicle mileage of approximately 700 million miles per year. This is an ambitious target given that only about 2,500 electric cars are currently registered in the county and that electric vehicles presently make up only around 0.2% of the vehicle fleet nationally.

2.6.3 The impacts of achieving a lower uptake of electric vehicles have been investigated by modelling what might happen if the actual uptake of electric cars and LGVs was either 75% or 50% of the target, comprising 51,000 electric cars and 5,200 electric LGVs for the first test and 34,000 electric cars and 3,500 electric LGVs for the second test.

2.6.4 These reduced targets were included in revised EMIGMA runs for Option 8, to model the impacts of achieving a reduced uptake of electric vehicles on the package-as-a-whole.

3 Results

3.1 Introduction

3.1.1 This section presents the results of the tests described above. The results for the Car Fuel Cost (ST01), do-minimum Traffic Growth (ST02), Fleet Age (ST05) and Low Speed (ST06) tests are presented in Table 3- 1 and Table 3- 3, which show modelled changes in annual vehicle km and mass NOx emission totals from the EMIGMA modelling relative to the 2023 do-minimum. Equivalent information for the do-something traffic growth (ST04), Charge Level (ST03) and Electric Vehicle Uptake (ST07) tests are presented in Table 3- 2 and Table 3- 4, which show modelled changes in annual vehicle km and mass NOx emission totals from the EMIGMA modelling relative to the 2023 Option 8 do-something outputs.

3.1.2 Changes in modelled vehicle kilometres are presented separately for the Regional Centre and the whole of Greater Manchester, broken down by compliant and non-compliant vehicle types. Changes in mass NOx emissions are reported for the Regional Centre, the area inside the M60 and the whole of Greater Manchester, for all vehicles combined. The location of the Regional Centre cordon is shown in Figure 3- 1.

3.1.3 The remainder of this section presents a discussion of the results.

3.2 Fuel Costs (ST01)

3.2.1 The results for this test are shown in Table 3- 1 and Table 3- 3. The analysis indicates that changes to fuel costs have a negligible impact on modelled vehicle km and mass emission totals, with only very small changes, demonstrating that the modelling is not sensitive to fuel cost changes over the ranges that have been considered.

3.3 Traffic Growth (ST02/ST04)

3.3.1 The do-minimum traffic growth tests show that vehicle kms are forecast to increase by between 5% and 6% for the high growth test and to decrease by between 5% and 6% for the low growth test. NOx emissions across the county-as-a-whole are forecast to increase by approximately 6% for the high traffic growth test and to decrease by about 6% for the low traffic growth test. Changes in NOx emissions within the Regional Centre for this test are marginally lower, as road traffic emissions in city centre are more strongly influenced by emissions from buses, which have not changed for the test.

3.3.2 The impacts of the traffic growth test on the results for Option 8 have focussed on the low growth test, which is better supported by local evidence which indicates that there has been relatively little traffic growth within the county in recent years, and suggests that growth forecasts from TEMPRO (which were used to create the forecast year matrices) are likely to over-estimate traffic growth in the region.

3.3.3 The results for the low growth test for Option 8 (reported in Table 3- 2 and Table 3- 4) are similar to those described above when comparing changes for the do-minimum, with reductions in vehicle kms of about 6% relative to the do-something scenario and reductions in NOx emissions of between 4 and 6%. It appears, therefore, that the results are moderately sensitive to traffic growth assumptions within a plausible range. The impact on compliance would depend on the distribution of growth. If, for example, growth was lower in the regional centre and approach roads than elsewhere, this could have a more significant impact on compliance than slightly lower growth spread across the region.

3.4 Charge Levels (ST03)

3.4.1 As expected, the charge level tests forecast reduced non-compliant car, LGV and HGV flows for the high charge scenario and increased flows for these vehicle types for the low charge test, as increased numbers of non-compliant drivers choose to pay the charge rather than acquire a compliant vehicle. Overall vehicle flows are relatively un-changed however. (Car drivers are not affected by the Option 8 scheme, as only non-compliant LGVs, HGVs, buses and taxis would be charged).

