



Midland Metro Phase 2 Birmingham Eastside Extension

Update to the Environmental Statement
MMD-300207-HS42-DOC-0000-0001 Rev C

05 October 2017

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Executive summary

In October 2016 the West Midlands Combined Authority (WMCA) submitted an application under the Transport and Works Act 1992 for the Birmingham Eastside Extension (the BEE, or the 'Scheme'). The application for a Transport and Works Act Order was accompanied by an Environmental Statement (ES) which identified and assessed the likely significant effects resulting from the construction and operation of the BEE. The submitted ES and accompanying volumes are Inquiry Documents BEE/A16/1, BEE/A16/2 and BEE/A16/3.

Since the submission of the application, changes to the operation of the city centre highway network have been made by Birmingham City Council (BCC) in their capacity as highway authority. In addition, the City Council's strategic transport model (SATURN Traffic Model) has been updated and so this report has been prepared in order to identify and assess any changes to the likely significant effects of the Scheme from those described in the ES. No changes have been made to the design of the Scheme since the application was submitted.

The scope of this report relates to updated environmental information for the following topic areas:

- Traffic and Transport
- Noise and Vibration
- Air Quality
- Greenhouse Gases

This update report follows the same format as the previously submitted ES. Where no changes or updates to the ES are necessary this is clearly identified in the relevant chapters. The Transport Assessment submitted with the application has also been updated to reflect the updates to the operation of the city centre highway network and the City Council's strategic model. An Update to the Transport Assessment and the associated Appendices is provided in a separate report (MMD-300207-HS42-DOC-0000-0002).

This report also provides an update to the overall ES conclusions, and confirms that no additional significant adverse effects have been identified.

1 Introduction

1.1.1 In October 2016 the West Midlands Combined Authority (WMCA) submitted an application under the Transport and Works Act 1992 (the TWA) for an extension to the Midland Metro light rail network in Birmingham (the Birmingham Eastside Extension, BEE), from Bull Street/Corporation Street to High Street Deritend. The Application related to a Transport and Works Act Order ('The Order') and was accompanied by an Environmental Statement (ES) (hereafter referred to as the 2016 ES) which identified and assessed the likely significant effects resulting from the construction and operation of the BEE. The purpose of this report is to provide updated environmental information to the ES due to changes in the operation of the city centre highway network and publication of the latest version of the underlying SATURN transport model for Birmingham.

1.2 Purpose and Scope of the Report

1.2.1 The key driver for revising elements of the 2016 ES is that BCC has already implemented some of the highway changes identified in the 2016 ES scenarios and that an update to the SATURN model has since been released. As such, the Applicant has produced this report to provide best and most up to date information to assist the Inquiry Process. The highway alterations that have already been implemented by Birmingham City Council (BCC) include the restrictions on Moor Street Queensway, previously referred to the ES.

1.2.2 It should be noted that the projected base and future years have changed in the SATURN model such that the base year is now 2016 and the future years are now 2026 and 2031. Baseline traffic counts used to derive the traffic flows in the assessment were also undertaken in December 2016. These are the only flows available with the road network as modelled in the new SATURN data and as such may not be directly comparable with the previous flows, taken in June 2015. In the underlying model various transport links around Broad Street and Granville Street are showing additional traffic flows, however consultation with BCC has confirmed that these are not related to the BEE and it has been agreed that this assessment does not need to mitigate for the increases in traffic flow in this area.

1.2.3 Apart from the changes to the underlying traffic model described above and alterations implemented at Moor Street Queensway, there have been no changes to the BEE route design since the 2016 ES. The embedded mitigation described in section 2.4 of the 2016 ES remains incorporated into the scheme design, namely:

- Use of a catenary-free system for approximately 67% of the alignment;
- The appropriate siting of lineside equipment to limit and potential electro-magnetic interference;
- The development of an Urban Design Strategy; and
- A Code of Construction Practice to be adopted by the construction contractor.

1.2.4 The changes to the underlying traffic data do not affect all the topics considered in the 2016 ES, and therefore this report is focused on the following topics:

- Traffic and Transport;
- Noise and Vibration;
- Air Quality; and
- Greenhouse gases.

- 1.2.5 There are no changes to the assessment of Need and Alternatives for the scheme, which is presented in Chapter 3 of the 2016 ES.
- 1.2.6 There are no changes to the plans and policies assessed in Chapter 4 of the 2016 ES.
- 1.2.7 There are no changes to the construction strategy since the 2016 ES.
- 1.2.8 A summary of significant effects is then presented in the Conclusions (Chapter 6) of this Report.

