

Greater Manchester's Clean Air Plan to tackle Nitrogen Dioxide Exceedances at the Roadside

Evidence Submission for a new GM Clean Air Plan

Analytical Assurance Statement



Salford City Council



Oldham Council



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APPROVED

1 Purpose of this Document

- 1.1.1 The purpose of this Analytical Assurance Statement (AAS) document is to consider the limitations, uncertainties and risks in the evidence base, and the implications of these for decision makers. It has been prepared in accordance with the requirements set out in the Joint Air Quality Unit's (JAQU) package of guidance and considers the development and assessment of the Investment-led Plan, and a CAZ Benchmark scenario.
- 1.1.2 The AAS provides a short summary of the level of assurance that can be attributed to a piece of analysis that forms part of the decision-making process. An AAS was previously prepared to support the Previous GM CAP, this AAS draws on and updates some of this analysis, since that document was prepared.
- 1.1.3 This document is part of a suite of documents that have been produced to describe the transport and air quality modelling deliverables for the study. The documents in the series include:
- Local Plan Transport Modelling Tracking Table (T1), which demonstrates that the transport modelling requirements for the study are being met;
 - Local Plan Transport Model Validation Report (T2), which explains in detail how the road traffic model was validated against real-world data;
 - Local Plan Transport Modelling Methodology Report (T3), this document details the development of the future year without scheme model (Do Minimum);
 - Local Plan Transport Model Forecasting Report (T4), which presents baseline and scenario forecasts for GM CAP;
 - Local Plan Air Quality Modelling Tracking Table (AQ1), which demonstrates that the air quality modelling requirements for the study are being met;
 - 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 NO_x and NO₂ concentrations for the base and forecast years, including comparisons with measured concentrations for the base year;
 - Sensitivity Testing Report, which provides a summary of the sensitivity tests carried out on the core scenarios to test areas of uncertainty, understand whether the tests result in a positive or negative benefit and the scale of benefit; and
 - Analytical Assurance Statement (this document), consider the limitations, uncertainties and risks in the evidence base, and the implications of these for decision makers.

2 Greater Manchester Clean Air Plan Overview

2.1 Background to the Clean Air Plan

- 2.1.1 In 2017 the Secretary of State (SoS) for Environment, Food and Rural Affairs issued directions under the Environment Act 1995 requiring many local authorities, to produce feasibility studies to identify the option which will deliver compliance with the requirement to meet legal limits for nitrogen dioxide (NO₂) in the shortest possible time. The legal limit being defined as the long-term annual mean legal limit of 40 µg/m³.
- 2.1.2 In Greater Manchester (GM), the ten local authorities, the Greater Manchester Combined Authority (GMCA) and Transport for Greater Manchester (TfGM) are working together to develop a Clean Air Plan to tackle NO₂ exceedances at the roadside, herein known as Greater Manchester Clean Air Plan (GM CAP).
- 2.1.3 The development of the GM CAP is funded by government and is overseen by the Joint Air Quality Unit (JAQU), the joint Department for Environment, Food and Rural Affairs (DEFRA) and Department for Transport (DfT) unit established to deliver national plans to improve air quality and meet legal limits. The costs related to the business case, implementation and operation of the GM CAP are either directly funded or underwritten by government acting through JAQU and any net deficit over the life of the GM CAP will be covered by the New Burdens Doctrine, subject to a reasonableness test¹.
- 2.1.4 In March 2019, the ten GM Local Authorities collectively submitted an Outline Business Case (OBC)² for the GM CAP to JAQU outlining a package of measures to deliver regional compliance with legal limits for NO₂ emissions in the shortest possible time.
- 2.1.5 In July 2019, the Environment Act 1995 (Greater Manchester) Air Quality Direction 2019 was made, which required all ten of the GM local authorities to implement a charging Clean Air Zone Class C³ with additional measures. There was also an obligation to provide further scenarios appraisal information to demonstrate the applicable Class of Charging CAZ and other matters to provide assurance that the local plan would deliver compliance in the shortest possible time and by 2024 at the latest.

¹ The new burdens doctrine is part of a suite of measures to ensure Council Tax payers do not face excessive increases. [New burdens doctrine: guidance for government departments - GOV.UK \(www.gov.uk\)](https://www.gov.uk/guidance/new-burdens-doctrine-guidance-for-government-departments)

² <https://cleanairgm.com/technical-documents/#outline-business-case>

³ <https://www.gov.uk/government/publications/air-quality-clean-air-zone-framework-for-england/annex-a-clean-air-zone-minimum-classes-and-standards>

- 2.1.6 In March 2020, the Environment Act 1995 (Greater Manchester) Air Quality Direction 2020 was made, which required the submission of an Interim FBC (along with confirmation that all public consultation activity has completed) as soon as possible and by no later than 30 October 2020. The 2020 direction confirmed that legal duty remains to ensure the GM CAP (Charging Clean Air Zone Class C with additional measures) is implemented so that NO₂ compliance is achieved in the shortest possible time and by 2024 at the latest and that human exposure is reduced as quickly as possible. The Ministerial letter accompanying the March 2020 direction confirmed that the minister was satisfied that the main evidence queries from the July 2019 direction had been addressed.
- 2.1.7 A statutory consultation on the proposals took place in Autumn 2020.
- 2.1.8 The GMCA - Clean Air Final Plan report⁴ on 25th June 2021⁵ endorsed GM's Final CAP and policy in compliance with this direction, following a review of all of the information gathered through the GM CAP consultation and wider data, evidence and modelling work. Throughout the development of the previous Plan, the JAQU reviewed and approved all technical and delivery submissions. Within this document, this is referred to as the Previous GM CAP.

2.2 The Previous GM CAP and the impacts of Covid-19

- 2.2.1 Under the Previous GM CAP, GM was awarded £123 million by government for funds aimed at encouraging vehicle upgrades to secure compliance and mitigating the impacts of the GM-wide CAZ. The funds included £15.4 million for bus retrofit, £3.2 million for bus replacement, £10.2 million for Private Hire Vehicles (PHVs), £10.1 million for Hackney Carriages, £7.6 million for Heavy Goods Vehicles (HGVs), £4.4 million for coaches, £2.0 million for minibuses and £70.0 million for Light Goods Vehicles (LGVs).
- 2.2.2 The June 2021 Clean Air Final Plan report set out that the Air Quality Administration Committee (AQAC) had the authority to establish and distribute the funds set out in the agreed GM Clean Air Plan policy. On 21 September 2021 the AQAC approved the establishment and distribution of the agreed bus replacement funds.
- 2.2.3 On 13 October 2021 the AQAC agreed the distribution of Clean Air funds set out in the agreed GM Clean Air Plan policy as follows:
- From 30 November 2021 applications for funding would open for HGVs.
 - From the end of January 2022 applications for funding would open for PHVs, Hackney Carriages, coaches, minibuses and LGVs.