3.4.2 Estimates of mass NOx emissions do not appear to be sensitive to charge levels, with a small reduction in emission totals for the high charge test and a small increase in emissions for the low charge tests. This reflects the relatively small proportion of non-compliant vehicles in 2023, where approximately 80% of HGV's and taxis and 70% of LGVs are assumed to be already compliant, due to vehicle fleet changes over time.

3.4.3 Note that the impact at key locations may differ from the average, and therefore that the impact on compliance may be greater than indicated by the mass emissions changes.

3.5 Fleet Age (ST05)

3.5.1 The results for this test are shown in Table 3- 1and Table 3- 3, which show the impacts of the test on modelled vehicle kms and mass NOx emission totals relative to the 2023 do-minimum forecasts.

3.5.2 The fleet age test does not have an impact on overall traffic flows, but does impact on the assumed split between compliant and non-compliant vehicle types. This is reflected in the estimated NOx totals for the test, which are approximately 19% lower than the do-minimum for the whole of GM for the 'Younger fleet' test, (which assumed that drivers would replace non-compliant vehicles more quickly than had been forecast), and are approximately 25% higher than the do-minimum for the 'older fleet' test, where it was assumed that the fleet turnover would be slower than the reference case, with drivers choosing to hold onto vehicles for longer.

3.5.3 The results for this test suggest that changes to the fleet mix have a significant impact on modelled NOx emissions, suggesting that the forecasts are likely to be highly sensitive to assumptions around fleet turnover and future fleet age.

3.5.4 Note that in the event of an older than forecast fleet, more vehicles would be in scope for a charge. In these circumstances, the proportion of drivers able to access support would be lower. It may be that sensitivity to charge levels would be more significant in this scenario.

3.6 Emissions at Low Speeds (ST06)

3.6.1 The results for the low speed test are shown in Table 3- 1and Table 3- 3. The test did not affect modelled traffic flows, but investigated the impacts of capping the minimum speed in the EMIGMA software to 10 kph. The purpose of this was to:

- Gauge the extent to which emissions at low speeds contributed to overall emissions in the modelling; and
- Measure the impacts of the uncertainty surrounding emissions rates for vehicles travelling at slow speeds.

3.6.2 The results for the test suggest that the impacts of slow speeds on the results generally are relatively modest, with a reduction in mass NOx emissions relative to the 2023 do-minimum forecast of approximately 1% for the whole of GM, and a reduction in NOx emissions for the area inside the M60 of approximately 3%. There are, however, more significant changes within the Regional Centre, which is more congested and has higher bus flows, which exhibit steep rises in emission rates at low speeds. It seems reasonable to assume that similar effects will be observed in other areas with low speeds and high heavy-duty vehicle flows, which is something that needs to be considered for monitoring during the implementation of the CAP proposals. Consideration should also be given to improving the modelling of slow speeds for the full business case submission.

3.7 Electric Vehicle Uptake (ST07)

3.7.1 The uptake of electric vehicles does not have an impact on total traffic flows in the modelling, but does affect the split between compliant and non-compliant vehicle types, as shown in Table 3- 2

3.7.2 The results indicate that a 25% reduction in the assumed take-up of electric vehicles would result in an approximate 10% increase in non-compliant car flows in the county and a 6% increase in non-compliant LGV flows relative to Option 8. A 50% reduction in the target uptake of electric vehicles is forecast to result in non-compliant car flows that are approximately 20% higher relative to the modelled Option 8 scenario.

3.7.3 The sensitivity of NOx emissions to the uptake of electric vehicle is shown in Table 3- 4. The results indicate that traffic emissions would be approximately 2% greater across GM (relative to Option 8) if the uptake of electric vehicles was 25% below the target and 4% greater if the uptake of electric vehicles was 50% below the target. Even when the uptake of electric vehicles is at this lower level, however, Option 8 is still forecast to deliver reductions in mass NOx emissions across the county of approximately 20% relative to the do-minimum in 2023, (compared to an overall reduction of 25% relative to the do-minimum with the full uptake of electric vehicles), which suggests that the scheme is only moderately sensitive to the different levels of electric vehicle flows that have been modelled. There are, however, a number of limitations in the modelling of electric vehicles and more work may be required during the development of the full business case to improve procedures.

