HIGHWAYS AGENCY

DD27

A453 Widening
M1 Junction 24 to A52 Nottingham

PROOF OF EVIDENCE

AIR QUALITY

BY

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Contents

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1. INTRODUCTION

1.1 My name is Matthew Holford. I am a Regional Director with WYG Environment where I specialise in delivering consultancy services in air quality and environmental noise. I hold a Bachelor of Science in Environmental Science and a Masters Degree in Integrated Environmental Management. I am a member of the Chartered Institute of Environmental Health and I am a Chartered Environmental Health Practitioner.

1.2 I have fourteen years experience in the fields of environmental air quality monitoring and assessment. I have been involved in the environmental assessment of the proposed A453 widening scheme since January 2008.

1.3 The full details of the air quality assessment are contained in the Environmental Assessment Air Quality chapter [DD05].

2. ASSESSMENT METHODOLOGY

2.1 In order to assess the air quality effects of the proposed A453 scheme WYG undertook a number of different air quality assessments based on the methods described in the May 2007 edition of the Design Manual for Roads and Bridges [DD176].Volume 11, Section 3, Part 7 and those contained in DfT Transport Analysis Guidance (webTAG) Environmental Objectives 3.3.3 to 3.3.5 [DD70]. Three different assessments were carried out based on the local, regional and greenhouse gas units outlined in the webTAG guidance. A further detailed assessment was also carried out in general accordance with the methods described in Local Air Quality Management Technical Guidance TG (03) [DD55].

2.2 In summary, the assessments consist of developing an atmospheric dispersion model which was used to predict the atmospheric emissions produced by road traffic on each constituent road link of the road network. The model is used to predict the dispersion of pollutants from the road sources and to calculate the exposure of surrounding receptors to the emissions over different averaging periods. In order to ensure that the model predictions are robust, its results are compared against long term air quality monitoring data from the survey area and adjustments are then made to the model to

ensure that the results produced by it accord with the data obtained from a year long baseline obtained from in the field. This is a process described as model verification.

2.3 Field data of existing ambient air quality was collected from a survey of nitrogen dioxide levels at 13 locations along the existing A453 road corridor between the M1 roundabout and the junction of the A453 and Farnborough Road in Clifton during 2006 - 2007. The survey was used to determine the average nitrogen dioxide levels along the A453 corridor over the period of a year. The results were adjusted in accordance with national guidance. The full methodology of the survey and the results are reported in full in Table 10 of Chapter 1 of the Environmental Assessment [DD05].

2.4 Atmospheric dispersion modelling software was used to create the air quality dispersion model. The software used is capable of modelling the dispersal of atmospheric emissions from multiple sources. The model is fully validated and is one of the most widely used and best performing in independent trials in the UK. A baseline model was developed of road traffic emissions in 2006 which covered the geographical area of the A453 between the M1 Junction 24 roundabout and the A52 in Clifton. The model requires various inputs relating to meteorological data, atmospheric chemistry, road specifications, traffic flows, speeds and compositions. The inputs are summarised in Table 4 of Chapter 1 of the Environmental Impact Assessment [DD15].

2.5 The model was run to give predictions of the contribution of nitrogen dioxide emissions from road sources at each of the monitoring locations. By adding these modelled road traffic contributions to predicted background nitrogen dioxide levels, the assessment was able to produce a total predicted nitrogen dioxide level at each monitoring location. The model was verified by comparing the model results against the results from the air quality survey. Based on my experience of other air quality assessments, the results compared very well, with the model results slightly under-predicting total nitrogen dioxide levels compared to the monitoring results. A small model verification adjustment factor of 1.04 was required to be applied to the overall results from the baseline model in order to verify it to the baseline monitoring data. The adjustment factor of 1.04 was also applied to the future year model predictions at

all receptor locations along the A453 between Junction 24 of the M1 and the Junction with the A52.

