



Birmingham Eastside Extension

Environmental Statement Volume 2 Technical
Appendix N: Air Quality Technical Information

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West Midlands Combined Authority

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1 Air Quality

1.1 Background

1.1.1 The BEE involves the construction of 1.9km of both on street and off-street twin-tracked tramway, and subsequent operation of the tram system. The BEE route starts from the existing section of the Birmingham City Centre Extension (BCCE) at Bull Street/Corporation Street providing a new link to the proposed HS2 Station at Curzon Street and terminating at High Street Deritend to the east of Birmingham City Centre.

1.1.2 This technical appendix should be read in conjunction with Chapter 11: Air Quality of ES Volume 1: Main Statement.

1.2 Legislation, Policy Guidance and Best Practice

1.2.1 This section summarises the relevant international and national legislation, policy and planning guidance in relation to air quality. In addition, UK regional and local planning policy guidance has been reviewed in order to identify air quality policy implications related to the BEE.

European legislation

1.2.2 European Union (EU) Framework Directive 96/62/EEC (EU, 1996) on ambient air quality assessment and management came into force in November 1996 and had to be implemented by Member States by May 1998. This Directive aimed to protect human health and the environment by avoiding, reducing or preventing harmful concentrations of air pollutants. As a Framework Directive, it required the European Commission (EC) to propose 'Daughter' Directives which set air quality limit and target values, alert thresholds and guidance on monitoring and measurement for individual pollutants. The four Daughter Directives are as follows:

- Council Directive 1999/30/EC (the first Daughter Directive) relating to limit values for sulphur dioxide (SO₂), NO₂ and oxides of nitrogen (NO_x), particulate matter (PM₁₀) and lead in ambient air;
- Directive 2000/69/EC (the second Daughter Directive) relating to limit values for benzene and carbon monoxide (CO) in ambient air;
- Directive 2002/3/EC (the third Daughter Directive) relating to ozone (O₃) in ambient air; and
- Directive 2004/107/EC (the fourth Daughter Directive) relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.

1.2.3 Directive 2008/50/EC (EU, 2008) on ambient air quality and cleaner air for Europe was adopted in May 2008. This Directive merges the first three existing Daughter Directives and one Council Decision into a single Directive on air quality. It also sets new standards and target dates for reducing concentrations of fine particles.

National legislation

- 1.2.4 The Air Quality Standards Regulations 2010 came into force in June 2010; they implement the EU's Directive 2008/50/EC on ambient air quality for the UK.
- 1.2.5 Part IV of the Environment Act 1995 requires that every local authority shall periodically carry out a review of air quality within its area, including likely future air quality. As part of this review, the local authority must assess whether air quality objectives are being achieved, or likely to be achieved within the relevant periods. Any parts of a local authority's area where the objectives are not being achieved, or are not likely to be achieved within the relevant period, must be identified and declared as an Air Quality Management Area (AQMA). Once such a declaration has been made, authorities are under a duty to prepare an Action Plan which sets out measures to pursue the achievement of the air quality objectives within the AQMA.

Air quality – ecological receptors

- 1.2.6 Table 1.1 presents the air quality objectives and limit values, relevant to the BEE, for the protection of vegetation and ecosystems.

Table 1.1: Vegetation and ecosystems air quality objectives

Pollutant	Averaging period	Objective	Attainment date
Nitrogen oxides (NO _x)	Annual	30µg/m ³	31 December 2000

Notes: µg/m³ = micrograms per metre cubed

- 1.2.7 The areas where the UK air quality objectives for the protection of vegetation and ecosystems apply are:
- more than 20 km from an agglomeration (i.e. an area with a population of more than 250,000); and
 - more than 5 km away from industrial sources regulated under Part A1 of the Environmental Permitting regulations, motorways and built up areas of more than 5,000 people.

Statutory nuisance

- 1.2.8 Section 79(1)(d) of the Environmental Protection Act 1990 defines one type of 'statutory nuisance' as *"any dust, steam, smell or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance"*. Where a local authority is satisfied that a statutory nuisance exists, or is likely to occur or recur, it must serve an abatement notice. Failure to comply with an abatement notice is an offence. However, it is a defence if an operator employs the best practicable means (BPM) to prevent or to counteract the effects of the nuisance.

UK policy

UK Air Quality Strategy

- 1.2.9 As described above, the Environment Act 1995 requires the UK Government to produce a national Air Quality Strategy (AQS). The AQS establishes the UK framework for air quality improvements. Measures agreed at the national and international level are the foundations on which the strategy is based. The first AQS was adopted in 1997 (DEFRA, 1997) and replaced by the AQS for England, Scotland, Wales and Northern Ireland published in January 2000 (DEFRA, 2000). The 2000 Strategy has subsequently been replaced by the AQS for England, Scotland, Wales and Northern Ireland 2007 (DEFRA, 2007).
- 1.2.10 The Environment Act 1995 requires that the Environment Agency has regard to the AQS in exercising its pollution control functions. Local Authorities are also required to work towards the Strategy's objectives prescribed in regulations for that purpose.
- 1.2.11 The air quality objectives in the AQS are a statement of policy intentions and policy targets. As such, there is no legal requirement to meet these objectives except in as far as they mirror any equivalent legally binding Limit Values in EU Directives and English Regulations.

National Planning Policy Framework

- 1.2.12 The NPPF (Department for Communities and Local Government (DCLG), 2012) sets out the government's planning policies for England. With regard to air quality, NPPF states that:
- "The planning system should contribute to and enhance the natural and local environment by:... preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability..."*
- 1.2.13 NPPF also states that: *"Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative effects on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan."*

National Planning Practice Guidance

- 1.2.14 On 6 March 2014, the DCLG published the National Planning Practice Guidance (NPPG) web-based resource.
- 1.2.15 The NPPG includes a dedicated section on 'Air Quality'. It notes that, for new planning applications, the local planning authority may want to know about:
- *"the 'baseline' local air quality;*

- *whether the proposed development could significantly change air quality during the construction and operational phases; and/or*
- *whether there is likely to be a significant increase in the number of people exposed to a problem with air quality, such as when new residential properties are proposed in an area known to experience poor air quality.”*

1.2.16 The ‘Air Quality’ section in NPPG also contains the following statement in relation to determining whether air quality is relevant to a planning decision:

1.2.17 “Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife)”.

Regional and local policy

Local planning policy

1.2.18 The Birmingham Unitary Development Plan (UDP) (BCC, 2005) was adopted by BCC in 1993 and reviewed in 2005. The UDP is the existing development plan for BCC but will be largely replaced by the Birmingham Development Plan 2031 (BDP) when it is adopted. The BDP was submitted to the Secretary of State on July 1 2014 and was modified in July 2015. At the time of writing this assessment, the BDP is under a Holding Direction whereby BCC may not take any step in connection with the adoption of the BDP 2031 until such a time that the Holding Direction is withdrawn by the Secretary of State.

1.2.19 During the transition from UDPs to Local Development Plans, local authorities had the opportunity to submit planning policies that should be saved to the Secretary of State. Of the saved policies within the Birmingham UDP, two relate to air quality:

1.2.20 Birmingham UDP Policy 3.77 states:

“The City Council is committed to improving air quality within Birmingham and will require development which minimises or reduce air pollution. This will be addressed in various ways, including:

- *an increase in tree cover through the city;*
- *modes of transport which reduce the impact of travel on air pollution; and*
- *the use of alternative clean fuels”.*

1.2.21 Birmingham UDP Policy 3.78 states:

1.2.22 *“When assessing planning applications, the implications of new development for air quality will be taken into account.”*

- 1.2.23 The BDP contains a number of policies directly or indirectly relating to air quality. These are:
- policy TP7: Green infrastructure network: the maintenance and expansion of Birmingham's green infrastructure network would *"promote human health through air quality improvement"*;
 - policy TP36: Health: *"The City Council is committed to reducing health inequalities, increasing life expectancy and improving quality of life by:... seeking to improve air quality and reduce noise within the City"*;
 - policy TP37: A sustainable transport network: Delivery of this policy will require:
 - *"the facilitation of modes of transport that reduce carbon emissions and improve air quality"*; and
 - *"building, maintaining and managing the transport network in a way that reduces CO₂, addresses air quality problems and minimises transport's impact on the environment"*;
 - policy TP42: Low emission vehicles; and
 - policy TP43: Traffic and congestion management.

Air Quality Action Plan

- 1.2.24 The latest Air Quality Action Plan (AQAP) produced by BCC in 2011 lists 12 actions which will improve air quality within its boundary. These are:
- *action 2010/1 - Low Emission Zone within the City Centre;*
 - *action 2010/2 – Biomass in Birmingham Schools;*
 - *action 2010/3 – Red Routes;*
 - *action 2010/4 – New Roads;*
 - *action 2010/5 – Air Quality & Planning;*
 - *action 2010/6 – Control of Industry;*
 - *action 2010/7 – Control of Bonfires and other Unauthorised Fires;*
 - *action 2010/8 – Park & Ride;*
 - *action 2010/9 – Improvement of the Council Fleet;*
 - *action 2010/10 – Introduction of low carbon/electric Vehicles;*
 - *action 2010/11 – Improvement of the Public Service Fleet; and*
 - *action 2010/12 – Taxi Emission Strategy.*

1.3 Methodology

Construction phase

Construction dust

- 1.3.1 Guidance from the Institute of Air Quality Management (IAQM. 2014) recommends splitting the construction phase into four separate source categories and determining the dust risk associated with each of those categories individually as follows:
- demolition;
 - earthworks;
 - construction; and

- track out (the transport of dust and dirt onto the public road network).
- 1.3.2 The risk of each source for dust effects is described as 'negligible', 'low risk', 'medium risk' or 'high risk' depending on the nature and scale of the construction activities and the proximity of sensitive receptors to the construction site boundary. The assessment is used to define appropriate mitigation measures to reduce the level of effects such that they are not significant.
- 1.3.3 The assessment considers two separate effects from dust:
- nuisance due to dust soiling; and
 - the risk of human health effects due to an increase in exposure to PM₁₀.
- 1.3.4 Step 1 of the assessment determines whether there are human or ecological receptors within the vicinity of construction activities or the route used by construction vehicles. No assessment is required where there are no:
- 'Human Receptors' within:
 - 350m of construction activities; and
 - 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the construction site entrance(s).
 - 'Ecological receptors' within:
 - 50m of construction activities; and
 - 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).
- 1.3.5 There are no relevant ecological receptors (as defined in IAQM, 2014 and Chapter 17 Ecology in ES Volume 1 Main Statement) within the spatial extents defined above, and therefore no assessment of construction phase impacts on ecological receptors has been undertaken.
- 1.3.6 Step 2A of the assessment is to determine the overall dust emission magnitude ('small', 'medium' or 'large') from each of the dust sources identified (demolition, earthworks, construction and track out) in accordance with the criteria outlined in Table A.1 in Annex A.
- 1.3.7 Step 2B of the assessment involves defining the sensitivity of receptors (as high, medium or low) for each dust effect (dust soiling, human health and ecosystem impacts) in accordance with the criteria presented within Table A.2 in Annex A.
- 1.3.8 The sensitivity of the surrounding area is then determined for each dust effect by considering the criteria in Table A.3, Table A.4 and Table A.5 in Annex A. Criteria presented in these tables are based on the distance of the source to the closest receptors, the receptor sensitivity, and in the case of PM₁₀ effects, the local background concentration. The highest level of area sensitivity defined for each dust effect has been used in the assessment.
- 1.3.9 The final step of the assessment (Step 2C) combines the dust emission magnitude and the sensitivity of the area, to determine the overall dust risk category for each dust source and for

each dust effect. The criteria used to define the dust risk category for each dust source and effect is presented within Table A.6, Table A.7, Table A.8 and Table A.9 in Annex A.

- 1.3.10 The dust risk category defined for each of the dust source and effect, is then used to determine the appropriate site specific mitigation measures to be adopted. It should be noted that in line with the recommendations of IAQM guidance, significance is only assigned to construction effects following mitigation.

Operational phase

Meteorological data

- 1.3.11 The most important meteorological parameters governing the atmospheric dispersion of emissions are wind direction and wind speed as described below:
- wind direction determines the sector of the compass into which emissions are dispersed; and
 - wind speed affects the distance over which pollution travels with time and can affect dispersion by increasing the initial dilution of pollution.
- 1.3.12 For meteorological data to be suitable for dispersion modelling purposes, a number of parameters need to be measured on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature.
- 1.3.13 Following consideration of the meteorological data available, data from Birmingham Elmdon meteorological station was used in the dispersion model, as this is the most representative data available for the study area, has data for the most recent years and provides data for one hour periods which is required by the dispersion model. This meteorological station is located approximately 11km east of the BEE, with the dominant prevailing wind coming from the south west.
- 1.3.14 Air quality modelling has been undertaken using meteorological data from the period 2013 to 2015, and the maximum annual mean concentrations predicted across these years (on a receptor by receptor basis) are presented in this chapter, providing a 'worst case' assessment. The model verification has been carried out using 2011 meteorological data in order to be consistent with the year of air quality monitoring and traffic data.
- 1.3.15 Wind roses representing the meteorological data used in the assessment are shown in drawing MMD-300207-HS30-DRA-0000-0403 in ES Volume 2 Technical Appendix A: EIA Drawings.

Background pollutant concentrations

- 1.3.16 Total air pollutant concentrations comprise of a background and local component. The background concentration is determined by regional, national and international emissions, and

often represents a significant proportion of the total pollutant concentration. The local component is determined by local pollutant sources such as roads, and in this case has been considered using the ADMS (Advanced Dispersion Modelling Software)-Roads model.

- 1.3.17 Background pollutant concentrations are spatially and temporally variable throughout the UK. Annual mean background concentrations maps of NO_x, NO₂, PM₁₀ and PM_{2.5} were obtained from the Local Air Quality Management (LAQM) Review and Assessment page on the DEFRA website (2016). The DEFRA background pollutants maps provide yearly forecasts for each one kilometre grid square across the whole of the UK.
- 1.3.18 The background maps have also been adjusted to remove road sources modelled in ADMS-Roads, in order to prevent double counting the contribution of these sources to background concentrations. The background maps provide a breakdown of source contributions to the total concentration, allowing particular sources to be removed. The sources were removed following the methodology outlined on the DEFRA website for LAQM support.
- 1.3.19 The adjusted DEFRA background concentrations used in the assessment are presented in Section 1.4.
- 1.3.20 A sensitivity analysis of the background used in the assessment has been included in the assessment. This sensitivity has assumed that there is no future improvement in background concentrations from 2015 to 2021. Results from this analysis are presented in Annex E.

Traffic data

- 1.3.21 Outputs from the Transport Assessment (ES Volume 2 Technical Appendix L2) SATURN traffic model have been used for this assessment and supplemented with data derived from additional analysis based on traffic counts and Lin Sig modelling data produced for detailed junction design along the route of BEE. Traffic flow data on vehicle movements, speeds and a breakdown of Heavy Goods Vehicles (HGVs) and buses are available for the following periods in the base, Do-Minimum and Do-Something scenarios for the BEE:
- AM peak period (07:00 to 10:00);
 - Inter-peak period (10:00 to 16:00);
 - PM peak period (16:00 to 19:00); and
 - Off-peak period (19:00 to 07:00).
- 1.3.22 The diurnal traffic flow characteristics, and therefore emissions, are represented in the dispersion model using time varying emission factors. The same profile used for weekdays has been applied to the weekend providing a conservative profile of traffic flows.

Emission factors

- 1.3.23 The Emission Factor Toolkit (EFT) (Version 7) (DEFRA, 2016) has been used to provide emissions factors for road traffic. The EFT v7 takes account of new fleet composition data, developed for the UK by the National Atmospheric Emissions Inventory (NAEI) and Transport for London (TfL) and includes updated NO_x and PM speed emission coefficient equations for Euro 5 and 6 vehicles, taken from the European Environment Agency (EEA) COPERT 4v11 emission calculation tool, reflecting more recent evidence on the real-world emission performance of these vehicles.
- 1.3.24 EFT emission factors have been extracted for the assessment scenarios presented in the temporal scope section of the main statement.