Table 3- 1: 2023 Do-Minimum Annual Vehicle KM Totals By Year for Compliant and Non-Compliant Vehicle Types (Millions)

Vehicle Type	DM	Car Fuel Costs (ST01)			Traffic Growth (ST02)						Fleet Age (ST05)			Low Speeds (ST06)	
		High	% Change	Low	% Change	High	% Change	Low	% Change	Younger	% Change	Older	% Change	10kph Min	% Change
Regional Centre															
Compliant Car	48	48	0.1%	48	-0.1%	50	5.7%	45	-6.2%	51	7.3%	44	-8.5%	48	0.0%
Non-Compliant Car	8	8	0.1%	8	-0.1%	9	5.7%	8	-6.2%	5	-42.4%	12	49.2%	8	0.0%
All Car	56	56	0.1%	56	-0.1%	59	5.7%	52	-6.2%	56	0.0%	56	-0.1%	56	0.0%
Compliant LGV	7	7	0.3%	7	-0.1%	7	4.5%	7	-4.4%	8	16.4%	6	-14.7%	7	0.0%
Non-Compliant LGV	3	3	0.3%	3	-0.1%	3	4.5%	3	-4.4%	2	-34.2%	4	31.7%	3	0.0%
All LGV	10	10	0.3%	10	-0.1%	11	4.5%	10	-4.4%	10	0.1%	10	0.2%	10	0.0%
Compliant OGV	1	1	0.6%	1	-0.4%	1	5.7%	1	-5.3%	1	11.1%	1	-13.4%	1	0.0%
Non-Compliant OGV	0	0	0.6%	0	-0.4%	0	5.7%	0	-5.2%	0	-50.8%	0	61.6%	0	0.0%
All OGV	1	1	0.6%	1	-0.4%	1	5.7%	1	-5.3%	1	0.0%	1	0.0%	1	0.0%
Compliant Taxi	3	3	0.0%	3	-0.1%	3	5.3%	3	-5.4%	4	17.2%	2	-25.8%	3	0.0%

Vehicle Type	DM	Car Fuel Costs (ST01)			Traffic Growth (ST02)						Fleet Age (ST05)			Low Speeds (ST06)	
		High	% Change	Low	% Change	High	% Change	Low	% Change	Younger	% Change	Older	% Change	10kph Min	% Change
Non-Compliant Taxi	1	1	0.0%	1	-0.1%	1	5.3%	1	-5.4%	0	-61.1%	2	91.8%	1	0.0%
All Taxi	4	4	0.0%	4	-0.1%	4	5.3%	4	-5.4%	4	0.1%	4	-0.1%	4	0.0%
Bus	6	6	0.0%	6	0.0%	6	-1.0%	6	0.7%	6	0.0%	6	0.0%	6	0.0%
Total	77	77	0.1%	77	-0.1%	81	5.0%	73	-5.4%	77	0.0%	77	0.0%	77	0.0%
Greater Manchester															
Compliant Car	11,525	11,506	-0.2%	11,547	0.2%	12,177	5.6%	10,848	-5.9%	12,363	7.3%	10,554	-8.4%	11,525	0.0%
Non-Compliant Car	1,971	1,967	-0.2%	1,974	0.2%	2,082	5.6%	1,855	-5.9%	1,135	-42.4%	2,943	49.3%	1,971	0.0%
All Car	13,496	13,473	-0.2%	13,521	0.2%	14,259	5.6%	12,703	-5.9%	13,498	0.0%	13,497	0.0%	13,496	0.0%
Compliant LGV	1,911	1,909	-0.1%	1,913	0.1%	2,007	5.0%	1,811	-5.2%	2,221	16.2%	1,627	-14.9%	1,911	0.0%
Non-Compliant LGV	903	902	-0.1%	904	0.1%	948	5.0%	856	-5.2%	594	-34.2%	1,188	31.5%	903	0.0%
All LGV	2,814	2,812	-0.1%	2,817	0.1%	2,955	5.0%	2,667	-5.2%	2,815	0.0%	2,814	0.0%	2,814	0.0%
Compliant OGV	848	847	-0.1%	848	0.1%	898	5.9%	796	-6.1%	941	11.1%	734	-13.4%	848	0.0%