⁴ <https://democracy.greatermanchester-ca.gov.uk/documents/s15281/GMCA%20210621%20Report%20Clean%20Air%20Plan%20-%20FINAL%20FINAL.pdf>

⁵ Also considered by the GM authorities through their own constitutional decision-making arrangements.

2.2.4 On 20th January 2022, the AQAC considered the findings of an initial review of conditions within the supply chain of LGVs in particular following Covid-19 related impacts, which were impacting the availability of compliant vehicles and supply-side constraints resulting in price increases, particularly in the second-hand market⁶. The AQAC agreed that a request should be made to the SoS to pause the opening of the next phase of Clean Air Funds. This was to allow an urgent and fundamental joint policy review with government, to identify how a revised policy could be agreed to deal with the supply issues and local businesses' ability to comply with the GM CAP.

2.2.5 On 8th February 2022, the AQAC noted the submission of a report "Issues Leading to Delayed Compliance Based on the Approved GM CAP Assumptions". The report concluded that on balance, the latest emerging evidence suggested that with the approved plan in place, it was no longer likely that compliance would be achieved in 2024. Members also requested that arrangements were put in place for those vehicles owners who had already placed orders pending funding opening at the end of January to ensure they are not detrimentally impacted by the decision to pause the opening of the funds. Government subsequently issued The Environment Act 1995 (Greater Manchester) Air Quality Direction 2022⁷ which confirmed that the March 2020 Direction had been revoked and required that by 1st July 2022 the GM authorities should:

- Review the measures specified in the local plan for NO₂ compliance and associated mitigation measures; and
- Determine whether to propose any changes to the detailed design of those measures, or any additional measures.

2.2.6 This Direction ('the Direction') also stated that the local plan for NO₂ compliance, with any proposed changes, must ensure the achievement of NO₂ compliance in the shortest possible time and by 2026 at the latest. It should also ensure that human exposure to concentrations of NO₂ above the legal limit is reduced as quickly as possible.

2.3 The Case for a new GM CAP

2.3.1 On 1st July 2022, the AQAC noted that the 'Case for a new Greater Manchester Clean Air Plan⁸ document and associated appendices would be submitted to the SoS as a draft document subject to any comments of GM Authorities.

2.3.2 On 17th August 2022, the AQAC agreed to submit the 'Case for a new Greater Manchester Clean Air Plan' to the SoS as a final version and approved the Case for a New Plan - Air Quality Modelling Report for submission to JAQU.

⁶ <https://democracy.greatermanchester-ca.gov.uk/documents/s18685/ARUP%20Technical%20Note.pdf>

⁷ [The Environment Act 1995 \(Greater Manchester\) Air Quality Direction 2022 \(publishing.service.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/111111/Environment_Act_1995_Greater_Manchester_Air_Quality_Direction_2022.pdf)

⁸ https://assets.cfmassets.net/tlpgbv1k6h2/7jtkDc5AODypDQlw0cYwsl/67091a85f26e7c503a19ec7aeb2e8137/Appendix_1_-_Case_for_a_new_Greater_Manchester_Clean_Air_Plan.pdf

- 2.3.3 The 'Case for a new Greater Manchester Clean Air Plan' set out that challenging economic conditions, rising vehicle prices and ongoing pandemic impacts meant that the original plan of a GM-wide charging CAZ was no longer the right solution to achieve compliance, instead proposing an investment-led, non-charging GM CAP.
- 2.3.4 The primary focus of the 'Case for a new Greater Manchester Clean Air Plan' was to identify a plan to achieve compliance with the legal limit value for NO₂ in a way that considered the cost-of-living crisis and associated economic challenges faced by businesses and residents. This would be achieved through an investment-led approach combined with wider measures that the GM Authorities are implementing and aimed to reduce NO₂ emissions to within legal limits, in the shortest possible time and at the latest by 2026.
- 2.3.5 The 'Case for a new Greater Manchester Clean Air Plan' proposed using the remaining funding that the government has awarded to GM for the Previous GM CAP to deliver an investment-led approach to invest in vehicle upgrades, rather than imposing daily charges, and deliver new Zero Emission Buses (ZEBs) as part of the Bee Network⁹ (a London-style integrated transport network for GM). The new plan would ensure that the reduction of harmful emissions would be at the centre of GM's wider objectives. Within this document, this plan is referred to as the 'Investment-led Plan'.
- 2.3.6 The GM Authorities committed to a participatory approach to the development of the new plan to ensure that the GM Authorities' proposals would be well-grounded in evidence in terms of the circumstances of affected groups and possible impacts of the new plan on them, and therefore the deliverability and effectiveness of that plan.
- 2.3.7 Between August and November 2022, the GM Authorities carried out engagement and research with key stakeholders - vehicle-owning groups and representatives of other impacted individuals, such as community, business, environment and equality-based groups. This activity included targeted engagement sessions with all groups, and an online survey and supporting qualitative research activity with vehicle-owning groups.
- 2.3.8 Input from those engaged informed the ongoing policy development process as the GM Authorities developed the package of measures forming the Investment-led Plan.

⁹ The Bee Network is Greater Manchester integrated transport system joining together bus, Metrolink, rail and active travel
<https://tfgm.com/corporate/business-plan/case-studies/bee-network>

2.4 The Investment-led Plan and the impact of bus retrofit issues

2.4.1 Having submitted the 'Case for a new Greater Manchester Clean Air Plan'¹⁰ in July 2022, the GM Authorities were asked by government in January¹¹ 2023 to:

- *Provide modelling results for a benchmark CAZ to address the persistent exceedances identified in central Manchester and Salford, in order for these to be compared against your proposals.*
- *Identify a suitable approach to address persistent exceedances identified in your data on the A58 Bolton Road in Bury in 2025, and to propose a suitable benchmark.*
- *Set out how the measures you have proposed will be modelled and evidenced overall, and to ensure that they are modelled without any unnecessary delay.*

2.4.2 The GM Authorities undertook the work required to supply this further evidence and on 8th March 2023 submitted the report 'Approach to Address Persistent Exceedances Identified on the A58 Bolton Road, Bury'¹². GM Authorities also worked to address the remaining two requests from government by June 2023 on the basis of providing further information to support its Investment-led Plan and testing the proposal against a suitable benchmark CAZ, herein referred to as the 'CAZ Benchmark'.