Human Receptors

- 1.3.25 Pollutant concentrations have been predicted at sensitive receptors, defined according to DEFRA (2016) as:
- 1.3.26 *“Locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the relevant air quality objective”.*
- 1.3.27 Sensitive receptors such as residential properties, hospitals and schools, were identified within 200m of the affected roads in the study area. A total of 81 receptors have been considered in the local air quality assessment, and these are shown in drawing MMD-300207-HS30-DRA-0000-0404 in ES Volume 2 Technical Appendix A: EIA Drawings and listed in Annex C. These were selected using professional judgement of where the highest pollutant concentrations would be likely to arise and where the greatest impacts would be expected to occur due to the BEE.

Ecological Receptors

- 1.3.28 There are no Special Areas of Conservation (SAC), Special Protection Areas (SPA), Sites of Special Scientific Interest (SSSI) or Ramsar sites within 200m of the affected road network. Therefore, the effect of the BEE on ecological receptors has not been considered further.

NO_x to NO₂ relationship

- 1.3.29 Modelled road traffic NO_x was converted to NO₂ using Version 5 of the NO_x to NO₂ calculator developed for DEFRA (2016). The calculator takes into account the difference between vehicular and background NO_x, the concentration of ozone (O₃) (to oxidise NO to NO₂), and the different proportions of primary (directly emitted) NO₂ in different years.

Predicted 1 hour and 24 hour pollutant concentrations

- 1.3.30 For all receptors assessed, annual mean concentrations of NO₂ have been presented. According to DEFRA (2016) guidance, the hourly NO₂ air quality objective of 200µg/m³ (not to be exceeded more than 18 times per year) is unlikely to be exceeded at roadside locations where the annual mean concentration is less than 60µg/m³.
- 1.3.31 The prediction of daily mean concentrations of PM₁₀ is available as an output option within the ADMS-Roads dispersion model for comparison against the short-term air quality objective. However, as the model output for annual mean concentrations is considered more accurate than the modelling of the daily mean, an empirical relationship has been used to determine daily mean PM₁₀ concentrations. In accordance with DEFRA (2016) guidance, the following formula has been used:

$$\text{No. of 24-hour mean exceedances} = -18.5 + 0.00145 \times \text{annual mean}^3 + (206 / \text{annual mean}).$$

Assessment criteria

- 1.3.32 A number of approaches can be used to determine whether the potential air quality effects of the BEE are significant. However, there remains no universally recognised definition of what constitutes 'significance' for air quality effects.
- 1.3.33 Guidance is available from a range of regulatory authorities and advisory bodies on how best to determine and present the significance of effects within an air quality assessment. It is generally considered good practice that, where possible, an assessment should communicate effects both numerically and descriptively.
- 1.3.34 Any description of an air quality effect from the BEE is informed by numerical results. However, an element of professional judgement must also be involved. To ensure that the descriptions of effects used within the assessment are clear, consistent and in accordance with recent guidance, definitions for the assessment of changes in ambient air quality at discrete human health receptors have been adapted from the guidance IAQM (IAQM, 2015) 'Land-Use Planning and Development Control: Planning for Air Quality'.

Magnitude of impact

- 1.3.35 Table 1.2 provides impact descriptors for individual receptors as a result of the BEE. Impact descriptors regarded as moderate or substantial are typically considered likely to give rise to a significant effect, although overall significance of effects must be considered in the context of other factors as described below and should take account of the number of moderate and substantial impacts and their spatial distribution across the overall study area.

Table 1.2: Impact descriptors for individual receptor in assessment year (2021)

Long term average concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	<1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Source: EPUK, IAQM (2015)

Notes: AQAL = Air Quality Assessment Level i.e. $40\mu\text{g}/\text{m}^3$ for annual mean NO_2 and PM_{10} and $25\mu\text{g}/\text{m}^3$ for annual mean $\text{PM}_{2.5}$. The table is only designed to be used with annual mean concentrations

Percentage pollutant concentrations are intended to be rounded to whole numbers. For example, the '<1%' category in this table includes all changes from 0.5% to 1.4% (equivalent to an annual mean NO_2 or PM_{10} absolute concentration change of between $0.2\mu\text{g}/\text{m}^3$ and $0.6\mu\text{g}/\text{m}^3$). Changes of 0% (i.e. less than 0.5%) are described as negligible.

When defining the concentration as a percentage of the AQAL, use the 'do minimum' concentrations where there is a decrease in pollutant concentration and the 'do something' concentration for an increase.

Significance of effects

- 1.3.36 EPUK/IAQM (2015) notes that the significant impact descriptors (Table 1.2) are for individual receptors only and the overall significance should be determined using professional judgement, taking into account the degree of impact and factors such as:
- the existing and future air quality in the absence of the BEE;
 - the extent of current and future population exposure to the impacts; and
 - the influence and validity of any assumptions adopted when undertaking the prediction of impacts.

Compliance with the EU Directive on Ambient Air Quality

- 1.3.37 Highways England's Interim Advice Note (IAN) 175/13 provides guidance in relation to the assessment of the risk of the BEE affecting reported compliance with the air quality Directive. The compliance risk assessment is undertaken using the model results obtained from the local air quality assessment. To undertake the compliance risk assessment the following information is required:
- local air quality modelled results;
 - DEFRA's Pollution Climate Mapping (PCM) model outputs for the compliance road network; and
 - DEFRA's zones and agglomeration maps.
- 1.3.38 DEFRA uses the PCM model to report compliance with the air quality Directive. The PCM model provides NO_2 concentrations for a number of roads across the UK for a number of

future years. The PCM model data, released by DEFRA in 2015, has modelled concentrations incorporating the DEFRA action plan measures for 2013 (reference year), 2020 and 2025, with projected concentrations decreasing year on year in response to anticipated improvements in vehicle emissions. PCM data for the year 2014 and previous years can also be obtained from the DEFRA website.

- 1.3.39 The modelled opening year of the BEE is 2021, which falls between two of the years modelled by DEFRA (2020 and 2025). An equivalent 2021 PCM concentration can be calculated assuming a linear decrease in NO₂ between 2020 and 2025.
- 1.3.40 To determine the study area for the compliance risk assessment, the local air quality study area is compared to the compliance risk road network (CRRN) in the PCM model. A CRRN is then defined where the two networks intersect, which then forms the basis for the assessment of compliance risk.
- 1.3.41 The effects of the BEE (i.e. the change in concentrations at receptors) are added to the concentrations predicted by the DEFRA PCM model for the opening year where:
 - the equivalent opening year PCM or the equivalent BEE PCM modelled total NO₂ concentration is greater than 40 µg/m³; or
 - the change in NO₂ concentrations at receptors is 0.4 µg/m³ or more.
- 1.3.42 The outcome of the above approach is used to determine the BEE's 'compliance risk rating'.

Dispersion model assumptions and limitations

- 1.3.43 The assessment has been undertaken using an air quality dispersion model. The impacts assessed assume that model predictions are accurate and representative of the true impact of the BEE. These predictions are however associated with some uncertainties including:
 - uncertainties with model input parameters such as surface roughness length (defined by land use) and minimum Monin-Obukhov length (used to calculate stability in the atmosphere);
 - uncertainties with traffic forecasts;
 - uncertainties with vehicle emission predictions;
 - uncertainties with background air quality maps;
 - uncertainties with recorded meteorological data; and
 - simplifications made in the model algorithms or post processing of the data that represent atmospheric dispersion or chemical reactions.
- 1.3.44 The performance of the air quality model has been evaluated in this assessment using air quality measurements to verify model outputs. The model outputs have then subsequently been adjusted against the measurements to improve the robustness of the predictions. This model verification process has been undertaken in line with DEFRA (2016) guidance, and is discussed in Annex B.

- 1.3.45 Following the verification process for this Scheme an overall Root Mean Square Error value of less than 10% is achieved. On this basis the modelled results are considered appropriate to allow a robust professional judgement of significance to be determined.

1.4 Baseline Conditions

Overview

- 1.4.1 The first part of the baseline analysis characterises the existing conditions based on current monitoring data and background pollutant concentration data. The second part determines the background concentrations to be used within the assessment.

Local authority review and assessment

- 1.4.2 During its first round of review and assessment completed in 2002, BCC declared the whole of Birmingham city district as an Air Quality Management Area (AQMA) on the 10 January 2003, due to exceedances of the annual mean objective for NO₂. Further detailed assessment in 2004 concluded that the original AQMA order was valid.
- 1.4.3 In October 2004, BCC designated the entire Birmingham city district an AQMA due to exceedances of the PM₁₀ 24 hour mean and annual mean objectives.
- 1.4.4 The 2010 BCC Progress Report recommended a detailed assessment be carried out for PM₁₀ before a decision is made on revocation of the AQMA in respect of the PM₁₀ 24 hour mean and annual mean objectives. The progress report also concluded that NO₂ concentrations continued to exceed the annual mean objective at congested street canyons.
- 1.4.5 Following the Detailed Assessment, on the 1 December 2010, BCC revoked the citywide AQMA in respect to the PM₁₀ 24 hour mean and annual mean objectives.
- 1.4.6 Further progress reports have since been carried out; the most recent Updating and Screening Assessment in 2012 concluding that the NO₂ annual mean objective continues to be exceeded across the city but PM₁₀ concentrations are meeting both 24 hour mean and annual mean objectives. As a result, the declared citywide AQMA requires no further revision.

Local authority automatic monitoring

Nitrogen dioxide

- 1.4.7 BCC currently undertakes air quality monitoring for NO₂ at seven continuous monitoring stations within its boundary. Table 1.3 presents the latest automatic NO₂ monitoring results available for all these stations.

1.4.8 The monitoring results show that background concentrations are below the annual mean NO₂ objective and have fallen by an average of 3µg/m³ between 2011 and 2015, highlighting an overall improvement in NO₂ concentrations.

1.4.9 With the exception of Birmingham Tyburn Roadside and Moor Street Queensway, roadside concentrations show an overall improvement between historic years and 2015 and are below the annual mean NO₂ objective. The Birmingham Tyburn Roadside monitor is located 5.1km from the BEE and is not considered representative of background concentrations within the study area.

Table 1.3: BCC continuous monitoring data for NO₂ 2011-2015

Site ID	Site classification	National grid reference		Distance from the BEE (km)	Annual mean concentration (µg/m ³)				
		X	Y		2011	2012	2013	2014	2015
Birmingham Tyburn Roadside	Roadside	411577	290491	5.1	N/A	46	43	42	43
Birmingham Tyburn	Urban Background	411592	290440	5.1	34	32	29	31	30
New Hall	Urban Background	414574	296724	11.8	19	19	17	17	16
Stratford Road	Urban Roadside	408820	284591	2.0	36	35	31	36	33
Bristol Road	Roadside	404545	283020	4.5	33	30	34	34	29
Moor Street Queensway	Roadside	407435	286891	0.1	N/A	N/A	44	43	45
Acocks Green	Urban Background	411649	282207	5.6	23 ^(a)	32	36	37 ^(b)	18

Source: BCC

Note: N/A indicates data not available

Bold indicates exceedance of objective

^(a) Data annualised by BCC in accordance with DEFRA Technical Guidance 09

^(b) Data capture only 65%. Concentration not annualised by BCC.

Particulate matter (PM₁₀)

1.4.10 BCC currently undertakes air quality monitoring for PM₁₀ at two continuous monitoring stations within its administrative boundary. Table 1.4 presents the latest automatic PM₁₀ monitoring results available for these stations.

1.4.11 The monitoring results show that background concentrations are below the annual mean PM₁₀ objective and have fallen by 8µg/m³ between 2011 and 2015, highlighting an overall improvement in PM₁₀ concentrations.

Table 1.4: BCC continuous monitoring data for PM₁₀ 2011-2015

Site ID	Site classification	National grid reference		Distance from the BEE (km)	Annual mean concentration (µg/m ³)				
		X	Y		2011	2012	2013	2014	2015
Birmingham Tyburn	Roadside	411577	290491	5.1	24	22	19	20	17
Birmingham Tyburn	Urban Background	411592	290440	5.1	23	19	18	19	15

Source: DEFRA AIR

Note: Bold indicates exceedance of objective

Particulate matter (PM_{2.5})

- 1.4.12 BCC currently undertakes air quality monitoring for PM_{2.5} at three continuous monitoring stations within its administrative boundary. Table 1.5 presents the latest automatic PM_{2.5} monitoring results available for these stations. The results indicate concentrations are well below the objectives.

Table 1.5: BCC continuous monitoring data for PM_{2.5} 2011-2015

Site ID	Site classification	National grid reference		Distance from the BEE (km)	Annual mean concentration (µg/m ³)				
		X	Y		2011	2012	2013	2014	2015
Birmingham Tyburn	Roadside	411577	290491	5.1	17	13	16	14	12
Birmingham Tyburn	Urban Background	411592	290440	5.1	16	14	14	13	10
Acocks Green	Urban Background	411649	282207	5.6	9 ^(a)	11	13	12 ^(a)	9

Source: DEFRA AIR

Note: Bold indicates exceedance of objective

^(a) Data capture less than 75%

Local authority diffusion tube monitoring

- 1.4.13 BCC undertakes diffusion tube monitoring at multiple sites within its administrative boundary. Table 1.6 presents the latest results for diffusion tubes relevant to the study area and drawing MMD-300207-HS30-DRA-0000-0402 in ES Volume 2 Technical Appendix A: EIA Drawings presents the locations of the diffusion tubes. The data illustrates NO₂ concentrations are above the annual mean objective at the majority of sites in 2015. Monitored concentrations at the background location (locations not affected directly by emission sources such as roads and industry) are just below the annual mean NO₂ objective. The overall trend shows that monitored NO₂ concentrations have reduced by an average of 7µg/m³ between 2011 and 2015.

Table 1.6: BCC NO₂ diffusion tube data for 2011-2015

Site ID	Site classification	National grid reference		Distance from BEE (m)	Annual mean concentration (µg/m ³) ^(a)				
		X	Y		2011	2012	2013	2014	2015
1	Roadside	407060	286868	160	48	53	35	36	33
2	Roadside	407060	286868	160	49	48	35	37	36
3	Roadside	407114	286906	105	42	41	33	31	30
4	Roadside	407177	286996	15	72	61	35	36	32
5	Roadside	407205	287065	25	66	66	44	50	46
6	Roadside	407154	287104	70	37	41	32	30	29
7	Roadside	407217	287132	90	55	54	48	53	51
8	Roadside	407259	287110	95	61	50	43	47	42
9	Roadside	407407	287092	130	56	60	49	50	49
10	Roadside	407399	287078	120	54	62	50	55	50
11	Roadside	407548	287107	100	62	56	41	45	42
12	Roadside	407611	287110	80	51	53	42	45	43
13	Roadside	407628	287121	85	47	47	39	48	46
14	Roadside	407603	287033	10	57	57	56	55	54
15	Roadside	407547	287050	45	41	45	52	58	59
16	Roadside	407488	287023	40	60	61	50	56	49
17	Roadside	407510	286963	20	49	51	42	45	44
18	Roadside	407455	286989	20	49	51	45	49	47
19	Roadside	407433	286922	35	55	59	54	58	55
20	Roadside	407439	286886	70	47	52	51	52	51
21	Roadside	407372	286844	105	66	62	54	57	56
22	Roadside	407355	286769	175	65	50	59	57	54
23	Roadside	407320	286756	185	60	57	55	56	52
24	Roadside	407348	286722	220	68	74	67	66	61
25	Roadside	407377	286896	55	44	48	41	43	41
26	Roadside	407242	286822	120	40	42	37	38	33
27	Roadside	407255	286862	75	35	39	43	46	43
28	Roadside	407278	286931	10	37	46	40	47	47
29	Roadside	407233	286982	5	44	49	43	45	41
30	Background	406919	287037	245	39	43	34	36	39
31	Roadside	407033	287196	220	46	49	38	39	40
32	Roadside	407509	287226	225	40	42	33	33	36
33	Roadside	406973	286751	310	57	59	45	41	36

Site ID	Site classification	National grid reference		Distance from BEE (m)	Annual mean concentration ($\mu\text{g}/\text{m}^3$) ^(a)				
		X	Y		2011	2012	2013	2014	2015
621	Roadside	407321	287531	505	60	56	52	55	55

Source: BCC

Note: ^(a) All values are bias adjusted

Bold indicates exceedance of objective

Mott MacDonald diffusion tube monitoring

- 1.4.14 Mott MacDonald undertook a six month NO₂ diffusion tube monitoring survey at nine sites across the study area between 30 November 2015 and 8 June 2016. Details of the survey, including how the bias adjusted NO₂ annual mean concentrations presented in Table 1.7 were derived, are presented in Annex D.