Table 1.1: Summary of 2016 ES chapter changes

2016 ES Chapter	Status
1. Introduction	Not changed
2. BEE Description	Not changed
3. Need and Alternatives	Not changed
4. Plans and Policies	Not changed
5. EIA Methodology	Not changed
6. Construction Strategy	Not changed
7. Land use and Land Take	Not changed
8. Climate Change Resilience	Not changed
9. Traffic and Transport	Updated as per Chapter 2 of this Report
10. Noise and Vibration	Updated as per Chapter 3 of this Report
11. Air Quality	Updated as per Chapter 4 of this Report
12. Greenhouse Gases	Updated as per Chapter 5 of this Report
13. Townscape and Visual Amenity	Not changed
14. Historic Environment	Not changed
15. Soils, Geology and Contaminated Land	Not changed
16. Water Resources	Not changed
17. Ecology	Not changed
18. Socio-Economics	Not changed
19. Electromagnetic Fields	Not changed
20. Summary of Significant Environmental Effects	Updated as per Chapter 6 of this Report

Source: Mott MacDonald

2 Traffic and Transport

2.1 Background

2.1.1 This chapter updates the Traffic and Transport chapter of the 2016 ES.

2.1.2 This chapter provides updates to the relevant sections which result from changes to traffic model data and also notes where no changes have been made to the information provided in the 2016 ES chapter.

2.2 Summary of implications of the changes

2.2.1 Table 2.1 provides a summary of changes to the 2016 ES Main Statement Transport chapter. The information provided in this chapter includes the detailed data tables which were originally included in the ES Volume 2 Technical Appendix L1: Traffic and Transport Technical Information, and in this way differs from the 2016 ES Main Statement Transport chapter.

Table 2.1 Summary of Updates to Transport ES Volume 2 Technical Appendix

Section of Report	Updates
9.1 Background	Updated by section 2.1
9.2 Methodology	No updates required to the following sections: - Legislation, guidance and best practice - Spatial scope - Impacts - Assessment criteria Updates made to the following subheadings which are reflected in Section 2.4: - Technical scope - Birmingham City Centre traffic model - Calculation of daily and weekday traffic - Traffic and transport receptors
9.3 Consultation	Updates made to this section are reflected in Section 2.4
9.4 Assumptions and Limitations	Updates made to this section are reflected in Section 2.4
9.5 Baseline Conditions	Updates made to the following subheadings which are reflected in Section 2.5: - Existing driver delay - Existing accidents and safety
9.6 Embedded Mitigation	No updates required
9.7 Construction - Likely Significant Effects	Full update to this chapter based on updated traffic model data in Section 2.7
9.8 Operation Likely Significant Effects	Full update to this chapter based on updated traffic model data in Section 2.8
9.9 Cumulative Effects	Full update to this section based on updated traffic model data in Section 2.9
9.10 Summary	Full update to this section based on updated traffic model data in Section 2.10

2.3 Legislation, Policy Guidance and Best Practice

2.3.1 *No changes have been made to this section from the 2016 ES chapter.*

2.4 Methodology

Spatial scope

2.4.1 *No changes have been made to this section from the 2016 ES chapter.*

Surveys

2.4.2 As part of the Transport Assessment (ES Volume 2 Technical Appendix L2), where existing traffic data was not available, to allow a 2016 surveyed base to be established and to validate junction capacity models, data from a survey collection exercise in 2016 was utilised.

2.4.3 The data, collated as part of this survey exercise, was used to establish a 2016 surveyed base year for the purpose of detailed junction assessments.

2.4.4 No additional surveys were undertaken to inform this ES update.

Birmingham City Centre SATURN model

2.4.5 Atkins provided updated traffic data from a new SATURN model which has been created from two existing source models:

- PRISM Model (Policy Responsive Integrated Strategy Model) – providing the initial traffic demand
- BCC SATURN model providing the network.

2.4.6 The SATURN model has a detailed representation of the roads and junctions within and including the Birmingham Ring Road (the modelled network covers central Birmingham Ring Road and is extended by 1km west in the Edgbaston area).

2.4.7 Outputs from the SATURN model were provided for the average hour in the AM and PM peak periods for the following scenarios:

- 2016 Base Year;
- 2026 Future Year Do-Minimum;
- 2026 Future Year Do-Something;
- 2031 Future Year Do-Minimum; and
- 2031 Future Year Do-Something.

Period of assessment

2.4.8 The traffic flows provided by the BCC SATURN model are for the average hour in the AM and PM peak periods (between 07:30 and 09:30 and 15:30 and 19:00). This data was then factored to 18 hour weekday (AAWT – Annual Average Weekday Traffic) and 24 hour daily traffic flows (AADT-Annual Average Daily Traffic). The methodology used to convert weekday peak hour SATURN data into AAWT and AADT data is discussed in greater detail below.

Temporal scope

2.4.9 This updated assessment considers the impact of the proposed development on the following future year scenarios:

- 2026 (Do-Minimum and Do-Something); and
- 2031 (Do-Minimum and Do-Something).

Calculation of daily and weekday traffic

2.4.10 *No changes have been made to this section from the 2016 ES chapter.*

Conversion factors to expand hourly data provided by the SATURN model

- 2.4.11 Average hour data for both the AM and PM peak period traffic outputs from the SATURN model were converted to 24 hour AADT and 18 hour AAWT for use within this assessment using data extracted from the permanent loop counter EX01A which is located on the A38 Aston Expressway.
- 2.4.12 Data from permanent site EX01A was used to derive expansion factors for volume flow in 2016. Table 2.2 shows a summary of the resulting factors.