2.4.3 In April 2023, government advised TfGM that it was to pause any new spending on bus retrofit as it had evidence that retrofitted buses have poor and highly variable performance in real-world conditions¹³. This new evidence followed a JAQU-funded study to quantify nitrogen oxide (NO_x) and NO₂ emissions from buses under real-world driving conditions in three cities across the UK, including Manchester (monitoring took place in Manchester City Centre between 21st November and 12th December 2022). The monitoring indicated that retrofitted buses were not reducing emissions as expected, with significant variation in performance between bus models with retrofit technologies. Furthermore, emissions of primary-NO₂ (as opposed to NO_x) were highly variable, potentially worsening roadside NO₂ concentrations despite an overall reduction in NO_x emissions.

2.4.4 Government therefore commenced a six-month focused research programme to quickly investigate the causes of this poor performance and scope how it could be improved, which was anticipated to be reported in Autumn 2023.

¹⁰ https://assets.ctfassets.net/tlpgbvvy1k6h2/7jtkDc5AODypDQlw0cYwsl/67091a85f26e7c503a19ec7aeb2e8137/Appendix_1_-_Case_for_a_new_Greater_Manchester_Clean_Air_Plan.pdf

¹¹ <https://democracy.greatermanchester-ca.gov.uk/documents/s24937/Appendix%201.%20Ministerial%20Letter%20to%20GM%20with%20attachment.pdf>

¹² <https://democracy.greatermanchester-ca.gov.uk/documents/s24939/Appendix%203.%20GM%20CAP%20A58%20Bury%20Measure%20Report%20DRAFT%20for%20AQAC%20Approval%20Feb%202023.pdf>

¹³ <https://democracy.greatermanchester-ca.gov.uk/documents/s27699/Appendix%201.%20Letter%20from%20DfT%20to%20Greater%20Manchester%20regarding%20Bus%20Retrofit%20Update.pdf>

- 2.4.5 In the light of government's new evidence, JAQU issued revised general guidance¹⁴ to authorities producing CAPs nationwide. In summary, this required that air quality modelling should no longer assume any air quality benefits from a retrofitted bus.
- 2.4.6 GM incorporated the revised guidance, as agreed with JAQU, into the modelling which underpins the development of its CAP to produce a report that appraises the ability of the Investment-led Plan and the CAZ Benchmark to deliver compliance with the legal limit value in the shortest possible time and by no later than 2026. The key findings from government's six-month focused research programme were not available at the time this work was undertaken.
- 2.4.7 The first version of the *Appraisal Report* and supporting documentation was submitted to government in December 2023. The *Appraisal Report* concluded that GM's Investment-led Plan can deliver compliance in 2025 and performs better than a CAZ Benchmark.

2.5 Key developments since December 2023 submission

- 2.5.1 Since the submission of evidence to JAQU in December 2023 there have been a number of key developments, resulting in a need to update the modelling, the *Appraisal Report* and supporting documentation.
- 2.5.2 Further modelling was undertaken in Summer 2024 to consider and address the following key developments:
- Delay to Stockport all-electric bus depot;
 - Changes to bus fleets (operational and planned); and
 - Correction to Euro V retrofit bus modelling emission values.
- 2.5.3 Drafts of the *Appraisal Report* and supporting documentation were updated to take account of the key developments and the Summer 2024 modelling, in preparation for submission to government. These updates did not change GM's conclusion that the Investment-led, non-charging plan can deliver compliance in 2025 and performs better than a CAZ Benchmark.

2.6 Developments following Summer 2024 modelling

- 2.6.1 Following the substantial drafting to update the *Appraisal Report* and supporting material (to address the key developments since the December 2023 submission), two additional issues have arisen.
- 2.6.2 Firstly, a risk identified in the December 2023 submission "Delays to bus depot electrification" has materialised and there is now a delivery delay to the electrification of Queens Road depot. This was due to take place by January 2025, which was the assumed delivery date in the modelling of the Investment-led Plan.

¹⁴ Bus Retrofit Update - Technical Guidance for Local Authorities, JAQU Guidance, May 2023

- 2.6.3 This poses a significant challenge to achieving compliance in 2025, as 73 ZEBs are to be operated out of Queens Road depot. The issue affects 12 bus services, which run through 17 forecast 'Do Minimum' exceedance sites in 2025.
- 2.6.4 Secondly, in July 2024 National Highways also advised TfGM that the temporary speed limit on the M602 is to be removed, and the 70mph speed limit reinstated. The M602 temporary speed limit is assumed to be in place in the Investment-led Plan modelling assumptions.
- 2.6.5 The implications of these two issues are addressed in the Supplementary Appraisal Report, included as part of this evidence submission documentation. Therefore, the Appraisal Report and associated documentation, including this report, should be read in conjunction with the Supplementary Appraisal Report.
- 2.6.6 In addition, since the drafting of the Appraisal Report and supporting material, government published the 'Bus Retrofit Performance Report'¹⁵ on the 12th September 2024. The key findings of this report include that the retrofit technology fitted onto retrofitted buses is not reducing NOX emissions to the levels expected and retrofit performance is highly variable. These findings are consistent with the guidance issued in May 2023. Therefore, the publication of the study findings has no impact on the Investment-led Plan, the Appraisal Report and supporting material.

¹⁵ <https://assets.publishing.service.gov.uk/media/66e1ab11951c1776394a003c/bus-retrofit-performance-24.pdf>

3 Reasonableness of the Analysis / Scope for Challenge

3.1 Have we been constrained by time or cost, meaning further proportionate analysis has not been undertaken?

- 3.1.1 Since the Outline Business Case (OBC) submission in 2019, significant additional work has been undertaken to inform the development of the Previous GM CAP and the Investment-led Plan.
- 3.1.2 The areas of concern at the time of the OBC, and subsequent Option for Consultation forming the basis for the Previous GM CAP, have been targeted and additional work undertaken to strengthen the evidence base and this work has been shared with JAQU.
- 3.1.3 The GM CAP programme was delayed in 2020 as a result of the pandemic, with consultation delayed until October. In June 2021, the GMCA endorsed the policy forming the Previous GM CAP. Throughout the development of the previous Plan, JAQU reviewed and approved all technical and delivery submissions.
- 3.1.4 Following a review prompted primarily by conditions within the supply chain of Light Goods Vehicles (LGVs) and the availability of compliant vehicles, in August 2022, the Air Quality Administration Committee (AQAC) submitted the 'Case for a new Greater Manchester Clean Air Plan' to the SoS. The 'Case for a New GM CAP' set out that challenging economic conditions, rising vehicle prices and ongoing pandemic impacts meant that the original plan of a city-region charging CAZ was no longer the right solution to achieve compliance, instead proposing an investment-led, non-charging GM CAP.
- 3.1.5 Throughout this period, the analytical team has improved various aspects of the modelling process, incorporated the most up to date data, and produced analysis to support the project team in developing and making the case for the measures comprising the GM CAP. The updates to the modelling process have included:
- Changes to the transport model network to reflect the latest position on the City Centre Transport Strategy (CCTS);
 - Updates to transport demand to reflect the impact of the CCTS;
 - Updates to the vehicle fleet profiles to reflect recent information on delay to natural fleet turnover using data from SMMT and local ANPR;
 - Relevant TAG updates including EV car projections;
 - Revised position on the impact of bus retrofit following advice from JAQU;
 - Improved knowledge of the level and nature of bus service provision reflecting the new franchise arrangements;
 - Recent data from the GM Taxi licensing database; and