Table 1.7: BEE specific NO₂ diffusion tube data

Site ID ^(a)	Site Classification	National Grid Reference		Annual mean concentration (2015) ($\mu\text{g}/\text{m}^3$) ^(b)
		X	Y	
MM1	Roadside	407472	287307	35.8
MM2	Roadside	407757	287365	34.7
MM3	Roadside	407995	287174	34.6
MM5	Roadside	408222	286171	39.0
MM6	Roadside	408570	286261	56.4
MM7	Background	407677	286987	36.2
MM8	Roadside	407527	286989	38.5
MM9	Roadside	407854	286335	36.0
MM10	Roadside	407432	286884	44.1

Note: ^(a) Site 4 ID unused

^(b) Monitoring data annualised following DEFRA methodology (Defra, 2016).

Bold indicates exceedance of objective

- 1.4.15 The data presented in Table 1.7 shows that concentrations meet the NO₂ annual mean objective of 40 $\mu\text{g}/\text{m}^3$ at all monitoring sites other than at sites MM6 and MM10.
- 1.4.16 Monitored annual mean concentrations at sites MM6 and MM10 are both above the NO₂ annual mean objective. Concentrations at site MM6 appear to be primarily contributed to by emissions from the A4540 and are located approximately 580m from the BEE. Site MM10 appears to be affected primarily by Moor Street Queensway and the bus interchange and is

located approximately 70m from the BEE. It should be noted that these monitoring sites are not located where there is relevant long term exposure i.e. not in close proximity to residential properties or other locations where the annual mean objective applies (as described in Defra Guidance TG(16) (Defra, 2016) and reproduced in Table 11.2, Chapter 11: Air Quality of ES Volume 1: Main Statement.

- 1.4.17 The monitored annual mean concentrations at sites MM5 and MM8 are just below the NO₂ annual mean objective. It should be noted that neither of these monitoring locations are representative of long term exposure as they are not in close proximity to locations where the annual mean objective applies. Site MM8 is located at the Hotel La Tour; however in accordance with DEFRA guidance (Defra, 2016) the annual mean objective does not apply at hotels.

DEFRA projected background concentrations

- 1.4.18 DEFRA provides estimates of background pollution concentrations for NO_x, NO₂, PM₁₀ and PM_{2.5} across the UK for each one kilometre grid square for every year from 2013 to 2030. Future year projections to 2030 have been developed on the base year for the background maps which is currently 2013. The maps include a breakdown of background concentrations by emission source, including road and industrial sources which have been calibrated against 2013 UK monitoring data. Table 1.8 presents DEFRA projected background concentrations for the study area.

Table 1.8: DEFRA projected background concentrations of NO_x, NO₂, PM₁₀ and PM_{2.5} for the study area (sector removed)

Grid Square (national grid reference)		2015				2021			
X	Y	NO _x	NO ₂	PM ₁₀	PM _{2.5}	NO _x	NO ₂	PM ₁₀	PM _{2.5}
405500	285500	43.0	27.0	16.4	12.0	33.2	21.9	15.6	11.2
405500	286500	48.3	29.9	17.9	13.0	36.2	23.6	17.0	12.1
405500	287500	44.4	27.7	17.9	12.8	34.0	22.3	17.1	12.1
405500	288500	42.8	27.1	17.6	12.6	31.4	21.0	16.8	11.8
406500	285500	46.3	28.9	17.9	12.8	34.0	22.4	17.1	12.0
406500	286500	56.1	33.2	19.3	13.9	44.1	27.4	18.2	12.8
406500	287500	54.5	32.6	19.5	14.0	41.3	26.2	18.5	12.9
406500	288500	45.7	28.5	18.6	13.2	34.0	22.4	17.8	12.4
407500	285500	47.8	29.5	18.3	13.1	35.8	23.3	17.4	12.3
407500	286500	49.6	29.9	18.5	13.2	39.4	24.9	17.7	12.5
407500	287500	46.1	28.4	19.3	13.6	35.9	23.2	18.6	12.9
407500	288500	47.7	29.3	21.8	14.8	36.4	23.6	20.8	14.0
408500	285500	50.6	30.7	18.6	13.2	38.1	24.5	17.8	12.4

Grid Square (national grid reference)		2015				2021			
X	Y	NO _x	NO ₂	PM ₁₀	PM _{2.5}	NO _x	NO ₂	PM ₁₀	PM _{2.5}
408500	286500	49.6	30.1	18.9	13.4	38.2	24.4	18.1	12.7
408500	287500	51.0	30.7	18.9	13.5	39.6	25.1	18.1	12.7
408500	288500	50.7	30.7	19.4	13.7	38.8	24.8	18.5	12.8

Note: Background concentrations are applied to modelled receptors within the relevant grid square. E.g. a receptor at location grid reference (X, Y) 407492, 287707 will come under grid square 407500, 287500

Summary

- 1.4.19 Monitoring results from 2015 show NO₂ concentrations continue to exceed the annual mean objective at roadside locations within the existing Birmingham AQMA. Monitoring at background locations show NO₂ concentrations are below the annual mean objective away from roads. Table 1.6 presents the latest results for diffusion tubes relevant to the study area and shows NO₂ concentrations have decreased overall between 2014 and 2015.
- 1.4.20 Monitoring results from 2015 show PM₁₀ and PM_{2.5} concentrations within the BCC borough are below the relevant annual mean objectives, further supporting the AQMA revocation in 2010 for PM₁₀.
- 1.4.21 The DEFRA projected background concentrations at the BEE location are below the relevant air quality objectives for the baseline and opening year.

Background concentrations used within assessment

- 1.4.22 In the absence of continuous background monitoring data within the study area, background concentrations used within the assessment have been taken from DEFRA projected background concentrations for the Model Verification and Opening Year (2021).

1.5 Results

Construction dust

- 1.5.1 The risk assessment for construction dust impacts has been undertaken assuming no embedded mitigation in order to inform the appropriate level of embedded mitigation to be included in the Code of Construction Practice (CoCP).
- 1.5.2 Magnitude and sensitivity descriptors that have been applied to assess the overall effect of the construction phase are presented in Annex A. The construction phase assessment follows the defined steps in IAQM guidance (2014) and identifies dust emission magnitude first, followed by receptor sensitivity.

- 1.5.3 Table 1.9 presents the dust emission magnitude defined for each activity associated with the construction of the BEE (based on the latest construction information available at the time of writing).

Table 1.9: Dust emission magnitude

Activity	Dust emission magnitude	Justification
Demolition	Medium	The total volume of buildings to be demolished is approximately 21,000m ³ including buildings with potentially dusty construction material, e.g. concrete.
Earthworks	Large	Permanent land to be used or acquired is approximately 70,000m ² . Estimated to be between 20,000 and 100,000 tonnes of material moved throughout the construction period.
Construction	Medium	The total building volume will be less than 25,000m ³ . Concrete batching and piling will be undertaken.
Track out	Medium	Limited information is available at this stage; however current estimates show that there may be a total of approximately 20 HDV movements to and from the construction site, including construction compounds, each day. There will be approximately 50m to 100m of unpaved road.

- 1.5.4 Table 1.10 presents the sensitivity of receptors and the sensitivity of the area to air quality effects caused by construction activities, based on the criteria presented in Annex A and drawing MMD-300207-HS30-DRA-0000-0404. It should be noted that there are no ecological receptors within 500m of the BEE.

Table 1.10: Receptor and area sensitivity

Sensitivity to effect	Dust soiling		Health effects of PM ₁₀	
	Area sensitivity	Comment	Area sensitivity	Comment
Demolition	High	Less than 10 high sensitivity (residential) receptors within 20m of the construction boundary. Over 100 residential properties within 50m of the Scheme.	Low	1-10 residential properties within 20m of the Scheme and annual mean PM ₁₀ <24µg/m ³ .
Earthworks	High		Low	
Construction	High		Low	
Track out	High	Haulage routes not fully confirmed, but considered likely to be 1-10 receptors within 20m of the roads to be used and over 100 residential properties within 50m of the roads to be used by construction traffic.	Low	Haulage routes not fully confirmed but annual mean PM ₁₀ <24µg/m ³ and assumed <100 residential receptors within 20m of the roads to be used by construction traffic.

- 1.5.5 The overall risk of receptors to dust soiling effects and PM₁₀ effects are presented in Table 1.11. Risk is based on the criteria presented in Table A.6 to Table A.9 presented within Annex A.

Table 1.11: Summary of the risk of construction effects

Activity	Dust soiling effects	PM ₁₀ health effects
Demolition	Medium	Low
Earthworks	High	Low
Construction	Medium	Low
Track out	Medium	Low

1.5.6 As Table 1.11 shows, the greatest risk of dust soiling effects is from the earthworks activities (considered 'high' risk) and the greatest risk of PM₁₀ health effects is from demolition, earthworks, construction and track out (all considered 'low' risk).

1.5.7 Mitigation requirements as per IAQM guidance for 'high' risk construction sites have therefore been included in the CoCP and these are presented in Chapter 11: Air Quality of ES Volume 1: Main Statement. It is considered that the appropriate implementation of these mitigation measures will reduce the risk of construction dust and impacts will not be significant.

1.6 Operational Results

Nitrogen dioxide (NO₂) concentrations

1.6.1 Table 1.12 presents the annual mean NO₂ concentrations and impact descriptors for all modelled receptors in the DM and DS scenarios. Drawing MMD-300207-HS30-DRA-0000-0405 in ES Volume 2 Appendix A: EIA Drawings presents the location of the receptors which are predicted to experience changes in NO₂ concentrations following the operation of BEE.

1.6.2 The BEE is predicted to improve or have no impact on air quality at the majority of modelled receptors. The largest improvement is predicted on Floodgate Street (receptor 1) where a reduction in annual mean NO₂ of 5.8µg/m³ (-13.8% relative to the AQAL) is predicted. This corresponds to a 'substantial beneficial' impact based on the assessment approach adopted for this assessment. In total, 78 of the 81 modelled receptors experience either an improvement in air quality or no change in accordance with the approach adopted for this assessment. The improvements in air quality are due to changes in traffic flows in the existing road network as a result of BEE.

1.6.3 There are three receptors which are predicted to experience deterioration in air quality during the operation of BEE (Great Barr Street, Navigation Street and St Chads Queensway 4), as described in the following paragraphs.

1.6.4 A maximum increase in annual mean NO₂ of 1.2µg/m³ is predicted at Great Barr Street (corresponding to a 3% increase relative to the AQAL), however the BEE is not predicted to create an exceedance and the total annual mean NO₂ concentration at this receptor is below the AQAL of 40µg/m³. The impact descriptor at this receptor is described as 'slight adverse'.

- 1.6.5 Receptor 55 Navigation Street is predicted to experience a 'moderate adverse' impact as a result of future baseline concentrations being above the air quality objectives at this location. Concentrations as a result of BEE are predicted to increase by $0.5\mu\text{g}/\text{m}^3$ (corresponding to a 1.3% increase relative to the AQAL) due to an increase in traffic flows along Suffolk Street Queensway.
- 1.6.6 St Chads Queensway 4 is predicted to experience an increase in annual mean NO_2 of $0.3\mu\text{g}/\text{m}^3$, which corresponds to an increase of 0.9% relative to the AQAL. The BEE is not predicted to create an exceedance and the total annual mean NO_2 concentration at this receptor is below the AQAL of $40\mu\text{g}/\text{m}^3$. The impact descriptor at this receptor is described as 'slight adverse' as future baseline concentrations remain below the air quality objectives at this location.
- 1.6.7 All receptors along the route of the BEE are predicted to experience a beneficial impact in terms of NO_2 concentrations except receptor 65 (Minories 1), which is predicted to experience a 'negligible' change in concentrations of a $0.1\mu\text{g}/\text{m}^3$ (-0.3% relative to the AQAL).
- 1.6.8 As annual mean concentrations are predicted to be well below $60\mu\text{g}/\text{m}^3$ at all receptors, no exceedances of the hourly objective are predicted (Defra, 2016).

Table 1.12: Annual Mean NO_2 Predicted Concentrations ($\mu\text{g}/\text{m}^3$) (2021)

Receptor ID	Receptor name	Annual Mean NO_2 Concentration ($\mu\text{g}/\text{m}^3$)		% Change relative to AQ objective	Impact descriptor
		2021 DM	2021 DS		
1	Floodgate Street	38.3	32.8	-13.8	Substantial Beneficial
2	Digbeth 1	39.2	38.2	-2.5	Moderate Beneficial
3	Grosvenor Street	26.1	26.2	0.2	Negligible
4	Coleshill Street	34.7	35.0	0.6	Negligible
5	Jennens Road 1	27.5	27.4	-0.1	Negligible
6	St Chads Queensway 1	36.3	36.5	0.4	Negligible
7	Steelhouse Lane 1	32.1	31.9	-0.5	Negligible
8	Margaret Street	38.4	38.4	0.1	Negligible
9	Stratford Road	29.1	28.8	-0.6	Negligible
10	Farmacre	31.7	31.6	-0.1	Negligible
11	Hawthorn Close 1	30.3	30.2	-0.1	Negligible
12	Dart Street	29.6	29.5	-0.4	Negligible
13	Great Barr Street	32.2	33.4	3.0	Slight Adverse
14	Hawthorn Close 2	30.2	30.1	-0.1	Negligible
15	Coventry Road	29.8	29.7	-0.4	Negligible
16	Miles Druce Way	31.7	30.9	-2.0	Slight Beneficial
17	Upper Dean Street	33.7	32.9	-2.0	Slight Beneficial

Receptor ID	Receptor name	Annual Mean NO ₂ Concentration (µg/m ³)		% Change relative to AQ objective	Impact descriptor
		2021 DM	2021 DS		
18	Digbeth 2	38.2	37.2	-2.6	Moderate Beneficial
19	Jennens Road 2	26.3	26.4	0.3	Negligible
20	Jennens Road 3	26.1	26.0	-0.1	Negligible
21	Jennens Road 4	26.5	26.4	-0.2	Negligible
22	Masshouse Plaza	37.1	35.5	-4.1	Slight Beneficial
23	Adderley Street	27.5	27.3	-0.4	Negligible
24	High Street 1	35.7	32.0	-9.5	Moderate Beneficial
25	Lawley Middleway	34.9	34.0	-2.1	Slight Beneficial
26	Bagot Street	32.6	32.4	-0.4	Negligible
27	Moland Street	35.8	35.9	0.4	Negligible
28	Windsor Street South	33.0	32.4	-1.6	Slight Beneficial
29	Jennens Road 5	27.8	27.7	-0.2	Negligible
30	Bradford Street 1	29.2	28.8	-1.1	Negligible
31	Digbeth 3	38.4	34.8	-9.1	Moderate Beneficial
32	Ravenhurst Street	33.2	32.8	-0.9	Negligible
33	Bradford Street 2	34.2	33.6	-1.4	Negligible
34	Digbeth 4	34.2	32.3	-4.8	Slight Beneficial
35	Bradford Street 3	27.8	27.7	-0.3	Negligible
36	Aston Street 1	35.7	35.5	-0.4	Negligible
37	Aston Street 2	32.8	32.7	-0.2	Negligible
38	Aston Street 3	36.0	35.8	-0.6	Negligible
39	Lancaster Street 1	34.7	34.7	0.0	Negligible
40	Staniforth Street 1	42.7	42.6	-0.1	Negligible
41	Pritchett Street 1	27.5	27.5	0.0	Negligible
42	Lancaster Street 2	35.4	35.3	-0.2	Negligible
43	Price Street 1	32.4	32.4	0.0	Negligible
44	Aston Street 4	35.0	34.7	-0.7	Negligible
45	Aston Street 5	34.8	34.5	-0.7	Negligible
46	Ludgate Hill	33.1	33.1	0.0	Negligible
47	Princip Street	29.1	29.0	-0.2	Negligible
48	Staniforth Street 2	37.3	37.4	0.3	Negligible
49	Corporation Street 1	39.8	39.8	0.0	Negligible
50	Corporation Street 2	39.6	39.6	0.0	Negligible
51	Price Street 2	33.0	33.0	0.0	Negligible
52	Allison Street	31.9	31.3	-1.4	Negligible
53	Rea Street	34.0	32.6	-3.5	Slight Beneficial
54	Digbeth 5	51.8	47.6	-10.5	Substantial Beneficial