Table 2.2: All traffic SATURN combined peak hours to AADT/AAWT expansion factors

Periods for ES Assessment	Expansion factor
AADT24	6.388
AAWT18hr (06:00-24:00)	6.825

Deriving HDV proportions for periods outside the Weekday AM and PM peak period

- 2.4.13 Data from Birmingham Cordon Automatic Traffic Count (ATC) sites has been used to derive factors for HDVs which have been applied to the combined AM and PM average peak period SATURN model traffic data. Table 2.3 shows a summary of the resulting factors.

Table 2.3: HDV SATURN model combined peak hours to HDV AADT/AAWT expansion factors

Periods for ES Assessment	Expansion factor
AADT24	8.713
AAWT18hr (06:00-24:00)	7.494

Deriving speed factors for periods outside the Weekday AM and PM peak period

- 2.4.14 *No changes have been made to this section from the 2016 ES chapter.*

Impacts

- 2.4.15 *No changes have been made to this section from the 2016 ES chapter.*

Receptors and receptor sensitivity

- 2.4.16 *No changes have been made to this section from the 2016 ES chapter.*

Magnitude of impact

- 2.4.17 *No changes have been made to this section from the 2016 ES chapter.*

Determination of significance of effects

- 2.4.18 *No changes have been made to this section from the 2016 ES chapter.*

Assumptions

- 2.4.19 *No changes have been made to this section from the 2016 ES chapter.*

Limitations

- 2.4.20 This assessment is based on future forecast years of 2026 and 2031. At the time of writing, no traffic figures were available for the assumed BEE opening year of 2022. This is because the BCC SATURN Model currently forecasts for key future development timescales, with 2026 being the scheduled opening year for HS2, and 2031 representing the end of the Birmingham Development Plan.

- 2.4.21 Due to the construction of HS2, consideration of traffic forecasts earlier than 2026 would be temporary in nature and carry a degree of uncertainty due to the disruption caused by ongoing road closures, diversions and construction traffic. Completion of HS2 will result in further changes to the highway network, car parking provision and trip generation and distribution within Birmingham City Centre.
- 2.4.22 It is therefore considered that the operational impact of BEE cannot be accurately assessed during the disruption caused by HS2's construction prior to 2026. As a result it is considered that an assessment of the scheme in 2026, coinciding with the completion of HS2, is appropriate and will represent a robust assessment.
- 2.4.23 Similarly, the updated assessment of the construction impacts associated with BEE has considered anticipated traffic flows associated with construction activities against a 2026 do-minimum future year. Forecasting of potential quantified impacts associated with construction traffic flow changes during 2020 would not be possible due to the disruption associated with the construction of HS2, as noted above. Therefore, the updated assessment of traffic flow changes associated with the construction of BEE in 2026 utilises the best available data and is therefore considered appropriate for this assessment.
- 2.4.24 Due to the strategic nature of the BCC SATURN Model used to inform this updated assessment it has been recognised that some flows for minor links are lower than surveys undertaken to validate the baseline as a result of the zoning system used within the model. Where a comparison of these data sources has revealed a disparity, professional judgement has been used to evaluate which traffic flows are reflective of the baseline scenario and the most appropriate source has been used. This has usually led to survey data, which have recorded higher flows, being used in order to assess a robust baseline scenario.
- 2.4.25 This methodology has therefore ensured that results related to junction performance, and the associated impacts on delay relevant to this assessment, have been based on realistic traffic flows. The methodology has also been peer reviewed by appropriate Mott MacDonald staff.

Consultation

- 2.4.26 BCC and the Midland Metro Alliance (MMA) have been in discussion as part of the process to commission the update to the 2016 ES as a result of the redevelopment of the strategic traffic model.

2.5 Baseline conditions

- 2.5.1 *No changes have been made to this section from the 2016 ES chapter.*

Road network

- 2.5.2 *No changes have been made to this section from the 2016 ES chapter.*

Existing driver delay

- 2.5.3 Transport modelling software LinSig V3 and Junctions 9 (PICADY) were used to assess the current performance of the identified online and offline junctions. Modelling was undertaken using 2016 surveyed junction turning counts (AM Peak and PM Peak).
- 2.5.4 For a detailed description of all online and offline junctions and their associated baseline performance see the original Transport Assessment (TA) (ES Volume 2 Technical Appendix L2) and the update to the TA (MMD-300207-HS42-DOC-0000-0002).

Existing pedestrian amenity

2.5.5 *No changes have been made to this section from the 2016 ES chapter.*

Existing pedestrian severance and delay

2.5.6 *No changes have been made to this section from the 2016 ES chapter.*

Existing cycling amenity

2.5.7 *No changes have been made to this section from the 2016 ES chapter.*

Existing public transport – buses

2.5.8 *No changes have been made to this section from the 2016 ES chapter.*

Existing public transport – coaches

2.5.9 *No changes have been made to this section from the 2016 ES chapter.*

Existing commercial vehicles – taxis

2.5.10 *No changes have been made to this section from the 2016 ES chapter.*

Existing accidents and safety

2.5.11 The assessment considers the formal accident record over the five-year period up to 31 December 2016 and includes the online and offline junctions.

2.5.12 The accident history in the full assessment area is shown in Table 2.4.

Table 2.4: BEE study area accident history.