- Behavioural responses were updated within the cost response models to reflect recent Regional Centre ANPR data. The responses were benchmarked against JAQU guidance and other local authorities. Note this is only relevant for the CAZ Benchmark scenario.
- 3.1.6 In agreement with JAQU, a series of sensitivity tests have been identified and undertaken which are referenced within this document and detailed in the Sensitivity Testing Report. These have been designed to inform understanding of the potential impact of variations to the assumptions which underpin the modelling process and mitigate the risks associated with those potential variations.
- 3.1.7 We do not believe that there is any more proportionate analysis that could have been undertaken based on our internal reviews and JAQU's approval of all technical material delivered thus far.
- 3.2 Is there further analysis that could be done which would lead to different conclusions?**
- 3.2.1 Considerable additional analysis has been undertaken since the OBC and reported to JAQU.
- 3.2.2 Sensitivity tests have now been modelled on the Investment-led Plan, in agreement with JAQU, covering the following:
- Emissions at Low Speeds;
 - Projections of Primary NO₂;
 - Approach to zonal verification versus whole domain;
 - Primary NO₂ verification using continuous monitoring data;
 - Alternative bus retrofit assumptions;
 - Proportion of taxis operating in the Regional Centre;
 - Projection of fleet mix age profile from 2023 ANPR data;
 - Age of model - traffic growth associated with the Regional Centre; and
 - EFT emissions database version.
- 3.2.3 Consideration has also been given to other factors with qualitative analysis of the following:
- Older fleet assumptions including reduced EV car uptake;
 - Lower EV taxi uptake;
 - Increased non-GM licensed PHV numbers operating within GM; and
 - Delayed deployment of zero emission buses.

3.3 Does the analysis rely on appropriate sources of evidence?

- 3.3.1 The analytical process has drawn on numerous data sources considered appropriate and relevant. By and large, the analysis relies on well-established data sources and on values provided by JAQU, DfT's TAG and the Green Book. However, the GM emissions modelling utilises DEFRA's EFT v9.1a and the associated suite of background maps and NO_x to NO₂ Calculator tools. It is not possible to apply later versions of the EFT toolkits, because these versions exclude the functionality to use a 2016 base year (the base year for the GM CAP Modelling). The approach to using GM specific fleet mix and forecasts reduces the impact of changes in updates to the EFT, and sensitivity testing of the EFT version and fleet mix projections used have been undertaken. The data sources are more fully described in the relevant technical documents and appendices.
- 3.3.2 There were three local data sources referred to in the previous AAS; any changes to these and subsequent new data that has been collected since are summarised in **Table 3-1**.

Table 3-1 Local Data Sources

Item		Previous GM CAP Data Source and discussion	Update as at Summer 2024
1	Vehicle fleet composition	Utilised information from Automatic Number Plate Recognition (ANPR) cameras from 2016 and bus/taxi fleet data. This was used to inform the fleet mix in the base year and to forecast the future fleet mix.	Recent (2023) ANPR data has been used to support the analysis and sensitivity testing. The ANPR rolled forwards from 2023 to 2025, vs the 2016 core data rolled to 2025 leads shows an increase in emissions from private cars (+8% - due to a slightly older diesel fleet, which is partially offset by there being a lower proportion of diesel: petrol car traffic), a reduction in emissions from freight (LGV: -4%, HGV: -34%). The influence is greater for HGVs because the emissions reduction between Euro standards is greater than for cars/LGVs.

Item	Previous GM CAP Data Source and discussion	Update as at Summer 2024
		<p>At the GM level in 2025, the difference between the core fleet projection methodology based on 2016 data (which has been adjusted to account for impacts from Covid on vehicle sales and the increased penetration of electric cars), and a post-Covid 2023 ANPR dataset rolled to 2025 is less than 1% in the DM. By comparison, the annual rate of NOx emission decrease is ~9%, so the discrepancy is comparable with approx. 1 month of natural fleet change. Whilst there is variability in the scale of impacts this creates at roads with differing car vs freight usage, this is considered a close agreement.</p> <p>Taxi (PHV and hackney carriage) information has been taken from the GM licensing database for 2023.</p> <p>As a consequence of bus franchising, we now have a significantly improved knowledge of the GM bus fleet with more accurate data on the nature of the existing vehicles and where they are used, and robust forecasts of the future position following the franchise rollout.</p>
2	AQ Monitoring	<p>Ongoing monitoring of ambient NOx / NO₂ concentrations at sites across GM: the ADMS model has been validated against results from local air quality monitoring. This is described in more detail in the AQ2. Additional monitoring is being put in place to support scheme development and monitoring, to ensure monitoring is well aligned with the location of the last remaining sites of non-compliance</p> <p>The CAP monitoring survey has been extended to cover all roads forecast to be in exceedance by the Target Determination modelling for 2021.</p> <p>The 2020, 2021 and 2022 measured concentrations were impacted by the travel and economic restrictions as a result of Covid-19, and subsequent recovery. However, there is good agreement between the locations of forecast and measured concentrations in 2023. Direct comparison is complicated by the variable performance of bus retrofit equipment. Details are provided in AQ3.</p>

Item		Previous GM CAP Data Source and discussion	Update as at Summer 2024
3	Behavioural Responses	Behavioural responses to a CAZ derived from a Stated Preference Survey conducted in Bristol in 2018, re-weighted to better reflect local characteristics. This replaced the use of survey data from London's ULEZ scheme, used in earlier iterations of the modelling. On balance, it was considered that Bristol was more similar to GM than London in terms of demographic and travel characteristics and therefore that this data was more suitable.	<p>Note this is now only applicable to the CAZ Benchmark scenario.</p> <p>The cost response models that were developed and shared with JAQU for the Option Previous GM CAP (Previous GM CAP, which included a GM-wide CAZ) have been amended to reflect trip frequencies and fleet profiles for the Regional Centre.</p> <p>The outputs from those models have been benchmarked against other authority predictions and outturn data from the monitoring published in JAQU Guidance¹⁶, and found to be comparable. Further details provided in T4 Appendix A.</p>