2.6 Following consultations with local authority air quality specialists, an additional model verification was also considered necessary to support the detailed assessment in areas of existing poor air quality outside the A453 corridor. These areas included nine Air Quality Management Areas (AQMA) on the surrounding road network on various parts of the M1, A52 and A60. A baseline model was developed for 2006 of the road network in Rushcliffe Borough Councils Air Quality Management Area 1 around Trent Bridge. The model was used to give predictions of the contribution of nitrogen dioxide emissions from all of the roads at various monitoring locations operated by Rushcliffe Borough Council. The model verification again demonstrated that the model was under-predicting compared to the monitoring results and an adjustment factor of 1.3 was applied to the total baseline model results in order to verify it to the monitoring data. An adjustment factor of 1.3 was applied to all of the future year model predictions within all of the Air Quality Management Areas in Nottingham and Rushcliffe.

2.7 The selection of input parameters into the model can play a major part in the results given. A number of sensitivity tests were carried out in order to ensure that the key parameters selected would not unduly affect the results. These sensitivity tests involved assessing the effects of the meteorological year used and the use of topographical data within the model.

2.8 The year chosen for the air quality assessment was 2012. This was chosen on the basis that this is likely to be the worst case year for air quality as it is the opening year of the scheme and given that background air quality levels are predicted to progressively improve year on year thereafter. However improvements to the M1 are planned for completion in 2017 which are likely to increase traffic on the A453. Therefore comparative modelling of traffic emissions were carried out for 2012 and 2017. Exposure to traffic emissions at receptors were consistently predicted to be higher in 2012 than in 2017 which satisfied me that 2012 was the correct year on which to base the assessments as a worst case scenario.

2.9 Topography can play a role in the dispersion of traffic emissions. The A453 scheme length has no significant topographical features likely to influence dispersion. Significant features are generally likely to consist of gradients steeper than 10%. In order to establish whether local topography needed to be included in the model inputs, a comparison was made between model predictions with and without topographical inputs along the A453 between Barton and Clifton which is the part of the scheme with the greatest road gradients. The biggest difference in exposure at receptor locations between the two models was 0.33% which I consider demonstrated that topography is not significant in influencing emissions dispersion within the study area.

3. RELEVANT STANDARDS AND POLICIES

3.1 The key air quality pollutants produced by road traffic are nitrogen oxides (NOx), nitrogen dioxide (NO_2), respirable particulates (PM_{10}), un-burnt hydrocarbons, carbon monoxide (CO) and carbon dioxide (CO_2).

3.2 For the purposes of the local and detailed air quality assessments, nitrogen dioxide and respirable particulates are the key pollutants of concern. All other pollutants are considered as part of the regional and strategic air quality assessments.

3.3 Exposure limit values for the protection of human health relating to NO_2 and PM_{10} are contained in The Air Quality Limit Value Regulations 2001 [DD56]. As part of his duties under the 1995 Environment Act [DD107] it is a requirement of the Secretary of State to prepare and publish a strategy for implementing these limit values and for it to include statements with respect to standards relating to the quality of air, objectives for the restriction of the levels at which particular substances are present in the air; and measures which are to be taken by local authorities and other persons for the purpose of achieving those objectives. The most recently published strategy is the National Air Quality Strategy for England, Scotland, Northern Ireland and Wales 2007 [DD57]. The Air Quality Objectives within the Strategy for England are summarised in table 1 below.

Table 1 - UK Air Quality Objectives for England

Pollutant	Objective	Measured As	Target Date
Nitrogen dioxide (NO_2)	200 µg/m³ Not to be exceeded for more than 18 hours per annum	1 Hour Mean	01.01.2005
	Less than 40 µg/m³	Annual Mean	01.01.2005
Particles (PM_{10})	50 µg/m³ Not to be exceeded for more than 35 days per annum	24 Hour Mean	31.12.2004
	Less than 40 µg/m³	Annual Mean	31.12.2004

3.4 Research on the health effects of nitrogen dioxide and PM_{10} have not been able to confirm the levels at which both are absolutely certain to have no effect on health. The Air Quality Objectives within the Air Quality Strategy are based on standards from expert recommendations. They represent levels at which no significant health effects are considered likely, even within the most sensitive members of the community, in association with the standards and principles of better regulation. The Objectives are therefore based on a combination of the best available medical evidence and the practicalities of achieving the minimum levels of exposure based on technical and economic considerations.