Receptor ID	Receptor name	Annual Mean NO ₂ Concentration (µg/m ³)		% Change relative to AQ objective	Impact descriptor
		2021 DM	2021 DS		
55	Navigation Street	44.0	44.5	1.3	Moderate Adverse
56	Suffolk Street Queensway	45.7	45.8	0.3	Negligible
57	Coventry Street	30.9	31.1	0.6	Negligible
58	New Bartholomew Street	29.8	29.1	-1.7	Negligible
59	St Chads Queensway 3	36.5	36.9	1.0	Negligible
60	Corporation Street 3	26.8	26.6	-0.4	Negligible
61	Corporation Street 4	26.5	26.3	-0.4	Negligible
62	Steelhouse Lane 2	34.7	34.7	0.0	Negligible
63	Minories 1	26.2	26.1	-0.4	Negligible
64	Corporation Street 5	27.0	26.9	-0.4	Negligible
65	Minories 2	26.0	25.9	-0.3	Negligible
66	St Chads Queensway 4	37.5	37.8	0.9	Slight Adverse
67	Paradise Street	32.2	32.3	0.2	Negligible
68	Albert Street	28.3	26.1	-5.5	Slight Beneficial
69	Digbeth 6	36.7	35.2	-3.6	Slight Beneficial
70	Bromsgrove Street	29.1	29.1	0.0	Negligible
71	William Booth Lane	35.5	35.7	0.5	Negligible
72	Newhall Street	38.4	38.6	0.4	Negligible
73	Camp Hill 1	29.0	28.8	-0.5	Negligible
74	Camp Hill 2	32.8	32.6	-0.7	Negligible
75	Moseley Road	30.4	30.2	-0.4	Negligible
76	Ferndale Crescent 1	29.9	29.6	-0.7	Negligible
77	Ferndale Crescent 2	31.8	31.4	-0.9	Negligible
78	Bradford Street 4	30.7	30.5	-0.5	Negligible
79	Mill Street	32.1	32.1	0.0	Negligible
80	Pritchett Street 2	38.8	38.8	0.0	Negligible
81	Blews Street	27.7	27.7	0.0	Negligible

Note: DM = Do Minimum DS = Do Something;

Particulate matter (PM₁₀) concentrations

1.6.9 Table 1.13 presents the annual mean PM₁₀ concentrations and impacts descriptors for all modelled receptors in the DM and DS scenarios.

1.6.10 Concentration changes predicted as a result of the BEE are 'negligible' at all receptors and modelled concentrations of PM₁₀ are well below the annual mean objective in the DM and DS scenarios. Daily mean PM₁₀ concentrations are also well below the objective.

Table 1.13: Annual Mean PM₁₀ Predicted Concentrations (µg/m³) (2021)

Receptor ID	Receptor name	Annual mean PM ₁₀ concentration (µg/m ³)		% Change relative to AQ objective	Impact descriptor
		2021 DM	2021 DS		
1	Floodgate Street	19.31	18.75	-1.40	Negligible
2	Digbeth 1	19.40	19.02	-0.95	Negligible
3	Grosvenor Street	19.18	19.22	0.09	Negligible
4	Coleshill Street	19.88	19.92	0.10	Negligible
5	Jennens Road 1	19.40	19.40	-0.01	Negligible
6	St Chads Queensway 1	20.66	20.69	0.07	Negligible
7	Steelhouse Lane 1	19.50	19.48	-0.05	Negligible
8	Margaret Street	19.81	19.82	0.02	Negligible
9	Stratford Road	18.38	18.35	-0.08	Negligible
10	Farmacre	19.24	19.24	0.00	Negligible
11	Hawthorn Close 1	19.00	18.99	-0.01	Negligible
12	Dart Street	18.74	18.73	-0.04	Negligible
13	Great Barr Street	18.99	19.14	0.37	Negligible
14	Hawthorn Close 2	18.96	18.95	-0.01	Negligible
15	Coventry Road	18.76	18.74	-0.05	Negligible
16	Miles Druce Way	18.93	18.86	-0.17	Negligible
17	Upper Dean Street	18.60	18.52	-0.22	Negligible
18	Digbeth 2	18.93	18.70	-0.59	Negligible
19	Jennens Road 2	19.16	19.19	0.07	Negligible
20	Jennens Road 3	19.18	19.17	-0.03	Negligible
21	Jennens Road 4	19.20	19.17	-0.08	Negligible
22	Masshouse Plaza	19.67	19.60	-0.18	Negligible
23	Adderley Street	18.46	18.44	-0.05	Negligible
24	High Street 1	19.34	18.93	-1.02	Negligible
25	Lawley Middleway	19.40	19.33	-0.17	Negligible
26	Bagot Street	19.76	19.72	-0.09	Negligible
27	Moland Street	20.40	20.40	0.00	Negligible
28	Windsor Street South	19.16	19.09	-0.16	Negligible
29	Jennens Road 5	19.40	19.38	-0.05	Negligible
30	Bradford Street 1	18.18	18.13	-0.12	Negligible
31	Digbeth 3	18.93	18.62	-0.77	Negligible
32	Ravenhurst Street	18.95	18.89	-0.15	Negligible
33	Bradford Street 2	18.73	18.67	-0.16	Negligible
34	Digbeth 4	18.68	18.41	-0.67	Negligible
35	Bradford Street 3	18.45	18.41	-0.08	Negligible
36	Aston Street 1	19.89	19.86	-0.08	Negligible

Receptor ID	Receptor name	Annual mean PM ₁₀ concentration (µg/m ³)		% Change relative to AQ objective	Impact descriptor
		2021 DM	2021 DS		
37	Aston Street 2	19.60	19.59	-0.04	Negligible
38	Aston Street 3	19.96	19.93	-0.09	Negligible
39	Lancaster Street 1	20.02	20.01	-0.04	Negligible
40	Staniforth Street 1	21.54	21.51	-0.07	Negligible
41	Pritchett Street 1	21.32	21.32	0.00	Negligible
42	Lancaster Street 2	20.14	20.12	-0.05	Negligible
43	Price Street 1	19.73	19.71	-0.04	Negligible
44	Aston Street 4	19.88	19.84	-0.09	Negligible
45	Aston Street 5	19.63	19.60	-0.09	Negligible
46	Ludgate Hill	19.36	19.36	0.00	Negligible
47	Princip Street	19.32	19.31	-0.03	Negligible
48	Staniforth Street 2	20.52	20.52	0.00	Negligible
49	Corporation Street 1	20.98	20.96	-0.04	Negligible
50	Corporation Street 2	21.04	21.02	-0.05	Negligible
51	Price Street 2	20.02	20.03	0.03	Negligible
52	Allison Street	18.42	18.34	-0.19	Negligible
53	Rea Street	18.62	18.45	-0.42	Negligible
54	Digbeth 5	20.33	19.83	-1.26	Negligible
55	Navigation Street	20.32	20.37	0.13	Negligible
56	Suffolk Street Queensway	20.87	20.91	0.10	Negligible
57	Coventry Street	18.35	18.27	-0.21	Negligible
58	New Bartholomew Street	18.24	18.10	-0.34	Negligible
59	St Chads Queensway 3	20.52	20.55	0.08	Negligible
60	Corporation Street 3	19.24	19.21	-0.07	Negligible
61	Corporation Street 4	19.12	19.09	-0.07	Negligible
62	Steelhouse Lane 2	20.23	20.24	0.02	Negligible
63	Minories 1	19.03	19.01	-0.05	Negligible
64	Corporation Street 5	19.13	19.11	-0.05	Negligible
65	Minories 2	19.00	18.99	-0.03	Negligible
66	St Chads Queensway 4	19.98	20.00	0.06	Negligible
67	Paradise Street	19.32	19.35	0.06	Negligible
68	Albert Street	19.11	18.85	-0.64	Negligible
69	Digbeth 6	18.99	18.77	-0.54	Negligible
70	Bromsgrove Street	18.16	18.17	0.03	Negligible
71	William Booth Lane	19.57	19.58	0.03	Negligible
72	Newhall Street	20.15	20.17	0.06	Negligible

Receptor ID	Receptor name	Annual mean PM ₁₀ concentration (µg/m ³)		% Change relative to AQ objective	Impact descriptor
		2021 DM	2021 DS		
73	Camp Hill 1	18.33	18.30	-0.07	Negligible
74	Camp Hill 2	18.91	18.87	-0.10	Negligible
75	Moseley Road	18.40	18.38	-0.03	Negligible
76	Ferndale Crescent 1	18.45	18.42	-0.09	Negligible
77	Ferndale Crescent 2	18.69	18.66	-0.09	Negligible
78	Bradford Street 4	18.33	18.32	-0.03	Negligible
79	Mill Street	21.80	21.80	0.00	Negligible
80	Pritchett Street 2	22.53	22.52	-0.01	Negligible
81	Blews Street	21.33	21.33	0.00	Negligible

Note: DM = Do Minimum DS = Do Something;
Results presented to 2 decimal places to show changes in concentration and is not a reflection of model accuracy

Particulate matter (PM_{2.5}) concentrations

- 1.6.11 Table 1.14 presents the annual mean PM_{2.5} concentrations and impacts descriptors for all modelled receptors in the DM and DS scenarios.
- 1.6.12 Concentration changes predicted as a result of the BEE are 'negligible' at all receptors and modelled concentrations of PM_{2.5} are well below the annual mean objective in the DM and DS scenarios.

Table 1.14: Annual mean PM_{2.5} predicted concentrations (µg/m³) (2021)

Receptor ID	Receptor name	Annual mean NO ₂ concentration (µg/m ³)		% Change relative to AQ objective	Impact descriptor
		2021 DM	2021 DS		
1	Floodgate Street	13.36	13.04	-1.28	Negligible
2	Digbeth 1	13.42	13.21	-0.83	Negligible
3	Grosvenor Street	13.25	13.27	0.08	Negligible
4	Coleshill Street	13.65	13.68	0.09	Negligible
5	Jennens Road 1	13.38	13.38	0.00	Negligible
6	St Chads Queensway 1	14.08	14.09	0.06	Negligible
7	Steelhouse Lane 1	13.44	13.43	-0.05	Negligible
8	Margaret Street	13.70	13.71	0.02	Negligible
9	Stratford Road	12.78	12.76	-0.07	Negligible
10	Farmacre	13.30	13.30	0.00	Negligible
11	Hawthorn Close 1	13.16	13.16	0.00	Negligible
12	Dart Street	13.03	13.02	-0.04	Negligible

Receptor ID	Receptor name	Annual mean NO ₂ concentration (µg/m ³)		% Change relative to AQ objective	Impact descriptor
		2021 DM	2021 DS		
13	Great Barr Street	13.17	13.25	0.34	Negligible
14	Hawthorn Close 2	13.14	13.14	0.00	Negligible
15	Coventry Road	13.04	13.03	-0.04	Negligible
16	Miles Druce Way	13.15	13.11	-0.17	Negligible
17	Upper Dean Street	12.97	12.92	-0.20	Negligible
18	Digbeth 2	13.17	13.04	-0.52	Negligible
19	Jennens Road 2	13.25	13.26	0.06	Negligible
20	Jennens Road 3	13.25	13.25	0.00	Negligible
21	Jennens Road 4	13.27	13.25	-0.07	Negligible
22	Masshouse Plaza	13.55	13.50	-0.18	Negligible
23	Adderley Street	12.86	12.85	-0.05	Negligible
24	High Street 1	13.37	13.14	-0.93	Negligible
25	Lawley Middleway	13.42	13.38	-0.16	Negligible
26	Bagot Street	13.58	13.56	-0.08	Negligible
27	Moland Street	13.94	13.93	-0.02	Negligible
28	Windsor Street South	13.28	13.24	-0.15	Negligible
29	Jennens Road 5	13.38	13.37	-0.04	Negligible
30	Bradford Street 1	12.73	12.70	-0.11	Negligible
31	Digbeth 3	13.17	12.98	-0.72	Negligible
32	Ravenhurst Street	13.10	13.07	-0.13	Negligible
33	Bradford Street 2	13.04	13.01	-0.14	Negligible
34	Digbeth 4	13.01	12.86	-0.60	Negligible
35	Bradford Street 3	12.82	12.80	-0.07	Negligible
36	Aston Street 1	13.66	13.64	-0.07	Negligible
37	Aston Street 2	13.50	13.49	-0.04	Negligible
38	Aston Street 3	13.70	13.68	-0.08	Negligible
39	Lancaster Street 1	13.73	13.72	-0.04	Negligible
40	Staniforth Street 1	14.57	14.56	-0.06	Negligible
41	Pritchett Street 1	14.23	14.23	0.00	Negligible
42	Lancaster Street 2	13.79	13.78	-0.04	Negligible
43	Price Street 1	13.56	13.55	-0.04	Negligible
44	Aston Street 4	13.65	13.63	-0.08	Negligible
45	Aston Street 5	13.52	13.50	-0.08	Negligible
46	Ludgate Hill	13.44	13.44	0.00	Negligible
47	Princip Street	13.33	13.32	-0.03	Negligible
48	Staniforth Street 2	14.01	14.01	0.00	Negligible
49	Corporation Street 1	14.26	14.25	-0.03	Negligible

Receptor ID	Receptor name	Annual mean NO ₂ concentration (µg/m ³)		% Change relative to AQ objective	Impact descriptor
		2021 DM	2021 DS		
50	Corporation Street 2	14.29	14.28	-0.04	Negligible
51	Price Street 2	13.72	13.73	0.02	Negligible
52	Allison Street	12.87	12.83	-0.18	Negligible
53	Rea Street	12.98	12.88	-0.38	Negligible
54	Digbeth 5	13.97	13.68	-1.16	Negligible
55	Navigation Street	14.05	14.08	0.12	Negligible
56	Suffolk Street Queensway	14.35	14.37	0.09	Negligible
57	Coventry Street	12.83	12.78	-0.18	Negligible
58	New Bartholomew Street	12.76	12.69	-0.30	Negligible
59	St Chads Queensway 3	14.00	14.02	0.08	Negligible
60	Corporation Street 3	13.29	13.27	-0.06	Negligible
61	Corporation Street 4	13.22	13.21	-0.06	Negligible
62	Steelhouse Lane 2	13.84	13.85	0.02	Negligible
63	Minories 1	13.17	13.16	-0.04	Negligible
64	Corporation Street 5	13.23	13.22	-0.05	Negligible
65	Minories 2	13.16	13.15	-0.03	Negligible
66	St Chads Queensway 4	13.79	13.80	0.06	Negligible
67	Paradise Street	13.48	13.49	0.05	Negligible
68	Albert Street	13.22	13.07	-0.59	Negligible
69	Digbeth 6	13.19	13.07	-0.49	Negligible
70	Bromsgrove Street	12.72	12.73	0.02	Negligible
71	William Booth Lane	13.56	13.57	0.03	Negligible
72	Newhall Street	13.89	13.90	0.05	Negligible
73	Camp Hill 1	12.75	12.73	-0.06	Negligible
74	Camp Hill 2	13.08	13.06	-0.09	Negligible
75	Moseley Road	12.79	12.79	0.00	Negligible
76	Ferndale Crescent 1	12.82	12.80	-0.08	Negligible
77	Ferndale Crescent 2	12.96	12.94	-0.08	Negligible
78	Bradford Street 4	12.81	12.81	0.00	Negligible
79	Mill Street	14.52	14.52	0.00	Negligible
80	Pritchett Street 2	14.96	14.95	-0.01	Negligible
81	Blews Street	14.24	14.24	0.00	Negligible

Note: DM = Do Minimum DS = Do Something;
Results presented to 2 decimal places to show changes in concentration and is not a reflection of model accuracy

Compliance risk assessment

- 1.6.13 Table 1.15 presents the compliance risk analysis for the PCM links in the CRRN where pollutant concentrations at the worst affected receptor are predicted to increase by more than $0.4\mu\text{g}/\text{m}^3$ in accordance with HE guidance. Only PCM links that are predicted to experience an increase in NO_2 concentrations have been included. The assessment shows that there is a low risk of the BEE affecting the UK's reported ability to comply with the EU Air Quality Directive.