3.4 How reliable are the underpinning assumptions?

3.4.1 **Table 3-2** identifies the underpinning assumptions in the modelling process. Commentary is now added regarding the extent that the position has changed. The GM Authorities have sought to apply reasonable modelling assumptions associated with the Investment-led Plan, which are set out in detail in the T4 and AQ3 reports. We have used sensitivity testing to assess the resilience of the Plan achieving compliance. There are a number of pessimistic assumptions with regard to bus and taxi. These include:

- for roads where exceedances are not forecast, a high proportion of retrofitted Euro V buses have been assumed because available OEM Euro VI and ZEB have been deployed based on known available fleet. This is particularly the case for the Bus Franchising Tranche 3 and the Stockport depot where the ZEBRA funding of the depot electrification has been delayed. This means that extrapolation of concentrations beyond 2025/2026 is likely to over-predict bus emissions and under-predict the rate of improvement because further fleet improvements beyond the 2025 scenario are not incorporated
- there is no allowance for compliant hackney carriages to upgrade to ZEC models despite funding being available
- taxi emissions are modelled based on the GM-wide average fraction of taxi flow of 7% as a proportion of total car trip demand, based on the evidence from ANPR data used for Target Determination. However, whilst ANPR evidence indicates that this continues to be representative of the majority of GM, the prevalence of taxi movements is greater in the Regional Centre. Inside the IRR taxi movements can be up to 25% of car traffic in 2023. The modelled impact of the Investment-led Plan will therefore underestimate the effect of the taxi upgrade.

¹⁶ Third Wave Local Authorities – Guidance Evidence Package Transport and Air Quality, JAQU

Table 3-2 Underpinning Assumptions in the Modelling Process

Source of uncertainty	Previous GM CAP Discussion	Update at Summer 2024
<p>Vehicle purchasing / ownership patterns and trends</p>	<p>The projected fleet mix for buses and other road traffic in the forecast year is estimated, based on an assumption that the age profile of the vehicle fleet remains unchanged over time.</p> <p>ANPR data has revealed that the GM fleet is older than the national average.</p> <p>There is some emerging national evidence of slowing new vehicle sales and of a shift from diesel to petrol in new car purchases.</p> <p>Sensitivity testing suggests that a slower change in the fleet age over time could result in mass NOx emissions for 2023 that are approximately 25% greater than the reference case.</p> <p>Monitoring of the fleet profile will be required. New ANPR survey data from 2019 will assist in determining the projection rate used between 2016 to 2021/23.</p>	<p>The forecast years for the modelling are now only 1-2 years away with consequently reduced uncertainty in the likely fleet composition. Sensitivity testing of fleet composition has also been undertaken.</p> <p>GM has used the national SMMT vehicle registrations to incorporate fleet impacts from Covid-19. Analysis of fleet projections using the roll-over methodology pivoting from the Base 2016 dataset, to projections from 2023 datasets show good agreement as described in the sensitivity testing report.</p> <p>Monitoring of the on-road fleet will be undertaken throughout the lifetime of the Plan using ANPR data and can be compared with the quarterly/annual SMMT releases to assess whether the Plan is likely to be affected by changes to purchasing patterns other than those forecast.</p>
<p>Trends in background emissions</p>	<p>Background emissions are based on the DEFRA background emissions maps 2015. Comparison of this with local background measurements suggests that the DEFRA maps are lower than monitored values.</p> <p>Background emissions are higher than average in parts of GM, accounting for 25 µg/m³ at some non-compliant sites, after removal of the transport sector, in 2021.</p> <p>GM assumes that DEFRA will keep abreast of trends in background emissions. GM will apply any new guidance as it emerges where possible.</p>	<p>No further update. It is not considered likely that Covid-19 has had a significant impact on background emissions in 2025/2026.</p> <p>Defra update national tools and background maps periodically, however updating the modelling to incorporate these datasets would mean re-opening the Target Determination process. The LAQM tools have not retained the functionality with a 2016 Base required to enable direct sensitivity testing.</p>
<p>Age of model and traffic growth trends</p>	<p>The SATURN model forecasts traffic growth of around 12% between 2016 and 2025, reflecting population and economic growth. Current trends suggest traffic is not growing at this rate and therefore sensitivity testing of a low traffic growth scenario has been carried out.</p>	<p>Whilst recent modelling has included several updates to the committed transport schemes and representation of bus, the background traffic growth forecasts reflect the existing Do Minimum forecasts.</p>

Source of uncertainty	Previous GM CAP Discussion	Update at Summer 2024
	<p>Sensitivity testing suggested that a plausible low growth scenario resulted in relatively small reductions in vehicle kms and NOx emissions of about 6% relative to the Do Minimum scenario.</p>	<p>A sensitivity test has been undertaken which reflects the age of the model, in particular with regard to the traffic growth forecasts which were compared to recent observed traffic levels in the vicinity of the Regional Centre. This test aligns the model to those lower observed levels in the Regional Centre.</p> <p>Analysis has been undertaken of the long-term trends in traffic reduction observed within the Regional Centre (see Appendix A to T3, CCTS Demand) which shows as long term trend of falling traffic flows within the Regional Centre over the last 15 years.</p>
<p>Fuel costs and other wider changes in costs/travel time</p>	<p>Traffic modelling assumes fuel costs as recommended by TAG. In theory, if fuel costs or other similar costs were to change in future, it could have an impact on vehicle purchasing choices and on kilometres travelled.</p> <p>Sensitivity testing of the GM CAP has demonstrated that the conclusions are not sensitive to fuel costs.</p>	<p>The recent updates to the modelling have incorporated the latest values of time and operating cost from May 2023 TAG Databook (V1.21) and other relevant TAG parameters. It is noted a new version of the TAG Databook was released in May 2024, this was following the completion of the modelling, though does not contain materially different parameters in the context of GM CAP.</p>
<p>Effectiveness of future emissions standards</p>	<p>It is assumed that future emissions standards perform as planned. The performance of earlier emissions standards against forecasts has been variable.</p> <p>This is a known source of uncertainty that cannot meaningfully be mitigated at a local level.</p>	<p>Whilst the performance of pre-Euro VI standards has been demonstrated to be poorer than originally expected, real-world emissions testing of Euro VI vehicles that are now operating on the road provides greater confidence in future forecasts.</p>
<p>Assumptions about real-world emissions</p>	<p>Emissions rates have been based on the EFT version 8.0. The emissions rates of vehicles in the real world may differ from those modelled. The analysis in the base year is calibrated to real data and so this is internalised into the analysis. However, this cannot be adequately weighted to differing vehicle types/ages/fuel types which affects future year assumptions as the fleet renews over time.</p> <p>This is a known source of uncertainty that cannot meaningfully be mitigated at a local level.</p>	<p>Emissions rates have been based on the EFT version 9.1a. The emissions rates of vehicles in the real world may differ from those modelled. The analysis in the base year is calibrated to real data and so this is internalised into the analysis. However, this cannot be adequately weighted to differing vehicle types/ages/fuel types which affects future year assumptions as the fleet renews over time.</p> <p>This is a known source of uncertainty that cannot meaningfully be mitigated at a local level.</p>