3.5 The spatial positions at which the Objectives must be met are important to any air quality assessment. The Objectives with relatively short average measurement periods are intended to prevent acute exposure to high pollution loads, whereas the annual mean Objectives are intended to prevent chronic exposure to lower levels. For the purposes of assessing whether there may be a potential breach of the annual average objective at any given location it is necessary to consider whether a receptor is likely to be present at that location for the averaging time. Therefore it is custom and practice that assessments for compliance with the annual average Objectives are made at locations where human receptors may reasonably be expected to be present for a substantial part of the year. Receptor locations are therefore treated as residential houses, care homes and hospitals.

3.6 The 1995 Environment Act [DD107] requires that local authorities must review and assess air quality within their administrative boundaries to determine if the Objectives in the National Air Quality Strategy are being met. Where the Objectives are not predicted to be met then the local authorities have the duty to declare an Air Quality Management Area (AQMA) covering at least the geographical area and receptors affected. There is a further duty for them to produce Air Quality Action Plans (AQAP) which must seek to work towards attaining the Objectives.

3.7 All local authorities in the region who have declared Air Quality Management Areas have published Air Quality Action Plans (AQAP). The Plans of most relevance to the A453 scheme are those authorities through which the A453 route passes – namely those published by Nottingham City Council, North West Leicestershire District Council and Rushcliffe Borough Council.

3.8 The most recent AQAP issued by North West Leicestershire District Council has been incorporated into the 2006-2011 Leicestershire Local Transport Plan (LTP)[DD58]. No specific reference is made to the A453 scheme within Chapter 7 – Improving Air Quality of the Leicestershire LTP.

3.9 The Nottingham City Council AQAP is embedded within the City's Local Transport Plan published in March 2006 [DD59]. The A453 widening scheme is included within the Plan as a part of the 'Big Picture' – namely one of the key strategic issues supported by the Greater Nottingham Transport Partnership to achieve the medium to long term transport vision for the city. The scheme is not specifically referred to within the Air Quality Section of the LTP.

3.10 The most recent Rushcliffe Borough Council AQAP [DD60] was published in November 2006. Within the proposed actions the Plan acknowledges the need to liaise with the Highways Agency and makes a commitment to comment and make recommendations on schemes proposed by the Highways Agency such as the A453.

3.11 The November 2008 DfT document Delivering a Sustainable Transport System [DD61] describes tackling climate change by reducing transport's emissions of carbon dioxide and other greenhouse gases, as one of the Government's five goals for transport. This is to be achieved whilst at the same time meeting another key goal of

providing a transport system which supports national economic competitiveness and growth by delivering reliable and efficient transport networks.

3.12 The Government acknowledges that adding capacity to the strategic road network is expected to result in a small increase in carbon emissions. However, it is developing a strategy for delivering transport's contribution to the UK-wide target of at least an 80% reduction in greenhouse gas emissions on 1990 levels by 2050.

4. ASSESSMENT RESULTS

4.1 The local air quality assessment is a process designed to quantify the aggregated local effects of a proposed road scheme based on standard guidance contained in unit 3.3.3 of the Department for Transports' Transport Analysis Guidance (webTAG) [DD70]. The purpose of the local air quality assessment is to produce a unit-less score which represents the total relative increase or decrease of the exposure of receptors to nitrogen dioxide and respirable particulates. A negative Overall Assessment Score indicates an overall net reduction in receptor exposure and therefore represents a net beneficial effect on local air quality.

4.2 PM_{10} exposure at 12,587 receptors in the opening year of 2012 is predicted to reduce, with an increase in exposure at 5,043 properties. There is no change at 1,754 receptors. The Overall Assessment Score of -343 for PM_{10} indicates that the effect of the scheme is likely to slightly reduce total exposure to PM_{10}.

4.3 Nitrogen dioxide exposure at 13,304 receptors in 2012 is predicted to reduce with an increase in exposure at 6,080 properties. The Overall Assessment Score of 87.7 for NO_2 indicates that the overall effect of the scheme is likely to very slightly increase total exposure to nitrogen dioxide.