Table 1.15 Compliance Risk Analysis for the BEE

Inputs				Defra PCM Model and Compliance Information					Modelled Receptor Results			
Receptor ID	Defra Link Census ID	Zone / Agglomeration Ref No	Is it a Compliant Zone?	Preceding Year: Total NO_2 2020	Following Year: Total NO_2 2025	Equivalent Opening Year: Total NO_2 2021	Maximum Modelled Conc in Zone 2013	Projected Compliance Year	Annual Mean DM NO_2 ($\mu\text{g}/\text{m}^3$)	Annual Mean DS NO_2 ($\mu\text{g}/\text{m}^3$)	Change in Annual Mean ($\mu\text{g}/\text{m}^3$) (DS-DM)	Equivalent PCM DS ($\mu\text{g}/\text{m}^3$)
55	77775	2	No	38.0	38.0	38.0	70.0	2020	44.0	44.5	0.5	38.5
59	77782	2	No	39.0	36.0	38.4	70.0	2020	36.5	36.9	0.4	38.8

Sensitivity analysis

- 1.6.14 Sensitivity analysis was carried out to determine the sensitivity of modelled results to assumptions regarding future baseline air quality. The sensitivity analysis assumed that background concentrations do not improve in future years as per existing Defra guidance. Full details of the sensitivity analysis, including modelled results, are presented in Annex E.
- 1.6.15 With respect to annual mean NO_2 four out of the 81 modelled receptors included in the sensitivity testing are predicted to have a 'moderate adverse' impact, namely Great Barr Street (receptor 13), Navigation Street (receptor 55), St Chads Queensway 3 (receptor 59) and St Chads Queensway 4 (receptor 66). One receptor (Coleshill Street, receptor 4) is predicted to have a 'slight adverse' impact. The maximum NO_2 increase of $1.2\mu\text{g}/\text{m}^3$ (corresponding to a 2.9% increase relative to the AQAL) was modelled at the Great Barr Street receptor (receptor 13). It should be noted that BEE is not predicted to cause an exceedance of the annual mean objective at any of these five receptors. At receptors where the DM concentrations are above the air quality objectives the maximum predicted increase in concentrations is 1.2% which is at Receptor 55, Navigation Street.
- 1.6.16 For all modelled receptors, PM_{10} and $\text{PM}_{2.5}$ impacts are 'negligible' and predicted concentrations remain below the relevant air quality objectives. The results for the sensitivity analysis indicate that with conservative assumptions, the BEE will not have a significant effect on air quality in terms of PM_{10} and $\text{PM}_{2.5}$ concentrations.

1.7 Summary

- 1.7.1 The results from the assessment show that BEE will have no impact or result in improvements in air quality at the majority of modelled receptors. The biggest increases in pollutant concentrations occur where concentrations are below the air quality objectives. At locations where concentrations in pollutants are predicted to be above the air quality objectives increases caused by BEE are small and approximately 1% of the AQAL.
- 1.7.2 The assessment has demonstrated that BEE will not affect compliance with the EU Air Quality Directive.
- 1.7.3 Overall, it can be considered that impacts on air quality are considered to be not significant in accordance with guidance set out by the IAQM.

Annexes

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A. Construction Dust Assessment Criteria

A.1 Construction Dust

Table A.1: Determination of dust raising magnitude

Source	Small	Medium	Large
Demolition	Total building volume <20,000m ³ , construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months	Total building volume 20,000m ³ - 50,000m ³ , potentially dusty construction material, demolition activities 10-20m above ground level	Total building volume > 50,000m ³ , potentially dusty construction material (e.g. concrete), on site crushing and screening, demolition activities > 20m above ground
Earthworks	Total site area <2,500m ² , soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <10,000tonne, earthworks during wetter months	Total site area 2,500m ² – 10,000m ² , moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4m – 8m in height, total material moved 20,000 tonne – 100,000 tonne	Total site area >10,000m ² , potentially dusty soil type (e.g. clay, which will be prone to suspension when dry to due small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8m in height, total material moved >100,000 tonnes
Construction	Total building volume <25,000m ³ , construction material with low potential for dust release (e.g. metal cladding or timber)	Total building volume 25,000m ³ – 100,000m ³ , potentially dusty construction material (e.g. concrete), piling, on site concrete batching	Total building volume >100,000m ³ , piling, on site concrete batching; sandblasting
Track out	<25 HDV (>3.5t) trips in any one day, surface material with low potential for dust release, unpaved road length <50m	25-100 HDV (>3.5t) trips in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50m – 100m	>100 HDV (>3.5t) trips in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100m

Source: IAQM, 2014

Table A.2: Receptor sensitivity

Sensitivity of effect	Low	Medium	High
Sensitivities of people to dust soiling effects	The enjoyment of amenity would not reasonably be expected ^A; or Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Indicative examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks ^B and roads.	Users would expect a to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or The appearance, aesthetics or value of their property could be diminished by soiling; or The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Indicative examples include parks and places of work.	Users can reasonably expect an enjoyment of a high level of amenity; or The appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Indicative examples include dwellings, museums and other culturally important collections, medium and long term car parks ^B and car showrooms.
Sensitivities of people to the health effects of PM ₁₀	Locations where human exposure is transient ^E Indicative examples include public footpaths, playing fields, parks and shopping streets.	Locations where the people exposed are workers ^D, and exposure is over a time period relevant to the air quality objective for PM₁₀ (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative examples include office and shop workers, but will generally not include workers occupationally exposed to PM₁₀, as protection is covered by Health and Safety at Work legislation.	Locations where members of the public are exposed over a time period relevant to the air quality objective for PM₁₀ (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).^C Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.
Sensitivities of receptors to ecological effects ^F	Locations with a local designation where the features may be affected by dust deposition. Indicative example is a local Nature Reserve	Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or • Locations with a	Locations with an international or national designation and the designated features may be affected by dust soiling; or

Sensitivity of effect	Low	Medium	High
	with dust sensitive features.	national designation where the features may be affected by dust deposition. • Indicative example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.	Locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List For Great Britain ⁶ . Indicative examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.

Source: IAQM, 2014

- A People's expectations will vary depending on the existing dust deposition in the area
- B Car parks can have a range of sensitivities depending on the duration and frequency that people would be expected to park their cars there, and the level of amenity they could reasonably expect whilst doing so. Car parks associated with work place or residential parking might have a high level of sensitivity compared to car parks used less frequently and for shorter durations, such as those associated with shopping. Cases should be examined on their own merits.
- C This follows DEFRA guidance as set out in LAQM.TG(16).
- D Notwithstanding the fact that the air quality objectives and limit values do not apply to people in the workplace, such people can be affected to exposure of PM10. However, they are considered to be less sensitive than the general public as a whole because those most sensitive to the effects of air pollution, such as young children are not normally workers. For this reason workers have been included in the medium sensitivity category.
- E There are no standards that apply to short-term exposure, e.g. one or two hours, but there is still a risk of health impacts, albeit less certain.
- F A Habitat Regulation Assessment of the site may be required as part of the planning process, if the site lies close to an internationally designated site i.e. Special Conservation Areas (SCAs), Special Protection Areas (SPAs) designated under the Habitats Directive (92/43/EEC) and RAMSAR sites.
- G Cheffing C. M. & Farrell L. (Editors) (2005), The Vascular Plant. Red Data List for Great Britain, Joint Nature Conservation Committee.

Table A.3: Sensitivity of the area to dust soiling effects on people and property

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		<20	<50	<100	<350
Low	>1	Low	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low

Source: IAQM, 2014

Table A.4: Sensitivity of the area to human health impacts

Receptor sensitivity	Annual mean PM ₁₀ concentration	Number of receptors	Distance from the source (m)				
			<20	<50	<100	<200	<350
Low	-	>1	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
High	>32 µg/m ³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m ³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m ³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m ³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low

Source: IAQM, 2014

Table A.5: Sensitivity of the area to ecological impacts

Receptor sensitivity	Distance from the source (m)	
	<20	<50
Low	Low	Low
Medium	Medium	Low
High	High	Medium

Source: IAQM, 2014

Table A.6: Risk of dust impacts - demolition

Sensitivity of area	Dust emission magnitude		
	Large	Medium	Small
Low	Medium Risk	Low Risk	Negligible
Medium	High Risk	Medium Risk	Low Risk
High	High Risk	Medium Risk	Medium Risk

Source: IAQM, 2014

Table A.7: Risk of dust impacts - earthworks

Sensitivity of area	Dust emission magnitude		
	Large	Medium	Small
Low	Low Risk	Low Risk	Negligible
Medium	Medium Risk	Medium Risk	Low Risk
High	High Risk	Medium Risk	Low Risk

Source: IAQM, 2014

Table A.8: Risk of dust impacts - construction

Sensitivity of area	Dust emission magnitude		
	Large	Medium	Small
Low	Low Risk	Low Risk	Negligible
Medium	Medium Risk	Medium Risk	Low Risk
High	High Risk	Medium Risk	Low Risk

Source: IAQM, 2014

Table A.9: Risk of dust impacts – trackout

Sensitivity of area	Dust emission magnitude		
	Large	Medium	Small
Low	Low Risk	Low Risk	Negligible
Medium	Medium Risk	Low Risk	Negligible
High	High Risk	Medium Risk	Low Risk

Source: IAQM, 2014

B. Model Verification

B.1 Overview

- B.1.1 Model verification is a process by which checks are carried out to determine the performance of a dispersion model at a local level, primarily by comparison of modelled results with monitoring data. Differences between modelled and monitored data may occur as a result of uncertainties associated with a number of model inputs including:
- traffic flows, speeds and vehicle splits;
 - emissions estimates;
 - background concentrations;
 - meteorological data; and
 - surface roughness length and terrain.
- B.1.2 The verification process benefits an assessment by investigating uncertainties and minimising them either through informed refinement of model input parameters or adjustment of the model output if it is deemed necessary.
- B.1.3 Verification of NO₂ has been carried out using 2011 monitored results from selected BCC roadside diffusion tube sites within the study area. Base Year (2011) traffic data was obtained from the SATURN traffic model. Meteorological data from 2011 for Birmingham Elmdon meteorological station was used in the modelling and all other inputs were as per the main assessment.
- B.1.4 As no suitable monitoring data is available to verify modelled PM₁₀ or PM_{2.5}, the verification has been carried out for NO₂ only. Given the low PM₁₀ and PM_{2.5} concentrations within the study area, and relatively low potential for impact associated with the BEE in comparison with NO₂, verification of PM₁₀ or PM_{2.5} is not considered necessary.
- B.1.5 DEFRA released a new set of LAQM tools for undertaking air quality assessments in July 2016. DEFRA guidance states that the old tools (which have a reference year of 2011) should not be used for new air quality assessments. Therefore, the DM and DS scenarios modelled in this assessment have used the new tools. However, the base traffic year for this project is 2011, while the new tools are only available for the year 2013 onwards. Although there has been no growth in traffic between 2011 and 2015 there have been a number of road layout alterations within Birmingham city centre which mean it is not possible to assume the 2011 base year traffic is comparable to 2015 traffic flows. In order to base this assessment on the latest set of assessment tools available and follow best practice, background concentration used in the model verification have been derived from new background maps for 2013 and emissions have been assigned from factors derived for 2013 as this is the earliest year that data from the new tools is available for. This approach is considered conservative for the model as background concentrations derived from the new 2013 background maps and emissions from 2013 are lower than those derived from the old 2011 background maps and emission factor toolkit. Therefore, the calculated model adjustment factor is higher increasing the predicted impacts from the BEE.

- B.1.6 To demonstrate the appropriateness of the above approach used for this assessment, the verification was also undertaken using the old tools to compare adjustment factors and model performance when using both the old and new sets of DEFRA tools. The results from this analysis are presented in Section B.3.

B.2 Methodology

- B.2.1 Guidance produced by DEFRA (2016) provides a methodology for model verification including calculation methods and directions on the suitability of monitoring data.
- B.2.2 Verification of NO₂ concentrations has been carried out using 2011 monitoring results from 9 diffusion tube sites. Only sites which are considered roadside locations, have high data capture rates, are not influenced by outside factors and represent suitable locations to assess model performance have been included.
- B.2.3 Background concentrations used in model verification have been taken from DEFRA and are presented in Table B.1. The DEFRA background concentrations used in the model verification were sector removed, as discussed in Section 1.4.

Table B.1: Background concentrations used in model verification

Verification site ID	Annual mean concentration (µg/m ³)	
	NO _x	NO ₂
3	54.2	32.5
7	50.9	31.2
8	50.9	31.2
16	54.2	32.5
5	50.9	31.2
6	50.9	31.2
9	50.9	31.2
15	54.2	32.5
17	50.9	31.2

- B.2.4 Table B.2 presents the monitored data used within the verification, the classification of the monitoring sites and monitored pollutant concentrations.

Table B.2: Monitored data used in model verification

Verification site ID	Classification	Annual mean monitored NO ₂ concentration 2011 (µg/m ³)
3	Roadside	41.7
7	Roadside	56.0
8	Roadside	53.6
16	Roadside	44.4

Verification site ID	Classification	Annual mean monitored NO ₂ concentration 2011 (µg/m ³)
5	Roadside	55.2
6	Roadside	61.4
9	Roadside	51.3
15	Roadside	36.7
17	Roadside	60.1

B.3 Verification Results

B.3.1 Table B.3 and Figure B.1 present a comparison of monitored and modelled concentrations of NO₂ at the diffusion tube sites for the year 2011. The modelled NO₂ concentrations are below the monitored values at the majority of sites indicating that the model is generally under-predicting annual mean NO₂ concentrations within the study area. Analysis of the range of modelled concentrations compared to monitored values was undertaken to investigate the change in performance of the dispersion model across the study area. Following the review, the model appeared to be performing differently at locations with a high percentage of HDV flows compared to other locations. It was therefore decided to apply two separate adjustment factors to the study area which were for the following locations:

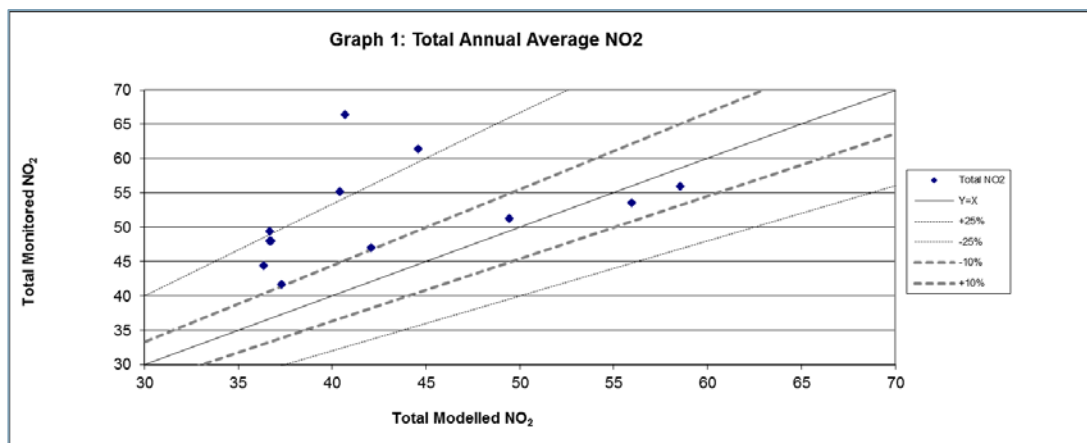
- Receptors which are adjacent to segregated bus lanes that have been included in the dispersion model or receptors which are adjacent to roads that have HDV percentages above 85% of total flows; and
- All other modelled receptor locations.