Source of uncertainty	Previous GM CAP Discussion	Update at Summer 2024
		<p>GM's modelling applies version 9.1a of the government's Emissions Factor Toolkit (EFT); EFTv12 is now available but is not compatible with GM's modelling process, because the base year of 2016 isn't available. EFTv12.1 reduces car, LGV and HGV emissions, compared with v9.1 for the 2025 fleet mixes, based on more recent real-world emissions testing data updating the Copert emissions functions used to calculate NO_x and f-NO₂ emissions. Sensitivity testing has been completed using EFT v12.1 emission factors.</p> <p>GM has carried out sensitivity testing as per JAQU's guidance to assess the impact on the GM CAP if the average primary NO₂ fraction (f-NO₂) in exhaust emissions from roadside vehicles is 40% lower than assumed in the core modelling for future years.</p> <p>The tests showed that with either EFTv12 or in the event that f-NO₂ rates were to substantially reduce then this would reduce NO₂ concentrations and improves confidence in the GM CAP achieving compliance as forecast.</p> <p>GM has incorporated the JAQU guidance on the variable exhaust emissions performance of retrofitted buses, based on real-world measured data including from GM surveys. It is noted that JAQU under still undertaking research which is due to be published, and will be kept under-review. However, as part of the Investment-led Plan, the targeted deployment of OEM Euro VI and ZEB fleet at locations of exceedances reduces the influence of this source of uncertainty with the scheme in place.</p>
Assumptions about the impact of urban canyons	GM is a complex urban environment. Overall, it is considered likely that there is considerable variation of modelled concentrations in central Manchester due to the presence of canyons. The assessment has applied a recognised best practice approach to representing model predictions in the vicinity of canyons. It is also noted that the highly variable and complex nature of modelling this type of environment is not readily compatible with the overall approach of the EU Ambient Air Quality	<p>No change.</p> <p>GM has implemented monitoring at locations of exceedance, including at streets with canyons in the regional centre.</p> <p>There is variability within the monitoring, which is frequently observed in NO₂ datasets and direct comparison with 2023 and the modelling is not reliable due to a variety of factors (such as retrofit bus operations, road layouts and</p>

Source of uncertainty	Previous GM CAP Discussion	Update at Summer 2024
	<p>Directive¹⁷, which indicates model outputs should be representative of relatively long stretches of road, not affected by changes to traffic flow or junctions. Canyons are a similar effect resulting in spatial discrepancy in NO₂ concentrations.</p> <p>JAQU guidance recognises this issue and recommends additional Scheme Evaluation Monitoring is implemented in canyon locations.</p>	<p>construction and model forecast year fleet mixes). However, there is generally good agreement between roads forecast to be in exceedance, and measured exceedances in 2023, as set out in AQ3.</p>
<p>Gradients and Topography</p>	<p>The effects of gradients have not been able to be incorporated in the timescales. The locations of significant gradients were reviewed and it is considered that this would have only a limited effect on verification or key output sites. Topography of the road network is difficult to determine as the road network is not always at grade.</p> <p>However, the last points of compliance in the modelling are not significantly affected by gradients.</p>	<p>No change.</p>
<p>Assumptions about bus service patterns and fleet profile</p>	<p>The highway modelling is based on 2015 bus service patterns. Bus mileage has, however, been falling in recent years and it is possible that this approach over-estimates likely future bus mileage.</p> <p>There is uncertainty around bus vehicle upgrade patterns. The impact of new funding to support the purchase of electric buses has not been incorporated in the analysis.</p>	<p>As a result of Bus Franchising, the knowledge base on the bus fleet is significantly improved. The traffic model reflects the latest (2023) bus service provision (vehicle frequency) in the Do Minimum modelling and the forecast position reflects the contracted arrangements under franchising and the developing electrification programme.</p> <p>The Investment-led Plan is dependent on the bus related measures, notably the deployment of ZEBs on key routes. The ZEB vehicles are expected to arrive in GM on programme, but the delays to the ZEBRA funded Stockport depot electrification mean the allocated ZEBs need to be relocated to other depots to be electrified. This wider depot electrification programme is subject to greater uncertainty, but the I is based on the confirmed depots to be electrified and the programmed status at the point of the appraisal modelling (though there are deliverability risks associated with electrification).</p>

¹⁷ Directive 2008/50/EC

Source of uncertainty	Previous GM CAP Discussion	Update at Summer 2024
		<p>Forecasts beyond 2025/26 become increasingly uncertain because future bus fleet upgrades are not incorporated, and the electrification of the Stockport depot is not reflected into the extrapolation process.</p> <p>However, overall this is significant upgrade compared to the OBC/Option for Consultation phase, because GM Bus Franchising has enabled much greater granularity and control of bus fleet and services, and now includes the known upgrade to ZEB and OEM Euro VI fleet.</p>
<p>Age of Model: Assumptions about future growth and related schemes</p>	<p>The GMVDM matrices were used to calculate demand changes; these matrices included early estimates of GMSF (GM Spatial Framework) growth, which were not available at the time that the 2021 CAP matrices were developed. It needs to be borne in mind, however, that the GMSF is still open to consultation and will be subject to uncertainty. Overall traffic growth has also been constrained to NTEM forecasts.</p> <p>It was decided as part of this process to also include all of the 2025 schemes in the 2023 networks, to ensure that both networks were topologically the same. This approach was adopted to avoid having to update the road width and street canyon files that had been developed for use with the 2025 dispersion model, which would have been time-consuming and could have delayed the project.</p>	<p>GM has carried out a review of any delays or cancellations to future schemes that affect the topology of the road network and of the assumed networks for 2025.</p> <p>The most significant network changes relate to CCTS where the latest position is now reflected.</p> <p>The model has also been used to assess the impact of demand changes into the Regional Centre as a consequence of CCTS.</p>
<p>Other assumptions about road network and weather conditions affecting air quality forecasting</p>	<p>The GM region is a very large study area, with a diverse range of topography and surface features. Additionally, road transport fleet age may vary depending on the nature of road type or function.</p> <p>This area has necessarily been modelled as a homogenous area in ADMS.</p>	<p>Meteorological data is a key input in any dispersion modelling process which has the potential to impact on the predicted performance of measures. The fact that the same meteorology has been assumed in the projected year as in the base year may be causing an over or under estimation of NO₂ concentrations in the projected year. It is a well-established fact that inter-annual variability in meteorology can have a significant impact on NO₂ concentrations.</p>

