MAY 2020

NORTH STAFFORDSHIRE LOCAL AIR QUALITY PLAN

UNAPPROVED OUTLINE BUSINESS CASE
APPENDIX 31 - Analytical Assurance Statement

Staffordshire County Council

NEWCASTLE UNDER LYME BOROUGH COUNCIL

City of Stoke-on-Trent

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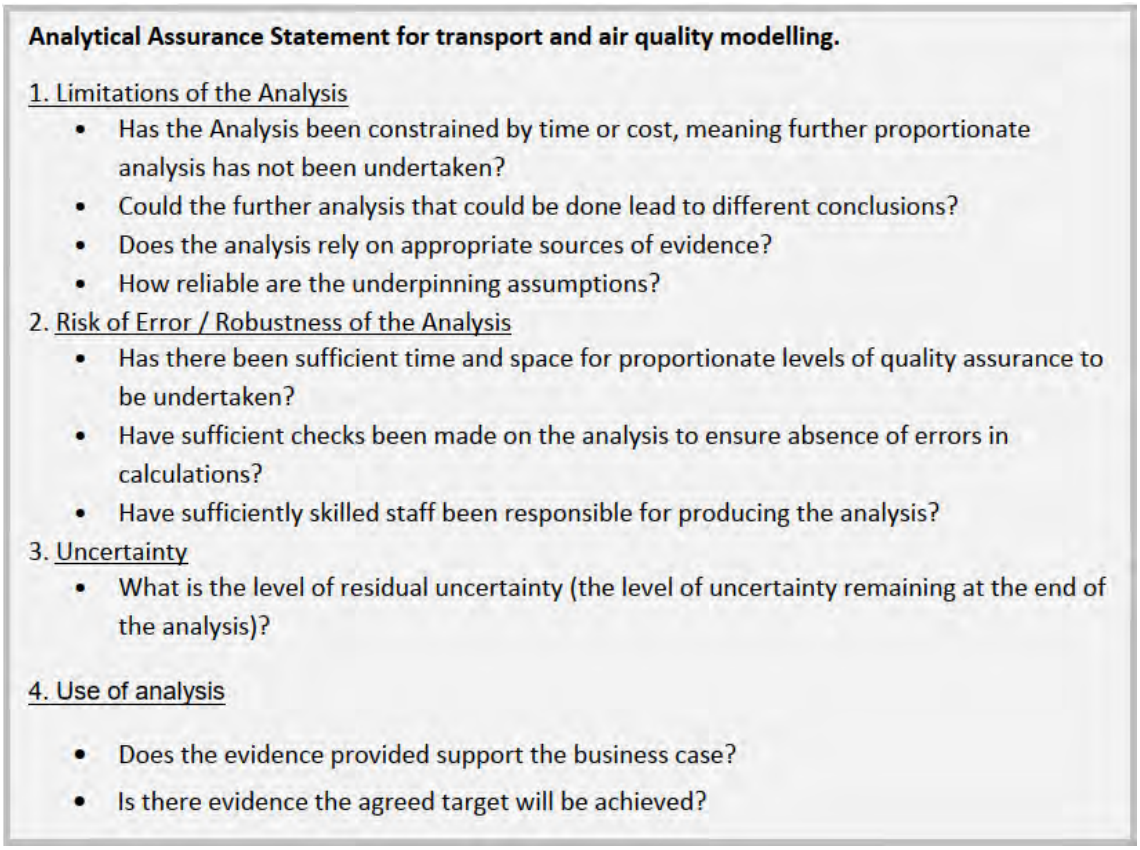
1 Purpose of the Analytical Assurance Statement

Analysis is integral in reducing uncertainty in decision-making and plays an important role in shaping, ranking and informing investment and policy decisions. To be fully informed, decision-makers must be aware of the robustness of the analytical advice and consequently how much weight to attach to it in final decision making.

The Analytical Assurance Statement (AAS) outlines the main limitations, risks, uncertainties and gives guidance on the suitability for use (details below). This Analytical Assurance Statement is based on the Department for Transport (DfT) Analytical Assurance Framework approach as outlined in the Strength In Numbers (September 2014) and is summarised in Figure 1-1.

Figure 1-1 Analytical Assurance Statement for Transport and Air Quality Modelling



Analytical Assurance Statement for transport and air quality modelling.