B.3.2 Following DEFRA guidance, modelled and measured road traffic concentrations have therefore been compared to derive a verification factor to apply to the modelled results. Following DEFRA guidance, verification has been undertaken based on road-traffic NO_x.

Table B.3: Base Year 2011 model verification results for NO₂ (unadjusted)

Model area	Side ID	Monitored Total NO ₂ (µg/m ³)	Modelled Total NO ₂ (µg/m ³)	% Difference
Bus Lane	3	41.7	37.3	-10.5
Bus Lane	7	56.0	58.5	4.5
Bus Lane	8	53.6	56.0	4.4
Other	16	44.4	36.4	-18.2
Other	5	55.2	40.4	-26.8
Other	6	61.4	44.6	-27.3
Other	9	51.3	49.4	-3.7
Other	15	36.7	36.1	-1.6
Other	17	60.1	45.4	-24.5

Figure B.1: Comparison of monitored and modelled total NO₂ (unadjusted)



B.3.3 As diffusion tubes only measure total NO₂, the road-traffic NO_x concentration measured by the diffusion tubes was calculated following DEFRA guidance (2016). DEFRA background NO₂ was subtracted from the total NO₂ concentration measured and the road-traffic NO₂ component was converted to NO_x using Version 5.1 of the NO_x to NO₂ calculator developed for DEFRA. Table B.4 presents modelled and monitored road NO_x concentrations at the diffusion tube sites.

Table B.4: Base Year 2011 model verification results for road NO_x (unadjusted)

Model area	Site ID	Monitored Road NO _x (µg/m ³)	Modelled Total NO _x (µg/m ³)
Bus Lane	3	20.8	10.6
Bus Lane	7	61.6	69.1
Bus Lane	8	54.8	61.6
Other	16	27.5	8.4
Other	5	59.4	20.8
Other	6	77.7	31.0
Other	9	48.5	43.4
Other	15	9.2	7.9
Other	17	73.7	32.9

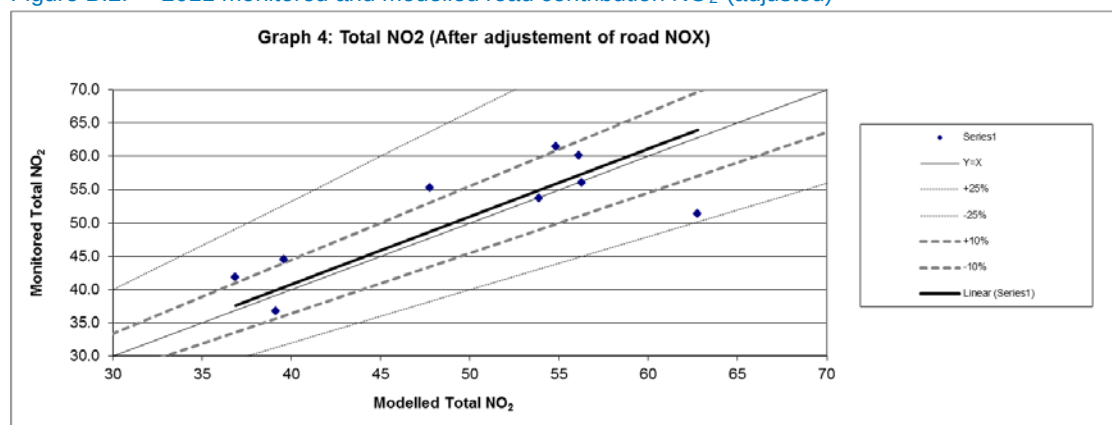
B.3.4 An adjustment factor of 0.92 was derived for diffusion tubes 3, 7 and 8 which are representative of receptors adjacent to segregated bus lanes which have been included in the dispersion model or receptors where adjacent to roads had HDV percentages above 85% of total flows. Therefore, in order to undertake a conservative assessment it was considered appropriate not to adjust modelled results for modelled receptors in these areas of the study area.

- B.3.5 An adjustment factor of 1.89 was derived for diffusion tubes 16, 5, 6, 9, 15 and 17. These diffusion tube sites are considered representative of all other modelled receptors. The appropriateness of this adjustment factor has been assessed by calculating the Root Mean Square Error (RMSE) and fractional bias which is suggested in DEFRA guidance (2016). The RMSE value is 3.56 and fractional bias is 0.03. These values are considered acceptable within DEFRA guidance which suggests that these values should be below 4 and 2 respectively. Table B.5 and Figure B.2 present the adjusted annual mean NO₂ concentrations for all the monitoring sites based on the derived adjustment factors. Modelled total NO₂ concentrations are within 10% of monitored concentrations at four out of nine sites and are within 25% of monitoring at all nine of the sites.
- B.3.6 On the basis of the above adjustment factors it can be concluded that the dispersion model is performing adequately to inform the assessment.

Table B.5: Base Year 2011 verified modelled results for NO₂ (adjusted)

Site ID	Adjustment factor (applied to modelled road NO _x)	Monitored total NO ₂ (µg/m ³)	Modelled total NO ₂ (µg/m ³)	% Difference
3	0.91	41.7	36.9	-11.6
7		56.0	56.3	0.5
8		53.6	53.9	0.6
16	1.89	44.4	39.6	-10.9
5		55.2	47.8	-13.4
6		61.4	54.9	-10.6
9		51.3	62.8	22.4
15		36.7	39.2	6.8
17		60.1	56.2	-6.6

Figure B.2: 2011 monitored and modelled road contribution NO₂ (adjusted)



B.4 Verification Sensitivity

- B.4.1 In July 2016, DEFRA released new LAQM tools for undertaking air quality assessments, including a new version of the Emission Factor Toolkit, projected background maps, NO_x to NO₂ calculations and background sector removal tools. These new tools have a reference year of 2013 and are only available for 2013 onwards. As the base year for this project is 2011, and in the absence of any guidance from DEFRA or the Review and Assessment helpdesk on suitable backcasting methods, a verification sensitivity analysis was undertaken using the old and new tools, which have reference years of 2011 and 2013 respectively, to compare adjustment factors and model performance. The results from the verification modelling analysis are presented in Table B.6.

Table B.6: Verification model outputs using the old and new DEFRA LAQM tools

LAQM tool version	Bus lane			Other		
	Adjustment factor	RMSE	Fractional bias	Adjustment factor	RMSE	Fractional bias
Old (2011 reference year)	0.84	3.65	0.04	1.78	5.05	0.04
New (2013 reference year)	0.91	2.42	0.03	1.89	3.56	0.03

- B.4.2 The analysis demonstrates that the adjustment factors are similar irrespective of the DEFRA tools used with the adjustment factor derived using the new tools being slightly higher and therefore conservative.
- B.4.3 The RMSE and fractional bias values demonstrate that the model is adjustment is performing better using the new 2013 DEFRA tools and therefore the approach used in this assessment is considered robust.

C. Modelled Receptors

C.1.1 This annex presents the locations of receptors included within the modelling assessment. The locations of these receptors are shown in drawing MMD-300207-HS30-DRA-0000-0404 in ES Volume 2 Technical Appendix A: EIA Drawings.

Table C.1: Modelled receptors

Receptor ID	National Grid Reference		Modelled height above ground (m)
	X	Y	
1	407811	286358	1.5
2	407586	286466	1.5
3	407743	287300	1.5
4	407860	287915	1.5
5	407636	287238	1.5
6	407224	287553	1.5
7	407362	287452	1.5
8	406633	287040	1.5
9	408374	285589	1.5
10	408577	286541	1.5
11	408602	286464	1.5
12	408662	286203	1.5
13	408203	286633	4.5
14	408626	286358	1.5
15	408674	286172	1.5
16	408233	287230	1.5
17	407272	286400	1.5
18	407712	286422	4.5
19	407671	287230	4.5
20	407726	287343	1.5
21	407779	287397	1.5
22	407542	287056	4.5
23	408279	286350	4.5
24	408060	286303	4.5
25	408254	287298	4.5
26	407326	287858	1.5
27	407486	287849	1.5
28	408245	287333	1.5
29	407927	287508	4.5
30	407666	286266	7.5
31	407757	286395	4.5
32	408288	285705	1.5
33	407665	286288	1.5

Receptor ID	National Grid Reference		Modelled height above ground (m)
	X	Y	
34	407584	286428	4.5
35	408308	285868	4.5
36	407467	287444	1.5
37	407481	287473	1.5
38	407469	287398	1.5
39	407315	287700	1.5
40	407465	287745	1.5
41	407395	288174	4.5
42	407356	287704	4.5
43	407299	287729	1.5
44	407474	287358	1.5
45	407497	287243	1.5
46	406663	287352	1.5
47	407243	287788	1.5
48	407440	287731	1.5
49	407454	287707	4.5
50	407474	287775	4.5
51	407216	287635	1.5
52	407610	286750	1.5
53	407716	286377	4.5
54	407413	286589	1.5
55	406694	286617	1.5
56	406743	286538	1.5
57	407637	286597	4.5
58	407718	286889	1.5
59	407059	287562	1.5
60	407366	287335	4.5
61	407341	287216	4.5
62	407294	287527	4.5
63	407210	287130	4.5
64	407227	287181	4.5
65	407172	287091	4.5
66	406988	287532	1.5
67	406607	286781	4.5
68	407788	287082	4.5
69	407498	286499	4.5
70	407249	286230	4.5

Receptor ID	National Grid Reference		Modelled height above ground (m)
	X	Y	
71	406907	287544	6.0
72	406659	287128	6.0
73	408398	285850	1.5
74	408337	285681	4.5
75	408179	285937	4.5
76	408241	285626	1.5
77	408216	285583	1.5
78	407989	286066	1.5
79	407709	288128	1.5
80	407597	288123	1.5
81	407315	288106	4.5

D. BEE Specific Air Quality Monitoring Methodology

D.1 Overview

- D.1.1 A monitoring survey of NO₂ concentrations was undertaken at 10 sites in the study area from 30 November 2015 to 8 June 2016. Monitoring was carried out using diffusion tubes, which are a passive method designed to provide information on long term trends and existing concentrations. The tubes were exposed at each location for approximately 1 month, then collected, sent back to a laboratory for analysis and replaced with new tubes. The tubes were prepared and analysed by Gradko using the 20% triethanolamine (TEA) in water method.

D.2 Monitoring Locations

- D.2.1 Monitoring sites were selected based on their proximity to major roads and junctions likely to be affected by the BEE and at locations where sensitive receptors are present. The location of each tube is indicated in drawing MMD-300207-HS30-DRA-0000-0402 in ES Volume 2 Appendix A: EIA Drawings.
- D.2.2 The raw data obtained from the six month diffusion tube survey was bias adjusted and annualised to enable comparison with the annual mean NO₂ objective. The methodology behind the adjustment process is outlined below.

D.3 Bias Adjustment

- D.3.1 Diffusion tubes typically under or over-read concentrations compared to continuous monitoring methods. In order to correct for this, diffusion tubes are co-located with continuous monitoring stations, and a bias adjustment factor is calculated by comparing results from both techniques. Diffusion tube results were bias adjusted based on the DEFRA national diffusion tube bias adjustment factor spreadsheet for June 2016.
- D.3.2 The overall bias adjustment factor for Gradko diffusion tubes (20% TEA in water) was 0.88 in 2015. In line with this data, the five month average diffusion tube results obtained here were bias adjusted by a factor of 0.88.

D.4 Annual Adjustment

- D.4.1 Since the diffusion tube survey was undertaken from November 2015 to June 2016, it was necessary to convert the period data to an annual mean concentration. The bias adjusted diffusion tube data was converted to a representative annual mean for 2015 using the approach outlined in Box 7.8 of DEFRA (2016) guidance.
- D.4.2 Automatic monitoring data was obtained from the DEFRA Automatic Urban Rural Network background air quality stations shown in Table D.1 and the period average concentration was compared to the annual mean concentration monitored for the stations in 2015. The results of this comparison are also shown in Table D.1 below.

Table D.1: Annualisation factor

Monitoring station	Period mean NO ₂ (µg/m ³) ^(a)	2015 annual mean NO ₂ (µg/m ³) ^(b)
Birmingham Acocks Green	20.2	18.8
Coventry Allesley	22.7	22.8
Leamington Spa	19.7	19.3
Walsall Woodlands	19.0	19.1
Annualisation Factor	0.98	

Note: ^(a) Average for period 30 November 2015 to 8 June 2016

^(b) Average for 2015

Data capture for annual mean and period mean greater than 96% for all monitoring stations

E. Sensitivity Analysis

E.1 Overview

- E.1.1 This annex presents the predicted modelled concentrations of NO₂, PM₁₀ and PM_{2.5} at modelled receptors with traffic data from 2021 DM and DS and background pollutant concentrations from 2015. (i.e. it assumes there is no improvement in future background pollutant concentrations between 2015 and 2021).

E.2 Sensitivity results

Nitrogen Dioxide (NO₂) concentrations

- E.2.1 The results for the sensitivity analysis for annual mean NO₂ are presented in Table E.1.
- E.2.2 Out of the 81 modelled receptors included in the assessment a total of 4 receptors are predicted to have a 'moderate adverse' impact and one receptor is predicted to have a 'slight adverse' impact, The maximum NO₂ increase of 1.2µg/m³ (corresponding to a 2.9% increase relative to the AQAL) was modelled at the Great Barr Street receptor (receptor 13). It should be noted that BEE is not predicted to cause an exceedance of the annual mean objective at any of these five receptors. At receptors where the DM concentrations are above the air quality objectives the maximum predicted increase in concentrations is 1.2% which is at Receptor 55 Navigation street.
- E.2.3 No receptors predicted concentrations in the DS scenario which were greater than 60µg/m³ and therefore there are unlikely to be any exceedences of the short term NO₂ objective.

Table E.1: Annual Mean NO₂ Predicted Concentrations (µg/m³)

Receptor ID	Receptor Name	Annual Mean NO ₂ Concentration (µg/m ³)		% Change relative to AQ objective	Impact Descriptor
		DM	DS		
1	Floodgate Street	42.7	37.4	-13.2	Substantial Beneficial
2	Digbeth 1	43.6	42.7	-2.4	Moderate Beneficial
3	Grosvenor Street	31.2	31.3	0.2	Negligible
4	Coleshill Street	39.4	39.7	0.5	Slight Adverse
5	Jennens Road 1	32.5	32.4	-0.1	Negligible
6	St Chads Queensway 1	41.0	41.1	0.4	Negligible
7	Steelhouse Lane 1	36.9	36.8	-0.4	Negligible
8	Margaret Street	44.2	44.2	0.0	Negligible
9	Stratford Road	35.1	34.8	-0.6	Negligible
10	Farmacre	37.0	37.0	0.0	Negligible
11	Hawthorn Close 1	35.7	35.7	0.0	Negligible
12	Dart Street	35.1	34.9	-0.4	Negligible

Receptor ID	Receptor Name	Annual Mean NO ₂ Concentration (µg/m ³)		% Change relative to AQ objective	Impact Descriptor
		DM	DS		
13	Great Barr Street	37.6	38.7	2.9	Moderate Adverse
14	Hawthorn Close 2	35.6	35.6	0.0	Negligible
15	Coventry Road	35.3	35.1	-0.4	Negligible
16	Miles Druce Way	37.0	36.3	-1.9	Slight Beneficial
17	Upper Dean Street	38.3	37.6	-1.9	Moderate Beneficial
18	Digbeth 2	42.6	41.6	-2.4	Moderate Beneficial
19	Jennens Road 2	31.4	31.4	0.0	Negligible
20	Jennens Road 3	31.2	31.1	-0.1	Negligible
21	Jennens Road 4	31.5	31.4	-0.2	Negligible
22	Masshouse Plaza	41.7	40.1	-4.0	Moderate Beneficial
23	Adderley Street	33.0	32.9	-0.4	Negligible
24	High Street 1	40.9	37.3	-9.0	Moderate Beneficial
25	Lawley Middleway	40.0	39.2	-2.0	Moderate Beneficial
26	Bagot Street	37.4	37.2	-0.4	Negligible
27	Moland Street	40.4	40.6	0.3	Negligible
28	Windsor Street South	38.3	37.7	-1.6	Moderate Beneficial
29	Jennens Road 5	32.8	32.7	-0.2	Negligible
30	Bradford Street 1	34.0	33.6	-1.1	Negligible
31	Digbeth 3	42.8	39.3	-8.7	Substantial Beneficial
32	Ravenhurst Street	39.0	38.6	-0.9	Slight Beneficial
33	Bradford Street 2	38.8	38.3	-1.3	Slight Beneficial
34	Digbeth 4	38.8	37.0	-4.6	Moderate Beneficial
35	Bradford Street 3	33.9	33.8	-0.3	Negligible
36	Aston Street 1	40.4	40.2	-0.4	Negligible
37	Aston Street 2	37.6	37.5	-0.2	Negligible
38	Aston Street 3	40.7	40.4	-0.5	Slight Beneficial
39	Lancaster Street 1	39.4	39.4	0.0	Negligible
40	Staniforth Street 1	47.0	47.0	0.0	Negligible
41	Pritchett Street 1	33.0	33.0	0.0	Negligible
42	Lancaster Street 2	40.1	40.0	-0.2	Negligible
43	Price Street 1	37.2	37.2	0.0	Negligible
44	Aston Street 4	39.7	39.4	-0.7	Slight Beneficial
45	Aston Street 5	39.5	39.2	-0.6	Slight Beneficial
46	Ludgate Hill	39.1	39.2	0.1	Negligible
47	Princip Street	34.1	34.0	-0.3	Negligible
48	Staniforth Street 2	41.9	42.0	0.3	Negligible
49	Corporation Street 1	44.2	44.3	0.1	Negligible