Source of uncertainty	Previous GM CAP Discussion	Update at Summer 2024
		<p>The modelling has used a 2016 base year meteorological dataset, for all Base and Forecast years. As per JAQU guidance, meteorological data from the same station has been used for 2015, 2017 and 2018 to understand the variability this produces in forecast scenario NO₂ concentrations. This confirms that the performance of the Plan is sensitive to weather conditions, as would be expected.</p> <p>JAQU have developed statistical analysis tools within their monitoring and evaluation team to enable the analysis of the influence of meteorology on air quality, which will be used to ascertain the success of clean air plans. GM will work with JAQU to ensure local monitoring data can be utilized within these statistical analysis tools, so that the impact of actual weather conditions on the performance of the Plan can be understood.</p>

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4 Risk of Error / Robustness of the Analysis

4.1 Has there been sufficient time and space for proportionate levels of quality assurance to be undertaken?

- 4.1.1 The traffic and air quality modelling process has been agreed with JAQU via ongoing technical discussions throughout the lifetime of the project. The analysis has been carried out by specialists at TfGM and their consultants.
- 4.1.2 Since the December 2023 submission, GM was in the process of updating the emissions modelling tool to prepare for the sensitivity testing on the impacts of bus retrofit performance when an issue was found in the emissions modelling. It was identified that the amount of primary-NO₂ has been underrepresented in the model outputs and therefore in the predicted NO₂ concentrations that have been reported in the December 2023 submission for both the with and without scheme scenarios.
- 4.1.3 The GM CAP modelling process is a complex series of models that links vehicle travel demand, the dispersal of these emissions into the atmosphere and in the emissions modelling. When a series of revisions to the bus emission factors were made (following evidence from JAQU that bus retrofit solutions from Euro V vehicles have poor and highly variable performance in real world conditions) one of the calibrated parameters (a single standard formula in an Excel spreadsheet tool, that applies a static value for primary nitrogen dioxide in the bus emissions database) was not updated.
- 4.1.4 Following this issue being identified and to ensure the robustness of modelling going forward, TfGM's Head of Modelling & Analysis has reviewed the modelling processes, to consider any weaknesses in the process, to strengthen the Quality Assurance process for these steps and to update the checking/reviewing process.
- 4.1.5 TfGM's Audit & Assurance Team have audited the modelling analysis that underpins the Clean Air Plan submission and reviewed the documentation of the analysis to assure that it has been completed as per the documented QA process. Further information is provided in the *Air Quality Modelling Assurance Report*, included as part of this evidence submission documentation.

4.2 How complicated is the analysis?

- 4.2.1 Traffic and air quality modelling are inherently complex tasks, but the tools have been used extensively by GM for many years and shown to be reliable and robust in their application.
- 4.2.2 The duration of the project, and the number of options and scenarios that have been considered both during and since the submission of the OBC means there is a detailed understanding within the project team of how the process is likely to react in a given situation which aids checking and verification.

4.3 How innovative is the approach?

- 4.3.1 The underlying traffic model, although large, would be seen as typical within the industry and has been developed in accordance with standard TAG processes. The use of cost models to forecast behavioural responses is bespoke to this project but the outputs have been benchmarked against other authorities' models and outturn observed data and found to be comparable. The cost models themselves have been shared with JAQU and approved by them.
- 4.3.2 The emissions modelling tools have incorporated innovative approaches such as a roll-over methodology using local ANPR for forecast fleet age, and new vehicle sales data to reflect the impact of Covid-19, economic conditions and the changes to uptake of EV cars. These techniques have been compared to 2023 ANPR datasets, and shown to have been robust in forecasting 2025 from the original 2016 baseline dataset.
- 4.3.3 The air quality modelling has followed established best practice following published guidance and approved tools.

4.4 Have sufficiently skilled staff been responsible for producing the analysis?

- 4.4.1 GM's in-house team has expertise in traffic and air quality models that has been developed over a considerable period. They have been supported in this project by consultants who were chosen following a competitive tendering process where the experience and skills of the individuals being put forward was a key factor in their selection.

5 Uncertainty

5.1 What is the level of inherent uncertainty (i.e. the level of uncertainty at the beginning of the analysis) in the analysis?

- 5.1.1 There is a level of uncertainty associated with producing forecasts from any model and in this instance there are two core components, the traffic model and the emissions/air quality model. The performance of the base traffic model in terms of its ability to replicate observed conditions is reported in T2. The performance of the Air Quality model in representing the base year condition is reported in AQ3.
- 5.1.2 The performance of the modelling and representation of the base year, have previously assessed by JAQU and the TIRP and deemed fit for purpose.
- 5.1.3 The additional uncertainty in regard to forecasting into the future is to some degree mitigated as the forecast horizon is only 1-2 years into the future. The standard uncertainties around models which are ultimately reliant on national economic forecasts will remain however there is no inherent bias between the assessment of the Investment-led Plan and the CAZ Benchmark as a consequence of the tools being used.
- 5.1.4 There is also materially less uncertainty with regard to the forecasts for the Investment-led Plan as that is less reliant on behavioural change than the CAZ Benchmark. The measures associated with the Investment-led Plan, and commentary on the uncertainty with regards to the traffic modelling follows:
- Bus Fleet enhancements – the changes in vehicle types required by the Investment-led Plan are embedded within the franchise contracts providing a greater degree of certainty. Although the Investment-led Plan forecast of compliance in 2025 depends on the timely delivery of the wider depot electrification programme (which is an identified risk in the *Appraisal Report*);
 - Bus Routeing – the franchise process also provides GM with control over which bus types use which routes therefore enabling the targeting of the lowest emission vehicles in those locations where they are most needed;
 - Local measures – the traffic management measures incorporated within the Plan are relatively small-scale, involving changes to traffic signal operations and some limited physical alterations to make certain routes within the Regional Centre less attractive to vehicles. The traffic impacts of these measures are set out in T4, with additional detail in Appendix 3 and 4 of the *Appraisal Report*. As these do not require significant capital cost or construction, the risk of delays in implementation should be low; and