1. Limitations of the Analysis
   - Has the Analysis been constrained by time or cost, meaning further proportionate analysis has not been undertaken?
   - Could the further analysis that could be done lead to different conclusions?
   - Does the analysis rely on appropriate sources of evidence?
   - How reliable are the underpinning assumptions?
2. Risk of Error / Robustness of the Analysis
   - Has there been sufficient time and space for proportionate levels of quality assurance to be undertaken?
   - Have sufficient checks been made on the analysis to ensure absence of errors in calculations?
   - Have sufficiently skilled staff been responsible for producing the analysis?
3. Uncertainty
   - What is the level of residual uncertainty (the level of uncertainty remaining at the end of the analysis)?

4. Use of analysis
   - Does the evidence provided support the business case?
   - Is there evidence the agreed target will be achieved?

2 Limitations of the Analysis

2.1 Has the analysis been constrained by time or cost, meaning further proportionate analysis has not been undertaken?

The modelling and analysis have been undertaken within a programme that has clearly defined deliverables and timescales which align with the necessary analysis and assurance needed to support the development of robust analytical advice.

The development and review of the analysis and evidence base has been undertaken by the consultancy team, Newcastle-under-Lyme Borough Council, Stoke-on-Trent City Council and Staffordshire County Council Officers. This process included:

- Checks on both transport and air quality modelling inputs and outputs to ensure robustness in the production of the future year forecasts and exceedance locations.
- Working in alignment with the Joint Air Quality Unit's (JAQU) guidance and seeking input from JAQU in determining suitable methodology and critical challenge throughout the development of the project.

As a result, we do not believe further proportionate analysis could usefully be carried out in the time available

It is recognised we are working to a tight programme given the Ministerial Direction and to an agreed budget. The analysis has not been constrained by cost however it is more restricted by time.

2.2 Could further analysis have been done that lead to different conclusions?

The modelling and analysis follow industry best practice and has proven to validate to these standards providing a robust platform to enable forecasting. As a result, additional analysis would not have led to different conclusions being established.

The base year 2015 NSMM transport model has been well calibrated and validated against a comprehensive set of traffic data and in accordance with WebTAG criteria. Indeed, it has been signed off recently by the DfT as part of the business case for the Etruria Valley Link Road. Checks against more recent traffic count data has shown there has been little flow change in the last few years making the NSMM model a reliable starting point for this work (see T2 report), Rating: HIGH

The vehicle composition has been derived from an extensive set of ANPR surveys carried out in the neutral month of April in 2019 for 15 locations across North Staffordshire, capturing traffic movements in both directions. As such it is considered a reliable evidence for the vehicle fleet composition for North Staffordshire. Rating: HIGH

Speed data has been taken from the NSMM transport model. The NSMM model times (and therefore speeds) have been validated against 16 journey time routes covering North Staffordshire and exceed WebTAG criteria of having 85% of modelled journey times within 1 minute or 15% of observed journey time data. The observed journey times were derived from Trafficmaster data. These routes however will not cover every road in North Staffordshire. Rating MODERATE

As for the transport modelling, the air quality modelling has been carried out following all relevant guidance, and the model is calibrated to measured concentrations following the approach outlined in LAQM TG(16). As a result, it is not expected that any additional analysis would lead to different conclusions being established.

The air quality models use the Emissions Factor Toolkit, published by Defra, to calculate emission rates from the traffic model data described above. The Defra NOx to NO2 calculator is used to calculate NO2 concentrations from NOx concentrations and primary NO2 fractions. These are industry-standard tools. Rating: MODERATE

The Emissions Factor Toolkit (version 9.1b) published by Defra, was used to project the vehicle fleet from the ANPR survey described above for future years. The EFT makes a range of assumptions, based on the latest available information, on fleet turnover and uptake of non-conventional (e.g. electric) vehicles. These assumptions are based on the latest available data, so are considered to be the best available representation of future fleet information. However, predictions of future fleet characteristics are inherently uncertain. Additional sensitivity testing has been carried out around uncertainties in the f-NO2 fraction as recommended by Defra; if the f-NO2 in future years proves to be lower than those predicted by the tool, it is possible that roads in North Staffordshire would achieve compliance without intervention more quickly. Rating: MODERATE

The model calibration uses 2018 air quality monitoring data from North Staffordshire to verify the model. This data is collected in accordance with LAWM TG(16), and is bias adjusted following current guidance. A large number of sites were available for use in this study, and as a result, this evidence is considered to be reliable. Rating: HIGH

Canyon effects have been calculated using building footprint and height information published by Ordnance Survey as part of the Mastermap dataset. This represents the highest-quality dataset available, and as such is considered reliable. Rating: HIGH

Background concentrations were taken from air pollution background concentration maps published by Defra. The current reference year for these maps is 2017. These maps are considered to be the best available source of information for projections of background concentrations in future years. Rating: MODERATE

2.3 Does analysis rely on appropriate sources of evidence?

The model development and resulting analysis has taken advantage of the best and most appropriate data available. All data collected has been from established sources, within neutral months and internally sense checked by the consultants and Local Authority officers before use. These have also been thoroughly documented and referenced within the appropriate supporting documentation.