Receptor ID	Receptor Name	Annual Mean NO ₂ Concentration (µg/m ³)		% Change relative to AQ objective	Impact Descriptor
		DM	DS		
50	Corporation Street 2	44.1	44.1	0.0	Negligible
51	Price Street 2	37.7	37.8	0.2	Negligible
52	Allison Street	36.6	36.1	-1.4	Negligible
53	Rea Street	38.6	37.2	-3.3	Moderate Beneficial
54	Digbeth 5	55.6	51.6	-10.0	Substantial Beneficial
55	Navigation Street	49.0	49.4	1.2	Moderate Adverse
56	Suffolk Street Queensway	50.6	50.7	0.3	Negligible
57	Coventry Street	35.6	35.8	0.6	Negligible
58	New Bartholomew Street	34.6	33.9	-1.6	Slight Beneficial
59	St Chads Queensway 3	41.1	41.5	1.0	Moderate Adverse
60	Corporation Street 3	31.8	31.7	-0.4	Negligible
61	Corporation Street 4	31.5	31.4	-0.4	Negligible
62	Steelhouse Lane 2	39.4	39.4	0.0	Negligible
63	Minories 1	31.3	31.2	-0.4	Negligible
64	Corporation Street 5	32.1	31.9	-0.4	Negligible
65	Minories 2	31.1	31.0	0.0	Negligible
66	St Chads Queensway 4	43.3	43.7	0.8	Moderate Adverse
67	Paradise Street	37.8	37.9	0.2	Negligible
68	Albert Street	33.3	31.2	-5.3	Slight Beneficial
69	Digbeth 6	41.2	39.8	-3.5	Moderate Beneficial
70	Bromsgrove Street	33.9	34.0	0.1	Negligible
71	William Booth Lane	41.5	41.6	0.4	Negligible
72	Newhall Street	44.2	44.3	0.3	Negligible
73	Camp Hill 1	35.0	34.8	-0.4	Negligible
74	Camp Hill 2	38.6	38.4	-0.7	Slight Beneficial
75	Moseley Road	36.3	36.2	-0.4	Negligible
76	Ferndale Crescent 1	35.8	35.6	-0.7	Negligible
77	Ferndale Crescent 2	37.7	37.3	-0.9	Negligible
78	Bradford Street 4	35.5	35.3	-0.5	Negligible
79	Mill Street	37.4	37.4	0.0	Negligible
80	Pritchett Street 2	43.8	43.8	0.0	Negligible
81	Blews Street	33.2	33.2	0.0	Negligible

Note: DM = Do Minimum DS = Do Something;

Particulate Matter (PM₁₀) Concentrations

- 1.7.4 The PM₁₀ impacts are predicted to be 'negligible' at all receptors and the overall impact descriptions for PM₁₀ in the sensitivity analysis are unchanged from the main assessment.

Table E.2: Annual Mean PM₁₀ Predicted Concentrations (µg/m³)

Receptor ID	Receptor Name	Annual Mean PM ₁₀ Concentration (µg/m ³)		% Change relative to AQ objective	Impact Descriptor
		DM	DS		
1	Floodgate Street	20.06	19.50	-1.40	Negligible
2	Digbeth 1	20.16	19.78	-0.95	Negligible
3	Grosvenor Street	19.91	19.95	0.09	Negligible
4	Coleshill Street	20.61	20.65	0.10	Negligible
5	Jennens Road 1	20.13	20.13	0.00	Negligible
6	St Chads Queensway 1	21.39	21.42	0.07	Negligible
7	Steelhouse Lane 1	20.23	20.21	-0.05	Negligible
8	Margaret Street	20.85	20.86	0.02	Negligible
9	Stratford Road	19.20	19.17	-0.08	Negligible
10	Farmacre	20.03	20.03	0.00	Negligible
11	Hawthorn Close 1	19.79	19.79	-0.01	Negligible
12	Dart Street	19.54	19.52	-0.04	Negligible
13	Great Barr Street	19.79	19.93	0.37	Negligible
14	Hawthorn Close 2	19.76	19.75	-0.01	Negligible
15	Coventry Road	19.56	19.54	-0.05	Negligible
16	Miles Druce Way	19.73	19.66	-0.17	Negligible
17	Upper Dean Street	19.36	19.27	-0.22	Negligible
18	Digbeth 2	19.69	19.45	-0.59	Negligible
19	Jennens Road 2	19.89	19.92	0.07	Negligible
20	Jennens Road 3	19.91	19.90	-0.03	Negligible
21	Jennens Road 4	19.93	19.89	-0.08	Negligible
22	Masshouse Plaza	20.40	20.32	-0.18	Negligible
23	Adderley Street	19.25	19.23	-0.05	Negligible
24	High Street 1	20.14	19.73	-1.02	Negligible
25	Lawley Middleway	20.20	20.13	-0.17	Negligible
26	Bagot Street	20.49	20.45	-0.09	Negligible
27	Moland Street	21.13	21.12	-0.02	Negligible
28	Windsor Street South	19.96	19.89	-0.16	Negligible
29	Jennens Road 5	20.13	20.11	-0.05	Negligible
30	Bradford Street 1	18.93	18.88	-0.12	Negligible
31	Digbeth 3	19.68	19.38	-0.77	Negligible

Receptor ID	Receptor Name	Annual Mean PM ₁₀ Concentration (µg/m ³)		% Change relative to AQ objective	Impact Descriptor
		DM	DS		
32	Ravenhurst Street	19.77	19.71	-0.15	Negligible
33	Bradford Street 2	19.48	19.42	-0.16	Negligible
34	Digbeth 4	19.43	19.16	-0.67	Negligible
35	Bradford Street 3	19.27	19.24	-0.08	Negligible
36	Aston Street 1	20.62	20.59	-0.08	Negligible
37	Aston Street 2	20.33	20.31	-0.04	Negligible
38	Aston Street 3	20.69	20.65	-0.09	Negligible
39	Lancaster Street 1	20.75	20.73	-0.04	Negligible
40	Staniforth Street 1	22.27	22.24	-0.07	Negligible
41	Pritchett Street 1	22.24	22.24	0.00	Negligible
42	Lancaster Street 2	20.87	20.85	-0.05	Negligible
43	Price Street 1	20.46	20.44	-0.04	Negligible
44	Aston Street 4	20.61	20.57	-0.09	Negligible
45	Aston Street 5	20.36	20.33	-0.09	Negligible
46	Ludgate Hill	20.40	20.40	0.00	Negligible
47	Princip Street	20.05	20.03	-0.03	Negligible
48	Staniforth Street 2	21.25	21.25	0.00	Negligible
49	Corporation Street 1	21.71	21.69	-0.04	Negligible
50	Corporation Street 2	21.76	21.74	-0.05	Negligible
51	Price Street 2	20.74	20.76	0.03	Negligible
52	Allison Street	19.17	19.10	-0.19	Negligible
53	Rea Street	19.37	19.20	-0.42	Negligible
54	Digbeth 5	21.08	20.58	-1.26	Negligible
55	Navigation Street	21.41	21.46	0.13	Negligible
56	Suffolk Street Queensway	21.96	22.00	0.10	Negligible
57	Coventry Street	19.11	19.02	-0.21	Negligible
58	New Bartholomew Street	18.99	18.86	-0.34	Negligible
59	St Chads Queensway 3	21.25	21.28	0.08	Negligible
60	Corporation Street 3	19.96	19.94	-0.07	Negligible
61	Corporation Street 4	19.85	19.82	-0.07	Negligible
62	Steelhouse Lane 2	20.96	20.97	0.02	Negligible
63	Minories 1	19.76	19.74	-0.05	Negligible
64	Corporation Street 5	19.85	19.83	-0.05	Negligible
65	Minories 2	19.73	19.72	-0.03	Negligible
66	St Chads Queensway 4	21.01	21.04	0.06	Negligible
67	Paradise Street	20.41	20.44	0.06	Negligible
68	Albert Street	19.83	19.58	-0.64	Negligible

Receptor ID	Receptor Name	Annual Mean PM ₁₀ Concentration (µg/m ³)		% Change relative to AQ objective	Impact Descriptor
		DM	DS		
69	Digbeth 6	19.74	19.53	-0.54	Negligible
70	Bromsgrove Street	18.92	18.93	0.03	Negligible
71	William Booth Lane	20.61	20.62	0.03	Negligible
72	Newhall Street	21.19	21.21	0.06	Negligible
73	Camp Hill 1	19.15	19.12	-0.07	Negligible
74	Camp Hill 2	19.73	19.69	-0.10	Negligible
75	Moseley Road	19.22	19.21	-0.03	Negligible
76	Ferndale Crescent 1	19.28	19.24	-0.09	Negligible
77	Ferndale Crescent 2	19.52	19.48	-0.09	Negligible
78	Bradford Street 4	19.08	19.07	-0.03	Negligible
79	Mill Street	22.71	22.71	0.00	Negligible
80	Pritchett Street 2	23.45	23.44	-0.01	Negligible
81	Blews Street	22.25	22.24	-0.01	Negligible

Note: DM = Do Minimum DS = Do Something;
Results presented to 2 decimal places to show changes in concentration and is not a reflection of model accuracy

Particulate Matter (PM_{2.5}) Concentrations

- 1.7.5 The PM_{2.5} impacts are negligible at all receptors and the overall impact descriptions for PM_{2.5} in the sensitivity analysis are unchanged from the main assessment.

Table E.3: Annual Mean PM_{2.5} Predicted Concentrations (µg/m³)

Receptor ID	Receptor Name	Annual Mean PM _{2.5} Concentration (µg/m ³)		% Change relative to AQ objective	Impact Descriptor
		DM	DS		
1	Floodgate Street	14.10	13.78	-1.28	Negligible
2	Digbeth 1	14.16	13.95	-0.83	Negligible
3	Grosvenor Street	13.98	14.00	0.08	Negligible
4	Coleshill Street	14.38	14.40	0.09	Negligible
5	Jennens Road 1	14.10	14.10	0.00	Negligible
6	St Chads Queensway 1	14.80	14.81	0.06	Negligible
7	Steelhouse Lane 1	14.16	14.15	-0.05	Negligible
8	Margaret Street	14.74	14.74	0.00	Negligible
9	Stratford Road	13.56	13.54	-0.07	Negligible
10	Farmacre	14.07	14.07	0.00	Negligible
11	Hawthorn Close 1	13.94	13.94	0.00	Negligible

Receptor ID	Receptor Name	Annual Mean PM _{2.5} Concentration (µg/m ³)		% Change relative to AQ objective	Impact Descriptor
		DM	DS		
12	Dart Street	13.80	13.79	-0.04	Negligible
13	Great Barr Street	13.95	14.03	0.34	Negligible
14	Hawthorn Close 2	13.92	13.92	-0.01	Negligible
15	Coventry Road	13.81	13.80	-0.04	Negligible
16	Miles Druce Way	13.93	13.89	-0.17	Negligible
17	Upper Dean Street	13.71	13.66	-0.20	Negligible
18	Digbeth 2	13.90	13.77	-0.52	Negligible
19	Jennens Road 2	13.97	13.98	0.06	Negligible
20	Jennens Road 3	13.97	13.97	0.00	Negligible
21	Jennens Road 4	13.99	13.97	-0.07	Negligible
22	Masshouse Plaza	14.27	14.22	-0.18	Negligible
23	Adderley Street	13.64	13.63	-0.05	Negligible
24	High Street 1	14.15	13.91	-0.93	Negligible
25	Lawley Middleway	14.20	14.15	-0.16	Negligible
26	Bagot Street	14.30	14.28	-0.08	Negligible
27	Moland Street	14.66	14.65	-0.02	Negligible
28	Windsor Street South	14.06	14.02	-0.15	Negligible
29	Jennens Road 5	14.11	14.09	-0.04	Negligible
30	Bradford Street 1	13.46	13.44	-0.11	Negligible
31	Digbeth 3	13.90	13.72	-0.72	Negligible
32	Ravenhurst Street	13.88	13.85	-0.13	Negligible
33	Bradford Street 2	13.78	13.74	-0.14	Negligible
34	Digbeth 4	13.75	13.60	-0.60	Negligible
35	Bradford Street 3	13.60	13.58	-0.07	Negligible
36	Aston Street 1	14.38	14.37	-0.07	Negligible
37	Aston Street 2	14.22	14.21	-0.04	Negligible
38	Aston Street 3	14.42	14.40	-0.08	Negligible
39	Lancaster Street 1	14.45	14.44	-0.04	Negligible
40	Staniforth Street 1	15.30	15.28	-0.06	Negligible
41	Pritchett Street 1	15.08	15.08	0.00	Negligible
42	Lancaster Street 2	14.52	14.51	-0.04	Negligible
43	Price Street 1	14.28	14.27	-0.04	Negligible
44	Aston Street 4	14.37	14.35	-0.08	Negligible
45	Aston Street 5	14.24	14.22	-0.08	Negligible
46	Ludgate Hill	14.48	14.48	0.00	Negligible
47	Princip Street	14.05	14.05	0.00	Negligible
48	Staniforth Street 2	14.73	14.73	0.00	Negligible

Receptor ID	Receptor Name	Annual Mean PM _{2.5} Concentration (µg/m ³)		% Change relative to AQ objective	Impact Descriptor
		DM	DS		
49	Corporation Street 1	14.98	14.97	-0.03	Negligible
50	Corporation Street 2	15.01	15.00	-0.04	Negligible
51	Price Street 2	14.44	14.45	0.02	Negligible
52	Allison Street	13.61	13.56	-0.18	Negligible
53	Rea Street	13.72	13.62	-0.38	Negligible
54	Digbeth 5	14.71	14.42	-1.16	Negligible
55	Navigation Street	15.14	15.17	0.12	Negligible
56	Suffolk Street Queensway	15.44	15.47	0.09	Negligible
57	Coventry Street	13.56	13.52	-0.18	Negligible
58	New Bartholomew Street	13.50	13.42	-0.30	Negligible
59	St Chads Queensway 3	14.72	14.74	0.08	Negligible
60	Corporation Street 3	14.01	13.99	-0.06	Negligible
61	Corporation Street 4	13.94	13.93	-0.06	Negligible
62	Steelhouse Lane 2	14.56	14.57	0.02	Negligible
63	Minories 1	13.89	13.88	-0.04	Negligible
64	Corporation Street 5	13.95	13.94	-0.05	Negligible
65	Minories 2	13.88	13.87	-0.03	Negligible
66	St Chads Queensway 4	14.82	14.84	0.06	Negligible
67	Paradise Street	14.57	14.58	0.05	Negligible
68	Albert Street	13.94	13.79	-0.59	Negligible
69	Digbeth 6	13.93	13.80	-0.49	Negligible
70	Bromsgrove Street	13.46	13.46	0.00	Negligible
71	William Booth Lane	14.60	14.61	0.03	Negligible
72	Newhall Street	14.92	14.94	0.05	Negligible
73	Camp Hill 1	13.53	13.52	-0.06	Negligible
74	Camp Hill 2	13.86	13.84	-0.09	Negligible
75	Moseley Road	13.57	13.57	0.00	Negligible
76	Ferndale Crescent 1	13.60	13.59	-0.08	Negligible
77	Ferndale Crescent 2	13.74	13.72	-0.08	Negligible
78	Bradford Street 4	13.55	13.54	-0.03	Negligible
79	Mill Street	15.37	15.37	0.00	Negligible
80	Pritchett Street 2	15.81	15.80	-0.01	Negligible
81	Blews Street	15.09	15.09	0.00	Negligible

Note: DM = Do Minimum DS = Do Something;
Results presented to 2 decimal places to show changes in concentration and is not a reflection of model accuracy

Summary

- E.2.4 The results from the sensitivity analysis demonstrate that when assuming there will be no future improvement in background concentrations the overall results indicates that impacts from BEE will not be significant.