Date	Fatal	Serious	Slight	Total
2012	0	3	18	21
2013	0	5	30	35
2014	0	4	25	29
2015	0	3	23	26
2016	1	4	14	19
Total	1	19	110	130

2.5.13 In total, there were one hundred and thirty collisions over the five-year period, of which nineteen of the collisions were serious and one fatal. As shown in Table 2.5, the one hundred and thirty collisions resulted in one hundred and ninety four casualties.

Table 2.5: BEE study area casualty data

Date	Casualty by Classification			Casualty by Severity			Total Casualties
	Driver	Passenger	Pedestrian	Fatal	Serious	Slight	
2012	12	13	8	0	4	29	33
2013	21	17	12	0	5	45	50
2014	23	10	12	0	4	41	45
2015	13	12	13	0	4	34	38
2016	11	9	8	1	4	23	28
Total	80	61	53	1	21	172	194

2.5.14 The online junction at New Canal Street / Bordesley Street / Meriden Street was highlighted as the worst collision cluster with one serious and seventeen slight collisions identified around the

junction. None of the collisions involved a pedestrian, one involved a cyclist, and one involved a powered two-wheel vehicle. The most common cause of collision were drivers overshooting or disobeying the give way markings, accounting for nine of the collisions. A further two collisions were caused by drivers undertaking a poor turn or manoeuvre, and two were caused by a slippery road due to the weather.

2.5.15 The offline junction at Moor Street Queensway / Park Street was highlighted as the worst collision cluster within the wider assessment area with two serious and twelve slight collisions identified around the junction.

2.5.16 A further cluster of collisions has been identified at the junction of Moor Street Queensway and Albert Street, with eleven slight collisions occurring over the five-year period. Of these collisions, seven involved pedestrians with the main cause being that the pedestrian failed to look properly or that the pedestrian crossing the road was masked by stationary or stopped vehicles. The remaining collisions in this cluster generally involved drivers performing poor movements.

Receptors

2.5.17 The BEE route has been divided up into short link sections for the purpose of this assessment. Using reasoned professional judgement, which has been informed by site visits, and background data including pedestrian surveys and collision analysis, each link has been assigned a level of sensitivity based on the receptors within it as identified above. Where a combination of receptors has been identified on each link, the value of sensitivity for the whole link is based on the receptor with the highest sensitivity. This ensures that the assessment is based on a realistic robust scenario.

2.5.18 Using baseline information set out above, the route has been broken down into short link sections within which the existing baseline receptors relevant to the individual link have been identified and are listed in Table 2.5. The sensitivity of these receptors, which are defined within this table, have been assessed based on guidance contained in Section 2.5 of the 'Guidelines for the Environmental Assessment of Road Traffic provided by the Institute of Environmental Assessment (now the Institute of Environmental Management and Assessment – IEMA 1993).

Table 2.6: Assessment of receptor sensitivity along the BEE route

Link No	Link name	Key features/receptors on link	Overall sensitivity
1	Lower Bull Street	Retail area with high pedestrian footfall	High
2	Albert St (DM) / New Alignment (DS)	Through route, access to NCP Car Park and Ikea collection point, pedestrian footways	Low
3	Moor St Queensway (between Albert Street and Masshouse Lane)	Main road, pedestrian footways/crossings, collision cluster, Hotel	High
4	Moor St Queensway (between Albert Street and Carrs Lane)	Main road, pedestrian footways/crossings, collision cluster	High
5	New Canal St to Curzon Street	Park, leisure with pedestrian crossing	Medium
6	New Canal St (north of junction with Fazeley St)	Park, leisure with pedestrian crossing	Medium
7	New Canal St (south of junction with Fazeley St)	Light industrial area	Low
8	New Canal St (north of junction with Bordesley St)	Light industrial area, collision cluster	High
9	Meriden St (between Bordesley Street and Coventry Street)	Light industrial area, collision cluster	High