The reliability of each assumption is summarised in Table 2-1.

Table 2-1 Reliability of assumptions

Assumption	Source	Rating (High/Moderate/Low)
Base year fleet composition	ANPR data	High
Base year traffic flows	NSMM transport model	High
Growth in traffic flows	NTEM V7.2 (Tempro)	Moderate
Traffic Speeds	NSMM transport model	Moderate
Fleet projections (fuel split and Euro standard split)	EFT projections applied to ANPR data	Moderate

Background concentrations	Defra background maps	Moderate
Measured concentrations	Diffusion tube and automatic monitoring sites	High
Canyon effects	OS Mastermap building footprint and height information; RapidAir canyon model	High
Road widths	OS Mastermap	High
Gradients	LIDAR data	Moderate
Emission Factor Toolkit	EFT version 9.1b	Moderate
Meteorological data	NOAA data from Leek Thorncliffe station	High

2.4 How reliable are the underpinning assumptions?

There are a wide range of assumptions used in the transport and air quality modelling and economic assessment work which are reported within the modelling documentation.

The model development has used the assumptions as provided by the JAQU and within DfT's Transport Appraisal Guidance (TAG). Where methodologies, namely the adoption of area specific fleet composition splits using local collected data through the use of Automatic Number Plate Recognition (ANPR) have changed, these have been clearly recorded and justification given.

As with all data and analysis there are limitations and uncertainties in the assumptions and data used to develop suitable tools. However, we believe that an appropriate quality assurance and review process has been established to reduce any risk associated with these.

3 Risk of Error/Robustness of the Analysis

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

Quality Assurance (QA) is embedded in everything Sweco do. Appropriate processes and checks are established before modelling is undertaking ensuring a repeatable, auditable process is achieved. QA procedures have been put in place at all levels of the team meaning Sweco's Project Manager (PM) and Project Director (PD) lead in ensuring the project is undertaken in accordance with the current Sweco Quality Assurance processes and that the system is effective.

In accordance with Sweco's QA processes all deliverables and outputs are reviewed and signed off by both the Project Manager and Project Director before release.

The delivery team have worked collaboratively meaning drafts of results are often released early to allow a full review and sense check by the relevant Local Authority officers and JAQU.

Quality management for all Ricardo projects (and all deliverables produced) is delivered in accordance to the requirements of the International Standard ISO 9001:2008. Principles of QA are integrated in all of Ricardo's activities and at all levels through established and implemented procedures according to the international standard. The formally appointed sub-consultant Project Manager and Project Director take the lead in ensuring that the project is undertaken in accordance with the current Ricardo Quality Assurance processes and that the system is effective.

As noted above, the citywide modelling of the air quality improvement options is both complex and time consuming, whilst being carried out under tight delivery timescales. However, all analysis has been developed in accordance with these over-arching Ricardo QA policies and procedures to ensure high quality and accuracy of deliverables. Specifically, this includes:

- Use of the core principles from our modelling QA group in the design of analysis spreadsheets and scripts
- Technical oversight of methodological modelling issues from our modelling knowledge leader
- Day-to-day oversight of the modelling work by the lead modeller
- Checks of assumptions, input data, calculation sheets and output results
- Overall review and sign off by Ricardo's technical director

All models have been developed in accordance with Ricardo's 'best practice' modelling guidance for the construction of workbooks and tools. This includes having separate sheets for data import, manipulation and results. In addition, the model has been developed with strict version control procedures (to avoid version error) and with assigned governance and responsibilities (i.e. the PM holds overall responsibility for the quality of the model, with analysts holding joint responsibility for the elements they developed).

All data sources used in the model are appropriately referenced and clearly marked where data is inputted into the model. All assumptions and data sources will be logged, in particular as part of the Air Quality and Economic Methodology Reports.