Vehicle Type	DM	Car Fuel Costs (ST01)			Traffic Growth (ST02)						Fleet Age (ST05)			Low Speeds (ST06)	
		High	% Change	Low	% Change	High	% Change	Low	% Change	Younger	% Change	Older	% Change	10kph Min	% Change
Non-Compliant OGV	185	185	-0.1%	185	0.1%	196	5.9%	174	-6.1%	91	-50.8%	298	61.5%	185	0.0%
All OGV	1,032	1,031	-0.1%	1,033	0.1%	1,094	5.9%	969	-6.1%	1,032	0.0%	1,032	0.0%	1,032	0.0%
Compliant Taxi	677	677	0.0%	678	0.1%	714	5.5%	639	-5.7%	793	17.1%	502	-25.8%	677	0.0%
Non-Compliant Taxi	189	189	0.0%	189	0.1%	199	5.4%	178	-5.6%	74	-61.0%	364	92.4%	189	0.0%
All Taxi	866	866	0.0%	867	0.1%	914	5.5%	817	-5.7%	866	0.0%	866	0.0%	866	0.0%
Bus	118	118	0.0%	118	0.0%	117	-0.5%	118	0.4%	118	0.0%	118	0.0%	118	0.0%
Total	18,327	18,299	-0.2%	18,356	0.2%	19,338	5.5%	17,274	-5.7%	18,329	0.0%	18,328	0.0%	18,327	0.0%
Notes: Totals may not sum due to rounding.															

Table 3- 2: 2023 Do-Something Annual Vehicle KM Totals By Year for Compliant and Non-Compliant Vehicle Types (Millions)

Vehicle Type	DS Option 8	Traffic Growth (ST04)				Charge Levels (ST03)				Electric Vehicle Uptake (ST07)			
		High	% Change	Low	% Change	High	% Change	Low	% Change	-25%	% Change	-50%	% Change
Regional Centre													
Compliant Car	50	Not carried out		47	-5.9%	50	0.0%	50	0.0%	50	-1.3%	49	-2.6%
Non-Compliant Car	6			5	-8.6%	6	0.0%	6	0.0%	6	12.0%	7	24.0%
All Car	56			52	-6.2%	56	0.0%	56	0.0%	56	0.0%	56	0.0%
Compliant LGV	10			9	-4.5%	10	1.5%	10	-2.5%	10	-0.3%	10	-0.5%
Non-Compliant LGV	0			0	-6.5%	0	-61.0%	1	133.8%	0	8.3%	0	16.5%
All LGV	10			10	-4.6%	10	-0.4%	10	1.6%	10	0.0%	10	0.0%
Compliant OGV	1			1	-5.1%	1	1.7%	1	-9.5%	1	0.0%	1	0.0%
Non-Compliant OGV	0			0	-5.2%	0	-96.7%	0	574.0%	0	0.0%	0	0.0%
All OGV	1			1	-5.1%	1	0.0%	1	0.3%	1	0.0%	1	0.0%
Compliant Taxi	3			3	-5.2%	3	0.4%	3	-0.5%	3	0.0%	3	0.0%
Non-Compliant Taxi	0			0	-5.0%	0	-63.5%	0	73.3%	0	0.0%	0	0.0%
All Taxi	4			3	-5.2%	4	-1.9%	4	2.2%	4	0.0%	4	0.0%
Bus	6			6	0.7%	6	0.0%	6	0.0%	6	0.0%	6	0.0%
Total	77			72	-5.4%	77	-0.1%	77	0.3%	77	0.0%	77	0.0%