4.4 The local air quality assessment illustrates that a large number of properties across the region outside the A453 corridor can expect to benefit from small reductions in exposure to NO_2 and PM_{10} whilst a smaller number of properties – predominantly within the A453 corridor itself, will have proportionately larger increases in exposure. There will not be any breaches of National Air Quality Objectives at any of the properties along the A453 at which increases in exposure are predicted.

4.5 The detailed local air quality assessment is a process designed to quantify the effects of the proposed scheme on receptors with specific reference to the Air Quality Strategy Objectives. The assessment is based on using the verified air quality dispersion model to predict both the change in road traffic emissions exposure and the absolute air quality levels at key receptors considered to be at greatest risk of exceeding the Air Quality Objectives. For the purposes of the assessment, the receptor properties selected were those closest to existing and proposed alignments of the A453 and properties within nine different Air Quality Management Areas (AQMAs) on roads in the region which were likely to be affected by changes in traffic flows as a result of the A453 scheme. A total of 70 residential locations were selected for the assessment.

4.6 Based on the assessment criteria and on the National Air Quality Objectives it is my opinion that the scheme will have no effect on health of the community as a whole. The assessment concluded that the annual average objective of not exceeding 40 $\mu g/m^3$ for both nitrogen dioxide and PM_{10} will be met at all receptors along the A453 corridor both with and without the proposed scheme. The highest predicted annual average NO_2 level is 23.98 $\mu g/m^3$ and the highest predicted PM_{10} level is 21.65 $\mu g/m^3$.

4.7 All nine of the AQMAs assessed have been declared due to predicted exceedences of the 40 $\mu g/m^3$ annual average Objective for NO_2. Of these AQMAs, five are predicted to experience improvements in air quality due to the effects of the proposed scheme while four are predicted to deteriorate. On the basis of the results from the detailed assessment of effects on the AQMAs it is my opinion that the overall effect of the scheme on local air quality is neutral.

4.8 The regional air quality assessment is based on guidance contained in unit 3.3.4 of the Department for Transports' Transport Analysis Guidance (webTAG) [DD71] The purpose of the assessment is to quantify the effects of the scheme on a different group of pollutants than that of the local or detailed assessment - particularly nitrogen oxides (NOx) and total hydrocarbons (THC). NOx is important due to its contribution to acidification and excess nitrogen deposition which is detrimental to aquatic health, plant health and species composition. Hydrocarbons contribute to the generation of

tropospheric ozone which contributes to photochemical smog. All of the roads subject to the Local Air Quality Sub-Objective assessment were included in the regional assessment. Data relating to the road length, annual average daily traffic flow (AADT), annual average speed and vehicle type composition for all road links were entered into the DMRB screening method spreadsheet (version 1.03(c)) [DD176]. The spreadsheet produced total emissions of NOx, PM10, THC and carbon monoxide in kg per year for all roads. This data was entered into the unit 3.3.4 worksheet and used to produce a regional air quality Assessment Summary Table.

4.9 Emissions of nitrogen oxides (NOx) from traffic on roads across the region is predicted to be 47 tonnes (3%) less in the 'do something' scenario than the 'do minimum' in 2012. Emissions of total hydrocarbons (THC) from traffic on roads affected by the scheme is predicted to be 8 tonnes (3.41%) less in the 'do something' scenario than the 'do minimum' in 2012. Emissions of carbon monoxide (CO) from traffic on roads affected by the scheme is predicted to be 40 tonnes (2.6%) less in the 'do something' scenario than the 'do minimum' in 2012.