In addition, for this specific work, additional QA checks have been performed with the input of the wider consultancy team. For example, where data and assumptions have been drawn from external models, we have discussed directly our interpretation of the data received, and its planned use in the economics model to sense check our approach (e.g. air quality emissions outputs and transport modelling outputs).

In accordance with Ricardo's QA processes, all deliverables and outputs have been signed off by both the Project Manager and/or Project Director before release. Also, where time has allowed, we have issued draft results to the councils and JAQU to allow them to review and scrutinise results prior to finalising.

3.2 Have sufficient checks been made on the analysis to ensure absence of errors in calculations?

Sweco have an established QA and audit process that is undertaken in parallel with our transport modelling work to reduce the risk of errors. DfT's best practice guidance on the development of models and programming has been incorporated into this.

An example of the checks followed are:

- Review and check all methods being used in the model set up and calculations focusing on the repeatability and removal of hard coded assumptions and values
- Review model input data for consistency which often involves established bespoke template for data so automated checks can be undertaken
- Peer review spreadsheets and formulas
- Sense check results using the lead modeller and local knowledge of the area through use of the Local Authority officers

We believe this level of check is proportionate for the time and resources available and have taken due diligence to remove possible errors that would negatively impact on the presented analysis.

Checks on modelling work are carried out as part of Ricardo's quality assurance process. Again, with complex models across several thousand road-links there is a large amount of data and calculations to check. Our approach has been as follows:

- Review and check all methods being used in the model set up and calculations
- Review model input data for consistency, this has focused on samples of data and key locations
- Check calculations in all scripts, again using a sampling approach to check calculation steps
- Sense check results using the experience of the lead modeller, knowledge leader, project director and Local Authority officers to ensure that they seem reasonable

Where any anomalies in results have been identified in the checking process these have then been explored for errors in data or calculations.

Finally, as part of the model validation process for the base year air quality model, the results are compared with monitoring data. Where there is a significant difference with the modelling data, + or – 30%, checks are carried out to explore why these differences occur.

We believe this level of checks is proportionate for the time available and has identified a number of issues that have had to be corrected. However, it is not an absolute guarantee that there are no errors, but it is sufficient to ensure that all results are reasonable and consistent.

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

The development team have been specifically chosen due to their experience and knowledge in the development of transport models and appraisal of environmental impacts.

The transport modelling team have extensive demonstrable experience in the modelling of transport networks, particularly in the study area. Sweco's team have developed and worked with the North Staffordshire Multi-Modal (NSMM) transport model since 2009 and have relevant experience in providing outputs that feed into air quality models. The team working on this Air Quality Local Development Plan comprises of a Project Director who has over 15 years' experience in transport modelling, including both multi and uni-modal transport modelling and leads the Transport Modelling and Appraisal Team within Sweco. The Project Director is supported by the Project Manager who is an experienced transport economist and data analyst who has successfully led and managed complex modelling and analytical programmes. The day-to-day modelling is undertaken by an established team of modellers whose experience reflects the complexity of the modelling and the need for robust outcomes. The project has technical oversight in all areas by technical experts who can use their extensive modelling and project experience to guide the assessment and appraisal.

The air quality modelling team at Ricardo have significant experience of developing, assessing and recommending measures to reduce emissions and improve air quality at a city-wide scale, including extensive expertise in air pollution modelling from the development of inventories and baselines, to modelling the future impacts of abatement scenarios.

The team is led by a Technical Director who holds over 20 years of experience working on transport and emissions reduction projects. Their key areas of expertise include vehicle emissions modelling, low emission vehicle technologies, sustainable transport measures and local air quality management and policy and they have worked on a number of LES, LEZ and CAZ projects in the UK including in Southampton, Derby, Nottingham, Oxford, London, Leicester and South Oxfordshire.

The day-to-day modelling work is led by an experienced atmospheric scientist with a strong focus on modelling transport and industrial emissions and characterising their effects on ambient air quality. They are an advanced user of ADMS, ADMS-Roads, ADMS-Urban, AERMOD, CALPUFF, ArcGIS, QGIS and other air dispersion modelling tools, as well as meteorological modelling software such as WRF.

The modelling lead is supported by our modelling knowledge leader, who developed our RapidAir and PyCOPERT models, to explore and resolve any methodological issues. In addition, a team of experienced consultants specialising in air quality impact assessment and atmospheric dispersion modelling are carrying out aspects of the modelling work guided by the modelling lead.

All staff at Ricardo have had specific training on all the modelling tools being used for this work.