F. Comparison of 2021 and 2031 emissions

F.1 Overview

F.1.1 A comparison of emissions associated with traffic flows in 2021 (opening year) and 2031 (design year) has been undertaken using the traffic data provided and Defra's Emission Factor Toolkit. The comparison has been made for modelled road links in the affected road network. The results of this comparison are presented below.

F.2 Results

F.2.1 Table F.1 presents the NO_x emission rate for modelled road links in 2021 and 2031 based on each years predicted traffic flows. Of the 241 links included in the comparison, 2021 emissions are the worst case for 230 links while 2031 are worst the worst case for just 11. Where 2031 emissions are higher than 2021 the increases are marginal.

F.2.2 In addition in 2031 background concentrations are also predicted to be lower and therefore it can be considered that 2021 represents the most conservative assessment year.

Table F.1: NO_x emission rate comparison for 2021 and 2031 traffic data

Link ID	NO _x emission rate (g/km/s)			
	2021	2031	Difference	Is 2021 the worst case?
7111-1001	0.015	0.009	-0.006	Yes
7115-1001	0.033	0.015	-0.018	Yes
1003-6179	0.012	0.013	0.001	No
7257-1005	0.037	0.021	-0.016	Yes
7304-1005	0.017	0.009	-0.008	Yes
8401-5115	0.081	0.057	-0.024	Yes
7740-6103	0.003	0.002	-0.001	Yes
6708-6103	0.005	0.003	-0.002	Yes
6108-6107	0.054	0.021	-0.033	Yes
6429-6108	0.053	0.021	-0.032	Yes
6162-6116	0.007	0.005	-0.003	Yes
7686-6116	0.018	0.012	-0.006	Yes
6196-6126	0.029	0.016	-0.013	Yes
6205-6136	0.038	0.024	-0.014	Yes
6161-6141	0.142	0.094	-0.048	Yes
6145-6144	0.078	0.046	-0.032	Yes
7144-6144	0.040	0.021	-0.019	Yes
7142-6145	0.040	0.026	-0.014	Yes
6144-6145	0.010	0.010	0.000	Yes
6301-6153	0.047	0.040	-0.007	Yes
6193-6155	0.023	0.013	-0.010	Yes

Link ID	NO _x emission rate (g/km/s)			
	2021	2031	Difference	Is 2021 the worst case?
6126-6156	0.009	0.006	-0.004	Yes
7637-6156	0.029	0.015	-0.014	Yes
6156-6158	0.035	0.019	-0.016	Yes
6158-6160	0.031	0.017	-0.014	Yes
6116-6162	0.023	0.015	-0.008	Yes
6169-6168	0.189	0.107	-0.083	Yes
6301-6173	0.043	0.026	-0.016	Yes
7686-6173	0.021	0.014	-0.007	Yes
6199-6174	0.042	0.026	-0.016	Yes
1003-6179	0.012	0.013	0.001	No
8943-6179	0.011	0.012	0.001	No
6205-6190	0.030	0.013	-0.017	Yes
6203-6191	0.075	0.076	0.001	No
7750-6191	0.054	0.042	-0.012	Yes
6205-6193	0.029	0.016	-0.014	Yes
6155-6193	0.031	0.018	-0.013	Yes
6174-6196	0.033	0.018	-0.015	Yes
6427-6199	0.027	0.017	-0.010	Yes
6174-6199	0.042	0.026	-0.016	Yes
6419-6201	0.041	0.011	-0.029	Yes
6153-6202	0.068	0.062	-0.006	Yes
6203-6202	0.063	0.053	-0.010	Yes
7142-6202	0.034	0.021	-0.013	Yes
6191-6203	0.068	0.057	-0.011	Yes
8943-6203	0.016	0.017	0.001	No
6202-6203	0.053	0.055	0.002	No
6193-6205	0.068	0.036	-0.032	Yes
6136-6205	0.040	0.025	-0.016	Yes
6173-6301	0.043	0.026	-0.016	Yes
7133-6310	0.055	0.012	-0.043	Yes
7419-6310	0.038	0.007	-0.031	Yes
7106-6315	0.052	0.025	-0.026	Yes
6420-6315	0.082	0.031	-0.051	Yes
6711-6419	0.023	0.006	-0.017	Yes
6420-6419	0.074	0.022	-0.052	Yes
6419-6420	0.074	0.022	-0.052	Yes
6430-6420	0.080	0.033	-0.046	Yes
7419-6420	0.081	0.024	-0.057	Yes

Link ID	NO _x emission rate (g/km/s)			
	2021	2031	Difference	Is 2021 the worst case?
6704-6424	0.101	0.024	-0.077	Yes
7740-6427	0.030	0.019	-0.011	Yes
6199-6427	0.027	0.017	-0.010	Yes
6315-6429	0.065	0.024	-0.041	Yes
6107-6430	0.046	0.019	-0.027	Yes
10001-6704	0.024	0.005	-0.019	Yes
7415-6704	0.039	0.008	-0.031	Yes
7420-6705	0.025	0.001	-0.024	Yes
7416-6705	0.044	0.006	-0.038	Yes
6707-6706	0.066	0.015	-0.052	Yes
7133-6707	0.081	0.018	-0.062	Yes
6103-6708	0.005	0.003	-0.002	Yes
7738-6708	0.021	0.008	-0.013	Yes
6424-6708	0.055	0.024	-0.031	Yes
6201-6711	0.023	0.006	-0.017	Yes
7181-7102	0.005	0.002	-0.002	Yes
7103-7102	0.000	0.000	0.000	No
7111-7106	0.014	0.009	-0.005	Yes
6315-7106	0.018	0.010	-0.008	Yes
1001-7111	0.015	0.009	-0.006	Yes
7106-7111	0.007	0.007	0.000	No
10000-7113	0.101	0.031	-0.070	Yes
7414-7113	0.137	0.038	-0.099	Yes
7144-7115	0.020	0.011	-0.009	Yes
1001-7115	0.015	0.009	-0.006	Yes
9502-7121	0.081	0.033	-0.048	Yes
7650-7122	0.007	0.005	-0.002	Yes
7148-7122	0.050	0.026	-0.024	Yes
7124-7123	0.066	0.027	-0.039	Yes
7121-7123	0.105	0.040	-0.064	Yes
7113-7124	0.099	0.032	-0.066	Yes
7181-7124	0.002	0.002	0.000	Yes
7123-7124	0.085	0.026	-0.059	Yes
7127-7125	0.048	0.020	-0.028	Yes
7125-7126	0.053	0.021	-0.031	Yes
7303-7127	0.046	0.020	-0.026	Yes
7132-7131	0.047	0.021	-0.026	Yes
9502-7132	0.051	0.022	-0.028	Yes

Link ID	NO _x emission rate (g/km/s)			
	2021	2031	Difference	Is 2021 the worst case?
7131-7132	0.047	0.021	-0.026	Yes
6705-7133	0.083	0.021	-0.062	Yes
7738-7133	0.071	0.029	-0.042	Yes
6310-7133	0.064	0.017	-0.047	Yes
6107-7133	0.042	0.016	-0.027	Yes
7138-7134	0.027	0.014	-0.013	Yes
7134-7138	0.027	0.014	-0.013	Yes
7143-7138	0.032	0.020	-0.012	Yes
6202-7142	0.072	0.039	-0.034	Yes
6145-7142	0.009	0.010	0.001	No
7138-7143	0.032	0.020	-0.012	Yes
7706-7143	0.028	0.017	-0.011	Yes
6144-7144	0.027	0.013	-0.014	Yes
7115-7144	0.007	0.007	0.000	No
7176-7145	0.016	0.009	-0.007	Yes
7613-7145	0.022	0.013	-0.010	Yes
7176-7147	0.010	0.008	-0.002	Yes
7149-7148	0.035	0.019	-0.015	Yes
7122-7148	0.050	0.026	-0.024	Yes
7171-7149	0.048	0.028	-0.020	Yes
7148-7149	0.035	0.019	-0.015	Yes
7151-7150	0.010	0.005	-0.005	Yes
7279-7151	0.060	0.038	-0.022	Yes
7150-7151	0.010	0.005	-0.005	Yes
7280-7151	0.051	0.035	-0.016	Yes
7812-7152	0.048	0.040	-0.008	Yes
7204-7162	0.063	0.037	-0.026	Yes
7708-7165	0.032	0.019	-0.013	Yes
7264-7170	0.030	0.018	-0.012	Yes
7265-7170	0.021	0.012	-0.009	Yes
7721-7171	0.038	0.015	-0.023	Yes
7149-7171	0.048	0.028	-0.020	Yes
7188-7171	0.061	0.030	-0.031	Yes
7145-7176	0.006	0.003	-0.003	Yes
7147-7176	0.015	0.009	-0.006	Yes
7196-7179	0.023	0.011	-0.012	Yes
7197-7179	0.012	0.011	-0.001	Yes
7732-7179	0.029	0.016	-0.013	Yes

Link ID	NO _x emission rate (g/km/s)			
	2021	2031	Difference	Is 2021 the worst case?
7102-7181	0.005	0.002	-0.002	Yes
7306-7182	0.042	0.022	-0.020	Yes
7308-7182	0.036	0.020	-0.016	Yes
7171-7188	0.061	0.030	-0.031	Yes
7250-7196	0.020	0.009	-0.011	Yes
7198-7196	0.007	0.005	-0.002	Yes
7179-7196	0.023	0.011	-0.012	Yes
7179-7197	0.012	0.011	-0.001	Yes
7734-7197	0.016	0.011	-0.005	Yes
7196-7198	0.007	0.005	-0.002	Yes
7123-7199	0.051	0.027	-0.024	Yes
7162-7204	0.075	0.049	-0.026	Yes
7294-7204	0.045	0.021	-0.024	Yes
7303-7250	0.100	0.050	-0.050	Yes
7196-7250	0.020	0.009	-0.011	Yes
7252-7250	0.035	0.014	-0.021	Yes
7250-7252	0.035	0.014	-0.021	Yes
7257-7252	0.018	0.009	-0.008	Yes
7252-7257	0.033	0.020	-0.013	Yes
1005-7257	0.037	0.021	-0.016	Yes
7305-7260	0.033	0.019	-0.014	Yes
7264-7260	0.021	0.012	-0.009	Yes
7170-7264	0.021	0.012	-0.009	Yes
7260-7264	0.025	0.016	-0.008	Yes
7322-7265	0.022	0.013	-0.009	Yes
7170-7265	0.028	0.020	-0.008	Yes
7318-7269	0.022	0.013	-0.009	Yes
7322-7269	0.028	0.020	-0.008	Yes
7275-7272	0.015	0.006	-0.009	Yes
7318-7272	0.027	0.019	-0.008	Yes
7307-7275	0.026	0.014	-0.012	Yes
7272-7275	0.020	0.015	-0.006	Yes
7307-7279	0.040	0.028	-0.011	Yes
7151-7279	0.036	0.025	-0.011	Yes
7151-7280	0.051	0.035	-0.016	Yes
7284-7280	0.024	0.016	-0.008	Yes
7280-7284	0.030	0.023	-0.006	Yes
7286-7284	0.024	0.016	-0.008	Yes

Link ID	NO _x emission rate (g/km/s)			
	2021	2031	Difference	Is 2021 the worst case?
7284-7286	0.038	0.026	-0.011	Yes
7309-7286	0.027	0.017	-0.010	Yes
7311-7290	0.014	0.010	-0.005	Yes
7311-7294	0.019	0.011	-0.008	Yes
7204-7294	0.031	0.021	-0.010	Yes
7650-7301	0.004	0.003	-0.001	Yes
7732-7301	0.023	0.012	-0.012	Yes
7250-7303	0.049	0.020	-0.029	Yes
7199-7303	0.129	0.064	-0.066	Yes
7305-7304	0.070	0.032	-0.038	Yes
7719-7304	0.030	0.016	-0.014	Yes
1005-7304	0.104	0.054	-0.051	Yes
7260-7305	0.029	0.014	-0.015	Yes
7304-7305	0.028	0.018	-0.010	Yes
7719-7306	0.022	0.012	-0.010	Yes
7182-7306	0.042	0.022	-0.020	Yes
7279-7307	0.073	0.034	-0.038	Yes
7308-7307	0.039	0.028	-0.012	Yes
7275-7307	0.070	0.034	-0.036	Yes
7307-7308	0.039	0.028	-0.012	Yes
7165-7308	0.037	0.020	-0.017	Yes
7182-7308	0.036	0.020	-0.016	Yes
7286-7309	0.091	0.048	-0.043	Yes
7290-7309	0.015	0.011	-0.004	Yes
7294-7311	0.071	0.041	-0.030	Yes
7721-7318	0.030	0.011	-0.019	Yes
7272-7318	0.073	0.034	-0.039	Yes
7269-7318	0.070	0.034	-0.035	Yes
7265-7322	0.028	0.020	-0.008	Yes
7269-7322	0.022	0.013	-0.009	Yes
7124-7414	0.055	0.013	-0.042	Yes
7113-7415	0.028	0.006	-0.022	Yes
6310-7419	0.033	0.007	-0.026	Yes
6420-7419	0.028	0.006	-0.022	Yes
6424-7420	0.069	0.007	-0.062	Yes
7145-7613	0.022	0.013	-0.010	Yes
7706-7613	0.005	0.003	-0.002	Yes
6155-7637	0.030	0.016	-0.015	Yes

Link ID	NO _x emission rate (g/km/s)			
	2021	2031	Difference	Is 2021 the worst case?
7301-7650	0.004	0.003	-0.001	Yes
7122-7650	0.007	0.005	-0.002	Yes
6173-7686	0.021	0.014	-0.007	Yes
6116-7686	0.018	0.012	-0.006	Yes
7613-7706	0.017	0.010	-0.007	Yes
7143-7706	0.028	0.017	-0.011	Yes
7311-7708	0.035	0.022	-0.014	Yes
7304-7719	0.030	0.016	-0.014	Yes
7306-7719	0.022	0.012	-0.010	Yes
7171-7721	0.038	0.015	-0.023	Yes
7318-7721	0.030	0.011	-0.019	Yes
7179-7732	0.029	0.016	-0.013	Yes
7301-7732	0.023	0.012	-0.012	Yes
7197-7734	0.016	0.011	-0.005	Yes
6708-7738	0.018	0.005	-0.013	Yes
7133-7738	0.071	0.029	-0.042	Yes
6427-7740	0.030	0.019	-0.011	Yes
6103-7740	0.003	0.002	-0.001	Yes
6191-7750	0.106	0.051	-0.055	Yes
5107-7802	0.054	0.024	-0.030	Yes
7152-7812	0.051	0.033	-0.018	Yes
7804-7812	0.066	0.056	-0.010	Yes
8130-8122	0.131	0.085	-0.045	Yes
8122-8401	0.079	0.051	-0.027	Yes
6179-8943	0.011	0.012	0.001	No
6203-8943	0.006	0.004	-0.002	Yes
7126-9502	0.102	0.039	-0.063	Yes
7132-9502	0.051	0.022	-0.028	Yes
6706-10000	0.045	0.010	-0.035	Yes
7113-10001	0.035	0.007	-0.028	Yes