Vehicle Type	DS Option 8	Traffic Growth (ST04)				Charge Levels (ST03)				Electric Vehicle Uptake (ST07)			
		High	% Change	Low	% Change	High	% Change	Low	% Change	-25%	% Change	-50%	% Change
Greater Manchester													
Compliant Car	12,083	Not carried out		11,399	-5.7%	12,084	0.0%	12,081	0.0%	11,947	-1.1%	11,810	-2.3%
Non-Compliant Car	1,424			1,309	-8.1%	1,424	0.0%	1,424	0.0%	1,561	9.6%	1,698	19.2%
All Car	13,508			12,708	-5.9%	13,509	0.0%	13,505	0.0%	13,508	0.0%	13,508	0.0%
Compliant LGV	2,570			2,438	-5.2%	2,609	1.5%	2,507	-2.5%	2,561	-0.3%	2,552	-0.7%
Non-Compliant LGV	154			144	-6.4%	106	-31.1%	256	66.6%	162	5.9%	171	11.7%
All LGV	2,724			2,581	-5.2%	2,715	-0.3%	2,763	1.4%	2,724	0.0%	2,724	0.0%
Compliant OGV	969			910	-6.1%	981	1.3%	896	-7.6%	969	0.0%	969	0.0%
Non-Compliant OGV	59			56	-6.1%	47	-21.4%	135	127.8%	59	0.0%	59	0.0%
All OGV	1,028			965	-6.1%	1,028	0.0%	1,031	0.3%	1,028	0.0%	1,028	0.0%
Compliant Taxi	700			660	-5.7%	705	0.7%	695	-0.8%	700	0.0%	700	0.0%
Non-Compliant Taxi	53			50	-5.6%	18	-66.4%	93	76.6%	53	0.0%	53	0.0%
All Taxi	753			710	-5.7%	723	-4.0%	788	4.6%	753	0.0%	753	0.0%
Bus	118			118	0.3%	118	0.0%	118	0.0%	118	0.0%	118	0.0%
Total	18,130			17,083	-5.8%	18,092	-0.2%	18,204	0.4%	18,130	0.0%	18,130	0.0%
Notes: Totals may not sum due to rounding.													