Link No	Link name	Key features/receptors on link	Overall sensitivity
10	Meriden St (north of Digbeth B4100)	Light industrial area	Low
11	Digbeth B4100 (east of Meriden St)	Retail frontages, wide trafficked street, pedestrian footways/crossings	Medium
12	Digbeth B4100 (west of Rea St)	Retail frontages, wide trafficked street, bus stops, pedestrian footways	Medium
13	High St Deritend (west of Milk St)	Retail frontages, wide trafficked street, pedestrian footways	Medium
14	High St Deritend (east of Milk St)	College, wide trafficked street, pedestrian footways	High
15	High St Deritend (east of Floodgate St)	Wide trafficked street, bus stops and pedestrian footways/crossings	Low
16	High Street Deritend (east of Heath Mill Lane)	Retail frontages, wide trafficked street, pedestrian footways	Medium
17	High Street Deritend (east of Alcester St)	Retail frontages, wide trafficked street, pedestrian footways/crossings	Medium
18	High St Deritend (east of Adderley St)	Light industrial, car garages, wide trafficked street, pedestrian footways	Low
19	Pedestrian area outside Hotel La Tour (new Bus Interchange)	Pedestrian area with high pedestrian footfall	High
Minor and offline links			
25	Carrs Lane and High Street	Retail area with high pedestrian footfall	High
26	Dale End	Retail area with high pedestrian footfall	High
27	Moor Street Queensway (between Masshouse Lane and Park Street)	Main road with junction identified as accident blackspot	High
28	Priory Queensway	Main road (bus only)	Low
29	A47 Jennens Road	Main road with junction identified as having a collision cluster	High
30	B4114 James Watt Queensway	Main road with junction identified as having a collision cluster	High
31	B4114 Park Street	Main road with junction identified as having a collision cluster	High
32	Masshouse Lane	Wide trafficked street, pedestrian footways	Low
50	Fazeley St (east of junction with New Canal St)	Light industrial area	Low
51	Fazeley St (west of junction with New Canal St)	Light industrial area	Low
52	Bordesley St (east of junction with New Canal St)	Light industrial area, collision cluster	High
53	Bordesley St (west of junction with New Canal St)	Light industrial area, collision cluster	High
54	Coventry St (east of Meriden St)	Light industrial area	Low
55	Coventry St (west of Meriden St)	Light industrial area	Low
33	Digbeth (B4100) / Moat Lane Gyratory	Retail frontages, wide trafficked gyratory	Medium
34	Oxford Street (directly off Digbeth B4100)	College and light industrial	Low
35	Rea Street (directly off Digbeth B4100)	Access to Coach Station – through route	Low
36	Milk Street (directly off High Street Deritend)	Light industrial area	Low
37	Floodgate Street (directly off High Street Deritend)	College and light industrial	High
38	Heath Mill Lane (directly off High Street Deritend)	Retail frontages, office, leisure	Medium

Link No	Link name	Key features/receptors on link	Overall sensitivity
39	Alcester Street (directly off High Street Deritend)	Residential, light industrial and offices	Medium
40	Adderley Street (directly off High Street Deritend)	Light industrial area	Low
41A	Great Barr Street (at Heath Mill Lane / Liverpool Street junction)	Light industrial area	Low
41B	Liverpool Street (at Heath Mill Lane / Liverpool Street junction)	Light industrial area	Low
41C	Heath Mill Lane (at Heath Mill Lane / Liverpool Street junction)	Light industrial area	Low
41D	Fazeley Street (at Heath Mill Lane / Liverpool Street junction)	Light industrial area	Low

2.6 Impact assessment

2.6.1 No changes have been made to this section from the 2016 ES chapter.

2.7 Construction – Likely Significant Effects

Temporary effects

- 2.7.1 The potential effects on traffic and transport associated with impacts caused during construction are all considered to be temporary in nature and limited to the construction phase.
- 2.7.2 The majority of the BEE construction works will be typical of regular highway and utility maintenance activities resulting in short term and localised impacts along the BEE alignment.
- 2.7.3 The work stages currently anticipated that are associated with the construction process have been matched in the following Table 2.7 with their respective key receptor links which were identified in Table 2.6.

Table 2.7: Construction work stage location and associated receptor links.

Work stage	Receptor link description	Receptor link ref.
Work Stage 1 Corporation Street to Moor Street Queensway	Lower Bull Street	1
	Albert St (DM) / New Alignment (DS)	2
	Carrs Lane and High Street	25
	Dale End	26
Work Stage 2 Moor Street Queensway	Moor St Queensway (between Albert Street and Masshouse Lane)	3
	Moor St Queensway (between Albert Street and Carrs Lane)	4
	Moor Street Queensway (between Masshouse Lane and Park Street)	27
Work Stage 3 Moor Street Queensway to New Canal Street	Park Street	31
	New Canal St to Curzon Street	5
	New Canal St (north of junction with Fazeley St)	6
Work Stage 4 New Canal Street to Digbeth (B4100)	New Canal St (south of junction with Fazeley St)	7
	New Canal St (north of junction with Bordesley St)	8
	Meriden St (between Bordesley Street and Coventry Street)	9
	Meriden St (north of Digbeth B4100)	10

Work stage	Receptor link description	Receptor link ref.
	Digbeth (B4100) / Moat Lane Gyratory	33
Work Stage 5	Digbeth B4100 (east of Meriden St)	11
High Street Deritend / Digbeth (B4100)	Digbeth B4100 (west of Rea St)	12
	High St Deritend (west of Milk St)	13
	High St Deritend (east of Milk St)	14
	High St Deritend (east of Floodgate St)	15
	High Street Deritend (east of Heath Mill Lane)	16
	High Street Deritend (east of Alcester St)	17
	High St Deritend (east of Adderley St)	18

Severance

Effects (without mitigation)

2.7.4

Table 2.8 shows the percentage impact of construction on the local highway network compared with 2026 Do-Minimum (DM) traffic flows. This is based upon a robust volume of construction traffic per quarter (two-way total of HGV movements and additional worker journeys).