The transport and air quality modelling work is also supported by significantly skilled and experienced staff of the Local Authorities.

4 Uncertainty

4.1 What is the level of residual uncertainty (the level of uncertainty remaining at the end of the analysis)?

The 'T2 - Local Model Validation Report' reports the validation process of the model and the conclusion that it adheres to industry guidance, giving confidence that it can be used for forecasting purposes.

This validation note will be reviewed by JAQU/DfT with the intention of them approving the model as 'Fit for Purpose' to assess the highway impacts of the air quality improvement measures.

The model adheres to industry best practice, however as with all transport models there are areas that provide greater uncertainty in the forecasts, especially relating to predicted traffic growth based on proposed developments and transport schemes and background traffic growth assumptions. The following areas have been highlighted for areas of potential improvement, but neither are likely to have a significant impact on forecasts:

- Inclusion of new leisure development (2015- 2022) in the future planning data
- Updating the factors for producing daily flows to establish bespoke ones for each user class within the model

A direct assessment of uncertainty in the air quality results is only carried out for the baseline model as part of the validation process against monitored air quality data. In this process, model performance and uncertainty is assessed using the Root Mean Square Error (RMSE) for the observed vs predicted NO_2 annual mean concentrations, as detailed in Technical Guidance LAQM.TG(16). In this case the RMSE was calculated at 5.2 $\mu g.m^{-3}$. This can then be used as a measure of error on forecast results for future years. This error metric has been used when considering the results by considering locations over 35 $\mu g.m^{-3}$ as being at risk of exceedance. Therefore, the reduction in the number links over 35 $\mu g.m^{-3}$ will also be used to compare options.

However, when assessing options in future years there will also be uncertainty related to the assumptions made in modelling these options. The reliability of the assumptions used in the modelling has been discussed above with the key areas of uncertainty relating to the behavioural response generated by given measures and how the vehicle fleet evolves in the future.

No direct assessment has yet been made in relation to the uncertainty related to these assumptions. However, as noted above sensitivity testing is planned in relation to the preferred option to explore these uncertainties and the robustness of the options in meeting air quality limit compliance.

4.2 Uncertainty – COVID 19

The transport and air quality modelling work underpinning the OBC does not take account of the impacts of the current global emergency, linked to the outbreak of Coronavirus (COVID-19). The impact of coronavirus, on public health, the local economy and on people's attitudes to travel, is unknown and will remain uncertain for some months to come. Future travel patterns could change following the outbreak including a greater propensity to work from home, an increase in active travel and a reduction in the use of public transport. We simply don't know what the long-term trends might be.

Whilst the authorities welcome the opportunity to complete this OBC and submit it to Government, they also urge the Government to review the requirements to progress and complete the FBC this year. It is highly likely that the initial evidence submission (IES), upon which the Preferred Option is based and designed to tackle, will be unsound as we emerge from the coronavirus pandemic.

4.3 Does the evidence provided - support the business case?

The assessment undertaken has provided evidence of the concentrations of NO_2 forecast for each modelled road link in the North Staffordshire conurbation. This has shown the preferred scheme delivers concentrations of NO_2 of 39.3-39.7µg/m3 in 2022 (the compliance year) at the three exceedance locations identified in the 2022 Reference Case. This therefore supports the business case that the preferred scheme delivers compliance.

The level of uncertainty is similar between each modelled future year scenario, as they have largely been completed with the same set of assumptions. All future year scenarios are based on the same set of:

- base year compliant / non-compliant split by vehicle type (from ANPR data)
- base year traffic flows
- future year planning assumptions
- national trip end model forecast traffic growth
- fleet projections from the Emissions Factor Toolkit
- background and measured concentrations
- air quality modelling assumptions

Future year options assessing a charging CAZ (which excludes the preferred scheme) including the benchmark CAZ D draw on local stated preference survey data in order to forecast the demand response of the local public and businesses to a charging CAZ. This does add greater uncertainty to the forecasts for these options. This additional uncertainty has however been addressed through undertaking sensitivity tests as per JAQU guidance on different charging levels and testing a 0% vehicle upgrade option. The forecast responses have also been benchmarked against the results obtained from other local authorities as a sense check.

The nature of modelling is such that it is never able to provide total certainty of a desired outcome. Given however that the preferred scheme is below the required 40µg/m3 threshold by around 1µg/m3, the most likely outcome is that it will deliver compliance and hence support the business case.