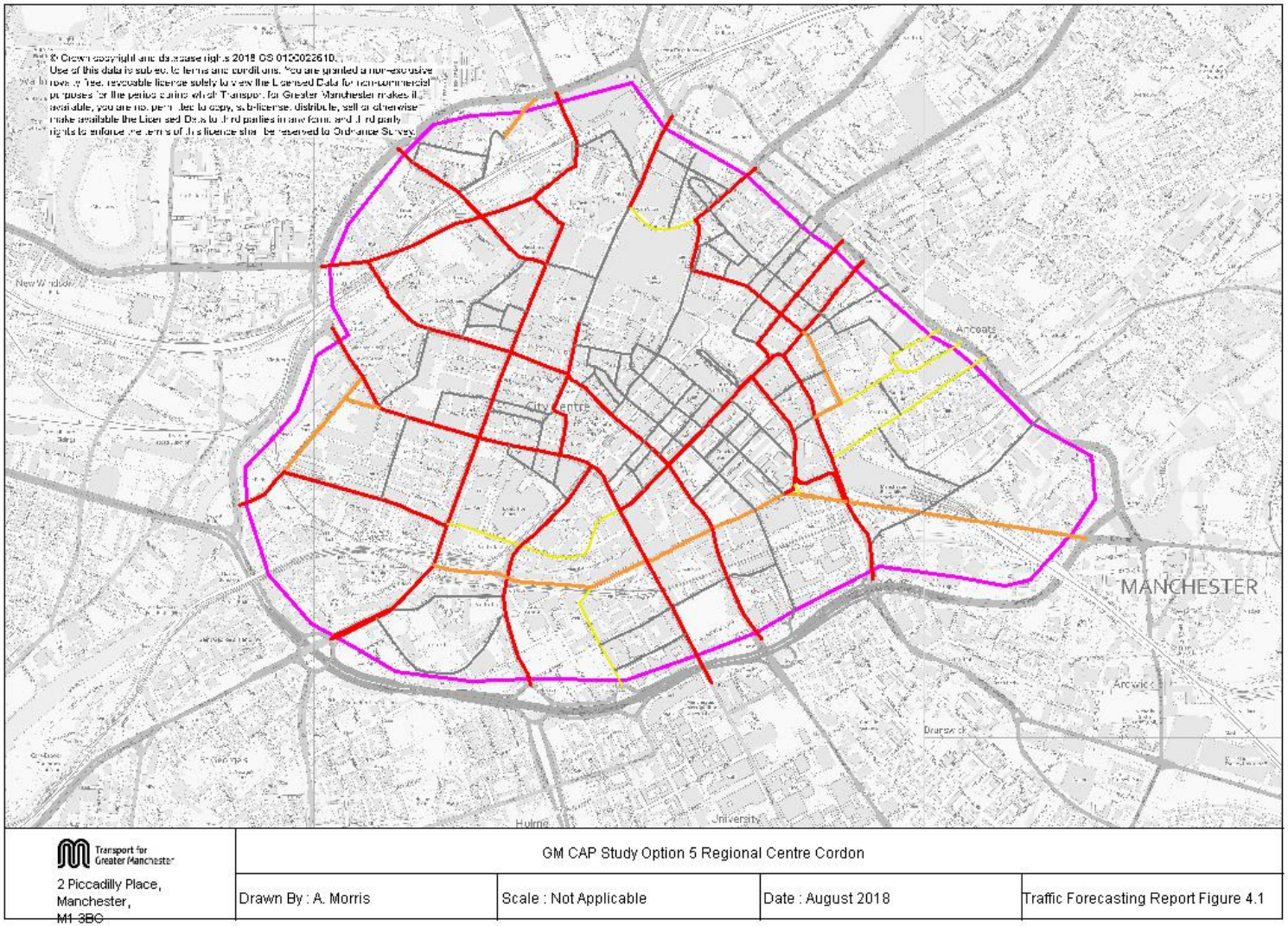
Table 3- 3: 2023 NOx Emissions (Tonnes Per Year, Percentage Changes Relative to Do-Minimum)

Location	Do-Minimum	Sensitivity Test													
		Car Fuel Costs (ST01)				Traffic Growth (ST02)				Fleet Age (ST05)				Low Speeds (ST06)	
		High	% Change	Low	% Change	High	% Change	Low	% Change	Younger	% Change	Older	% Change	10kph Min	% Change
Regional Centre	55	55	0.1%	55	-0.3%	57	2.8%	53	-3.9%	48	-13.5%	74	34.2%	44	-20.7%
Inside M60	1,134	1,137	0.2%	1,132	-0.2%	1,198	5.6%	1,071	-5.6%	930	-18.0%	1,442	27.1%	1,102	-2.9%
GM	6,385	6,384	0.0%	6,388	0.0%	6,743	5.6%	6,023	-5.7%	5,173	-19.0%	7,890	23.6%	6,304	-1.3%
Notes: Totals may not sum due to rounding.															

Table 3- 4: 2023 NOx Emissions (Tonnes Per Year, Percentage Changes Relative to Do-Something Option 8)

Location	Do-Something (Option 8)	Sensitivity Test											
		Traffic Growth (ST04)				Charge Levels (ST03)				Electric Vehicle Uptake (ST07)			
		High	% Change	Low	% Change	High	% Change	Low	% Change	-25%	% Change	-50%	% Change
Regional Centre	37			36	-4.6%	37	-0.9%	39	3.9%	38	1.3%	38	2.6%
Inside M60	822			770	-6.4%	807	-1.8%	880	7.1%	838	2.0%	855	4.0%
GM	4,820			4,520	-6.2%	4,730	-1.9%	5,161	7.1%	4,906	1.8%	4,993	3.6%
Notes: Totals may not sum due to rounding.													

Figure 3- 1: Inner Relief Road Cordon



References

1. Supplementary Note on Sensitivity Testing
JAQU Guidance, October 2017