Table 2.8: Impact of construction traffic - 2026

Work Stage	Link description	Receptor Link ref.	Sensitivity receptor	2026DM AADT (24 Hour, all vehicle type, 2 way Flows)	Worst case construction traffic volume (two way PCU's)	% impact of construction traffic on total flow	DM DMRB severance assessment	Magnitude of Severance Impact	Significance of effect
Work Stage 1	Lower Bull Street	1	High	1,046	67	6.42%	Slight	Negligible adverse	No Change
Corporation Street to Moor Street Queensway	Albert St (DM) / New Alignment (DS)	2	Low	3,982		1.69%	Slight	Negligible adverse	No Change
	Carrs Lane and High Street	25	High	2,814		2.39%	Slight	Negligible adverse	No Change
	Dale End	26	High	1,612		4.17%	Slight	Negligible adverse	No Change
Work Stage 2	Moor St Queensway (between Albert Street and Masshouse Lane)	3	High	8,634	14	0.16%	Moderate	Negligible adverse	No Change
Moor Street Queensway	Moor St Queensway (between Albert Street and Carrs Lane)	4	High	5,620		0.25%	Slight	Negligible adverse	No Change
	Moor Street Queensway (between Masshouse Lane and B4114 James Watt Queensway)	27	High	10,815		0.13%	Moderate	Negligible adverse	No Change
Work Stage 3	Park Street	31	High	4,310	81	1.87%	Slight	Negligible adverse	No Change
Moor Street Queensway to New Canal Street	New Canal St to Curzon Street	5	Medium	DS Link		N/A	N/A	N/A	N/A
	New Canal St (north of junction with Fazeley St)	6	Medium	DS Link		N/A	N/A	N/A	N/A
Work Stage 4	New Canal St (south of junction with Fazeley St)	7	Low	5,724	71	1.23%	Slight	Negligible adverse	No Change
New Canal Street to Digbeth (B4100)	New Canal St (north of junction with Bordesley St)	8	High	5,724		1.23%	Slight	Negligible adverse	No Change
	Meriden St (between Bordesley Street and Coventry Street)	9	High	4,652		1.52%	Slight	Negligible adverse	No Change
	Meriden St (north of Digbeth B4100)	10	Low	4,837		1.46%	Slight	Negligible adverse	No Change
	Digbeth (B4100) / Moat Lane Gyratory	33	Medium	18,193		0.39%	Severe	Negligible adverse	No Change
Work Stage 5	Digbeth B4100 (east of Meriden St)	11	Medium	20,876	45	0.22%	Severe	Negligible adverse	No Change
High Street Deritend / Digbeth (B4100)	Digbeth B4100 (west of Rea St)	12	Medium	20,118		0.22%	Severe	Negligible adverse	No Change
	High St Deritend (west of Milk St)	13	Medium	14,470		0.31%	Moderate	Negligible adverse	No Change
	High St Deritend (east of Milk St)	14	High	21,892		0.21%	Severe	Negligible adverse	No Change
	High St Deritend (east of Floodgate St)	15	Low	23,256		0.19%	Severe	Negligible adverse	No Change
	High Street Deritend (east of Heath Mill Lane)	16	Medium	24,621		0.18%	Severe	Negligible adverse	No Change
	High Street Deritend (east of Alcester St)	17	Medium	26,925		0.17%	Severe	Negligible adverse	No Change
	High St Deritend (east of Adderley St)	18	Low	26,689		0.17%	Severe	Negligible adverse	No Change

- 2.7.5 For each Work Stage we have assessed the highway links that are in close proximity to the construction area. The construction traffic volume has been assigned to each highway link regardless of different route options for construction traffic and this represents a robust case scenario.
- 2.7.6 Given the low levels of forecast construction traffic associated with each stage of the construction process, the impact on total traffic flows across an 18-hour week day will not contribute to changes to or relief from existing severance for pedestrians.
- 2.7.7 The resulting impact on severance for all of the links identified in Table 2.8 has been assessed to have no change for all high, medium and low sensitivity receptors. This is therefore assessed as having no change for all links and is not deemed to be significant.

Mitigation

- 2.7.8 No significant adverse effects of relevance to severance have been identified as part of the above assessment therefore no additional mitigation is proposed.

Residual effects

- 2.7.9 It has been assessed that there will be no significant adverse or beneficial residual effects associated with severance as a result of the construction of BEE.

Driver delay

Effects (without mitigation)

- 2.7.10 Whilst no specific detailed junction modelling has been undertaken to assess the impact of construction traffic on individual junctions, the increases in traffic flow associated with construction activities identified in Table 2.8 are considered to be negligible and would be unlikely to have an impact on the capacity of each junction and their associated performance and driver delay.
- 2.7.11 As part of the construction process it may be necessary to close individual carriageways or complete sections of road for short periods of time. This will inevitably lead to a reduction in capacity at certain junctions within the study area, which could have an adverse impact on driver delay particularly during peak times.
- 2.7.12 Moor Street Queensway and High Street Deritend are main routes into the City Centre from areas to the north and east respectively, with high associated traffic flows. The use of conventional construction techniques is therefore likely to result in additional driver delay and traffic re-routing. Special construction methods may have to be adopted to minimise disruption on these roads (for example, out of hours working and temporary closure / possession coupled with the use of prefabricated track elements).
- 2.7.13 It is not envisaged that excessive additional disruption will be caused by the construction of the BEE at minor junctions, such as the side road intersections with New Canal Street and Meriden Street. It is likely that construction can be achieved in these cases either by using conventional traffic management techniques, or where space is limited, by the use of temporary road closures, provided acceptable alternative routes can be provided and access can be maintained.