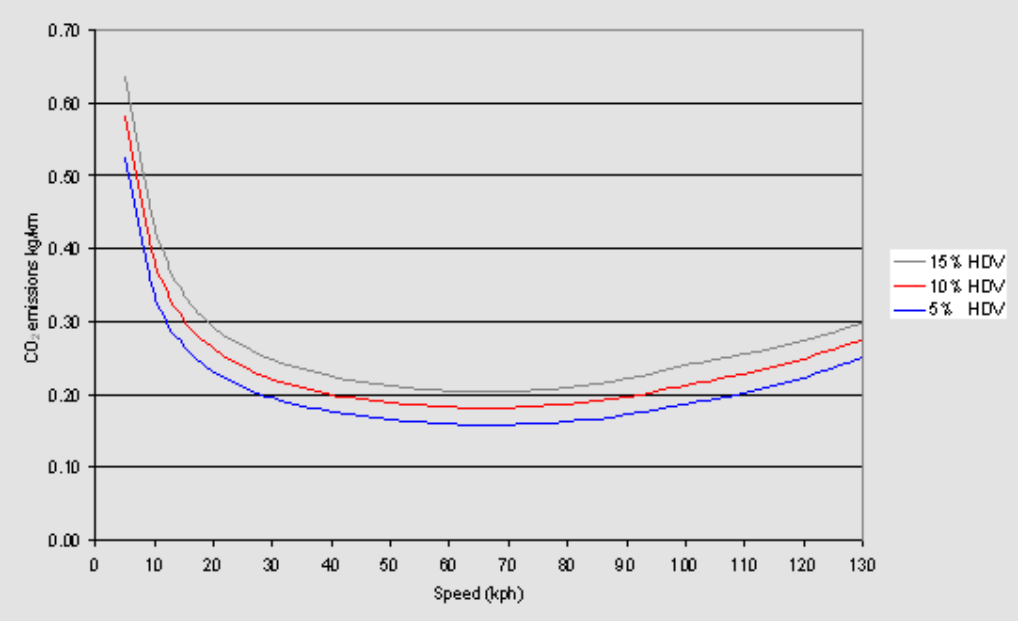
4.10 The strategic air quality assessment is based on guidance contained in unit 3.3.5 of the Department for Transports' Transport Analysis Guidance (webtag) [DD72]. The purpose of the assessment is to quantify the effects of the scheme on greenhouse gas emissions (and more specifically carbon dioxide) over a 60 year lifespan of the scheme. The assessment is produced from carbon dioxide emissions calculations produced from the TUBA (Transport Users Benefit Appraisal) model which is one of the models approved by DfT for road schemes.

4.11 The TUBA model predicted an increase of CO2 emissions in 2012 by 688 tonnes when comparing the 'do-something' scenario to the 'do-minimum'. This represents an increase of 0.05% in carbon emissions in the opening year. Across the 60 years of the scheme, the TUBA model predicts an increase of CO_2 emissions of 77,697 tonnes when comparing the 'do-something' scenario to the 'do-minimum'. This represents an increase of 0.079% in carbon emissions over a 60-year lifespan.

4.12 The TUBA model provides as robust a method for calculating carbon emissions as is currently available. However, it is not sufficiently flexible to fully predict the effect of congestion on carbon emissions. The TUBA model assumes that the emissions of

carbon dioxide from road traffic follows that illustrated in figure 1 and is based on an assumed steady state traffic speed. In congested conditions, driving behaviour is much more based on a cycle of acceleration and deceleration, which produces a relatively higher emissions per unit distance travelled than steady state driving. By reducing congestion, the scheme will result in a reduction in non steady state driving conditions and will therefore result in reduced emissions. It is my opinion that the way the TUBA model calculates greenhouse gas emissions from traffic means that this likely reduction in emissions is not fully accounted for by the model, resulting in an overly pessimistic prediction of carbon emissions.

Figure 1 – Relationship of CO_2 emissions (in kilograms per kilometre) to traffic speed



5. CONCLUSIONS

5.1 In conclusion it is my opinion that the overall effect of the scheme on air quality will be neutral. The scheme will have affects on air quality across much of the East Midlands region, with some parts of the region benefiting from reduced exposure and other parts of the region experiencing increases in exposure.

5.2 The most significant negative effect of the scheme is that it is predicted to increase CO_2 emissions overall across the region and that it will cause an increase in exposure within four existing AQMAs.

5.3 However, no new receptors are predicted to be exposed to any new breaches of the National Air Quality Objectives. The scheme will also improve air quality in five out of nine existing AQMAs where the Objectives are known to be exceeded and it will reduce exposure to NO_2 and PM_{10} at more receptors than it will increase.