- Taxi measures – any PHV or hackney carriage, which remains licensed within GM, will be compliant in order to meet the emission standards associated with those licences. There is a risk that the currently observed issue of some GM based taxis licensing in other authorities could increase in order to avoid those standards, but is mitigated somewhat by the model underpredicting the use of taxis within the Regional Centre.
- 5.1.5 It is also noted that the local traffic measures are supported by a series of enforcement measures. The purpose of these is to ensure a driver response which is more aligned to the modelled assessment. In the case of the Regent Rd corridor, average speed limit enforcement is proposed for the whole section of Regent Rd (between M602 and Inner Ring Road). This comprises of speed enforcement on the section of Regent Rd where the speed limit is reduced from 40mph to 30mph, plus the remaining existing 30mph section through the exceedance site. The approach to introduce average speed cameras, rather than spot location cameras was identified as an enforcement option which is more likely to achieve a closer alignment to the modelled position. Also, the inclusion of enforcement yellow box junctions was also identified to ensure a level of driver behaviour through the junctions which would align more closely to modelled junction turning behaviours.
- 5.1.6 The CAZ Benchmark has additional uncertainty as a consequence of the need to reflect a response to a charge; however, the model has been shown to provide similar outputs to both other authorities' forecasts and the actual outturn data from other local authorities such as the Birmingham CAZ¹⁸.
- 5.1.7 Included within the CAZ scenario is funding support for certain vehicle types to aid upgrade to compliant vehicles. Whilst the spread of ANPR data across GM provides a reasonable picture of the general level of compliance by vehicle type and the associated frequency of those trips, we do not have a full cordon of trips associated with the CAZ i.e. entering the IRR, although ANPR cameras close to the IRR from 2023 were used to understand trip frequency for journeys in the vicinity of the Regional Centre and reflects a refinement since the OBC.
- 5.1.8 Reasonable assumptions have been made but this does mean there is a level of uncertainty around the revenue from the CAZ Benchmark and the funding required to support it.
- 5.1.9 Separately, the opening date of a CAZ also contains uncertainty. The forecasts for 2025 and 2026 are considered optimistic because they assume full operation and necessary pre-opening upgrades to have occurred from the first day of the respective year, which is not considered realistic. It is considered that a realistic opening date for a CAZ would be July 2026.

¹⁸ <https://www.brumbreathes.co.uk/>

- 5.1.10 There is considered to be greater confidence in the Investment-led Plan modelling which applies known processes associated with bus and taxi upgrades/electrification, and implementation of traffic management measures, albeit with delivery risks of bus electrification and traffic management infrastructure which could affect the modelled assumptions. The CAZ uses behavioural responses that are less direct and forecast to be less impactful, and also contains delivery risks to the implementation programme.
- 5.1.11 A range of sensitivity tests have been undertaken, with the most relevant set out below, with their associated likelihood of occurring (or application in an updated appraisal) and general direction of worsening:

Table 5-1: Summary of Sensitivity Tests

Sensitivity Test	Likelihood	Scale of Impact
Projections of f-NO ₂	More Likely	Large Reduction
Bus Retrofit Low	Less Likely	Medium Reduction
Bus Retrofit High	More Likely	Large Reduction
Higher proportions of taxi inside the IRR	Very Likely	Small Increase
Fleet age projections by using 2023 ANPR 2023 data	More Likely	Small Increase
Reduced Regional Centre Travel Demand	Very Likely	Medium Reduction
EFT v12.1 Emission Factors	Very Likely	Medium Reduction

- 5.1.12 Of these sensitivity tests, the More or Very Likely tests generally reduce concentrations by more than those which increase concentrations. These tests provide reassurance that the Investment-led Plan is more likely to achieve compliance than the core scenario assumptions forecast. Further analysis of these influences is considered in the Sensitivity Testing Report.

5.2 Has the analysis reduced the level of uncertainty? What is the level of residual uncertainty (the level of uncertainty remaining at the end of the analysis)?

- 5.2.1 The updates to the modelling and air quality assessment of this submission has utilised, where available, the latest technical guidance, together with newly available information to support the assessment of GM CAP.
- 5.2.2 Sensitivity testing has been undertaken, and provides reassurance in the context of key modelling assumptions and variables, which reduce the level of uncertainty. The tests demonstrate that assumptions can have differential impacts at specific locations depending on the local conditions, notably:
- fleet mix (which is also a function of the Investment-led Plan measures); and
 - peak hour congestion.
- 5.2.3 However, generally across the 2025 exceedance sites, the tests indicate the methodology is more likely to be pessimistic (over-predict) than optimistic (under-predict) with the Investment-led Plan measures in operation, increasing confidence of the delivery of compliance.
- 5.2.4 In developing the CAP, Greater Manchester has adopted an evidence-led approach, using the most reliable information available to formulate and scrutinise the Investment-led Plan. Despite some inevitable uncertainties, with regards to the age of the model, within forecast year modelling based on a 2016 base traffic model, these have been addressed by performing sensitivity tests and analysing current observed data against modelled predictions.
- 5.2.5 These sensitivity tests have provided confidence in the robustness of the modelling assumptions and the decisions being derived from them. Nonetheless, as the Plan progresses towards implementation, subject to government agreement, there is a need for further evidence to track and assess how effectively the Investment-led Plan is delivering compliance with legal limits. It is at this time, the implementation stage, that an update of the GM CAP modelling tools is deemed timely to underpin the adaptive planning process.
- 5.2.6 This update will include aligning the models with recent data from 2023, such as traffic counts, ANPR data, and information on retrofitted buses. It will also take into account new results from air quality monitoring in 2023. This information has already been submitted to JAQU through the ASR and will serve as a benchmark to gauge the Plan's performance. The revised modelling will incorporate the latest emissions factors along with other tools like the NO_x to NO₂ calculator and improvements made to the ADMS canyons module. An updated 2023 model will be crucial to demonstrate that the implemented scheme has achieved compliance and will help with the ongoing annual evaluation by comparing forecasts with real-world observations.

5.2.7 The major advantage of this refined modelling is that it will enhance our understanding of the relationship between actual air quality conditions and those predicted by the models. Notably, it will facilitate tracking of the GM CAP's trajectory toward forecasted outcomes, offering early insights into whether air quality compliance might be achieved sooner than expected, or if certain sites may need additional analysis or refinement of measures as part of the adaptive planning strategy.

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