Mitigation

- 2.7.14 No significant adverse effects of relevance to driver delay have been identified as part of the above assessment therefore no additional mitigation is proposed.

Residual effects

- 2.7.15 It has been assessed that there will be no significant adverse or beneficial residual effects associated with driver delay as a result of the construction of BEE.

Pedestrian delay

- 2.7.16 *No changes have been made to this section from the 2016 ES chapter.*

Pedestrian amenity

Effects (without mitigation)

- 2.7.17 Using the indicative thresholds set out within IEMA guidance, that significant changes in pedestrian amenity can be attributed to changes in traffic flow, and its lorry component, where it is halved or doubled, it is not considered likely that pedestrian amenity will be adversely affected by changes in traffic flows or its composition during the construction period using data provided in Table 2.8.
- 2.7.18 It is acknowledged that pedestrian amenity can be further affected by changes in pavement width and separation from traffic. Where the construction process requires the closure of existing footways, it is anticipated that temporary footway facilities will be provided within the existing carriageway where possible with safety barriers providing separation from general traffic. The temporary footpath facilities will have an impact on the width of footways which pedestrians will use within the study area, with it being assumed that in the majority of cases due to restricted carriageway width that footways will be less wide. These changes in pedestrian amenity will be temporary and for short periods of time, associated with the progression of construction in stages, and as such are unlikely to have a detrimental impact on pedestrians.
- 2.7.19 The resulting impact on pedestrian amenity for all of the links and associated receptors identified within the study area has been assessed to be negligible adverse for all high, medium and low sensitivity receptors. This is therefore assessed as having a minor effect for all links and is not deemed to be significant.

Mitigation

- 2.7.20 No significant adverse effects of relevance to pedestrian amenity have been identified as part of the above assessment therefore no additional mitigation is proposed.

Residual effects

- 2.7.21 It has been assessed that there will be no significant adverse or beneficial residual effects associated with pedestrian amenity as a result of the construction of BEE.

Fear and intimidation

Effects (without mitigation)

- 2.7.22 Changes in traffic flow as a result of the BEE construction process are not anticipated to have an adverse or beneficial impact on links within the study in relation to pedestrian's experience of fear and intimidation. Data provided Table 2.8 confirms that changes in AADT flow will be

negligible during construction and that the negligible increase in HGVs within the study area will not cause excessive change in traffic flow composition which could contribute to new or additional experience of fear and intimidation for pedestrians.

- 2.7.23 The resulting impact on pedestrian experience of fear and intimidation for all of the links identified within the study area has been assessed to be negligible adverse for all high, medium and low sensitivity receptors. This is therefore assessed as having a minor effect for all links and is not deemed to be significant.

Mitigation

- 2.7.24 No significant adverse effects of relevance to fear and intimidation have been identified as part of the above assessment therefore no additional mitigation is proposed.

Residual effects

- 2.7.25 It has been assessed that there will be no significant adverse or beneficial residual effects associated with fear and intimidation as a result of the construction of BEE.

Accidents and safety

Effects (without mitigation)

- 2.7.26 Using indicative thresholds set out within IEMA guidance it is not considered that construction traffic will have an adverse impact during the construction period. The most affected links as shown in Table 2.8 are located around Work Stage 1. Traffic flows in this area have high existing HGV proportions (bus routes and restricted access routes to general traffic), therefore the introduction of temporary additional construction traffic is not anticipated to have a detrimental impact on road safety or to have the potential to contribute to higher levels of collisions.
- 2.7.27 It has been assumed that where construction activities require the temporary closure of existing pedestrian crossing facilities that alternative provision will be introduced which will continue to support the movements of pedestrians. These alternative facilities could also include temporary barriers which would allow a separation between traffic and pedestrians should temporary closure of a footpath be required.
- 2.7.28 Table 2.8 shows that construction traffic is anticipated to increase the total traffic volume on Moor Street Queensway by an average of 0.18%. The construction process should therefore not exacerbate the likelihood of collisions at the existing collision cluster which has been identified along Moor Street Queensway on links 3, 4, 29, 30 and 31. Additionally, construction traffic is anticipated to increase traffic on Canal Street at the junction with Bordesley Street by an average of 1.23%. The construction process should therefore not exacerbate the likelihood of collisions at the existing collision cluster which has been identified at links 8, 9, 52 and 53.
- 2.7.29 The construction work being carried out will adhere to best practice principles, as identified in Chapter 6 of the 2016 ES, which would include the provision of alternative facilities, such as pedestrian crossings and temporary footpaths, appropriate signage and reduced vehicle speeds through sections of construction works.
- 2.7.30 The resulting impact related to accidents and safety for all of the links and associated receptors identified within the study area has been assessed to be negligible for all high, medium and low sensitivity receptors. This is therefore assessed as having a minor effect for all links and is not deemed to be significant.

Mitigation

- 2.7.31 No significant adverse effects of relevance to fear and intimidation have been identified as part of the above assessment therefore no additional mitigation is proposed.

Residual effects

- 2.7.32 It has been assessed that there will be no significant adverse residual effects associated with fear and intimidation as a result of the construction of BEE.

Permanent effects

- 2.7.33 *No changes have been made to this section from the 2016 ES chapter.*

2.8 Operation – Likely Significant Effects

Temporary effects

- 2.8.1 *No changes have been made to this section from the 2016 ES chapter.*

Permanent effects

Severance

Effects (with mitigation)

- 2.8.2 The DMRB (Volume 11, Section 3, Part 8, Chapter 6 and 7) provides a set of measures to describe new severance within a community in terms of the two-way AADT flow on a link. Where
- 2.8.3 Table 2.9 reports the percentage change in 24 hour AADT flows between the 2026 Do-Minimum (DM) and 2026 Do-Something (DS) scenarios. These flows have been used to define relevant DMBC severance categories and where links report changes between the DM and DS, an assessment of the magnitude of impact has been undertaken in accordance with section 4.31 of the IEMA guidance based on the link's receptors and is also shown in the table.

Table 2.9: Change in 24 hour AADT between Do-Minimum and Do-Something scenario in 2026

Link No.	Link name	Sensitivity receptor	2026 DM AADT	2026 DS AADT	% difference	DM DMRB severance assessment	DS DMRB severance assessment	Magnitude of impact	Significance of effect
1	Lower Bull Street	High	1,046	1,372	31%	Slight	Slight	No Change	No Change
2	Albert St (DM) / New Alignment (DS)	Low	3,982	4,179	5%	Slight	Slight	No Change	No Change
3	Moor St Queensway (between Albert Street and Masshouse Lane)	High	8,634	4,323	-50%	Moderate	Slight	Moderate Beneficial	Major Beneficial
4	Moor St Queensway (between Albert Street and Carrs Lane)	High	5,620	4,635	-18%	Slight	Slight	No Change	No Change
5	New Canal St to Curzon Street	Medium	DS Link	327	N/A	N/A	Slight	N/A	N/A
6	New Canal St (north of junction with Fazeley St)	Medium	DS Link	327	N/A	N/A	Slight	N/A	N/A
7	New Canal St (south of junction with Fazeley St)	Low	5,724	5,951	4%	Slight	Slight	No Change	No Change
8	New Canal St (north of junction with Bordesley St)	High	5,724	5,951	4%	Slight	Slight	No Change	No Change
9	Meriden St (between Bordesley Street and Coventry Street)	High	4,652	5,581	20%	Slight	Slight	No Change	No Change
10	Meriden St (north of Digbeth B4100)	Low	4,837	5,715	18%	Slight	Slight	No Change	No Change
11	Digbeth B4100 (east of Meriden St)	Medium	20,876	21,408	3%	Severe	Severe	No Change	No Change
12	Digbeth B4100 (west of Rea St)	Medium	20,118	21,071	5%	Severe	Severe	No Change	No Change
13	High St Deritend (west of Milk St)	Medium	14,470	15,059	4%	Moderate	Moderate	No Change	No Change
14	High St Deritend (east of Milk St)	High	21,892	13,907	-36%	Severe	Moderate	Moderate Beneficial	Major Beneficial
15	High St Deritend (east of Floodgate St)	Low	23,256	13,907	-40%	Severe	Moderate	Moderate Beneficial	Minor Beneficial
16	High Street Deritend (east of Heath Mill Lane)	Medium	24,621	16,818	-32%	Severe	Severe	No Change	No Change
17	High Street Deritend (east of Alcester St)	Medium	26,925	22,529	-16%	Severe	Severe	No Change	No Change
18	High St Deritend (east of Adderley St)	Low	26,689	20,409	-24%	Severe	Severe	No Change	No Change
19	PT Interchange (Do Something only)	High	DS Link	1,041	N/A	N/A	Slight	N/A	
Minor and offline links									
25	Carrs Lane and High Street	High	2,814	2,679	-5%	Slight	Slight	No Change	No Change
26	Dale End	High	1,612	174	-89%	Slight	Slight	No Change	No Change
27	Moor Street Queensway (between Masshouse Lane and B4114 James Watt Queensway)	High	10,815	10,993	2%	Moderate	Moderate	No Change	No Change
29	Jennens Road	High	6,646	6,638	0%	Slight	Slight	No Change	No Change
30	B4114 James Watt Queensway	High	10,822	11,332	5%	Moderate	Moderate	No Change	No Change
31	Park Street	High	4,310	4,302	0%	Slight	Slight	No Change	No Change
32	Masshouse Lane	Low	10,190	9,577	-6%	Moderate	Moderate	No Change	No Change
50	Fazeley St (east of junction with New Canal St)	Low	5,724	5,624	-2%	Slight	Slight	No Change	No Change
51	Fazeley St (west of junction with New Canal St)	Low	0	0	N/A	Slight	Slight	No Change	No Change
52	Bordesley St (east of junction with New Canal St)	High	2,902	5,624	94%	Slight	Slight	No Change	No Change
53	Bordesley St (west of junction with New Canal St)	High	2,133	4,313	102%	Slight	Slight	No Change	No Change
54	Coventry St (east of Meriden St)	Low	2,413	204	-92%	Slight	Slight	No Change	No Change
55	Coventry St (west of Meriden St)	Low	2,226	71	-97%	Slight	Slight	No Change	No Change
33	Digbeth (B4100) / Moat Lane Gyratory	Medium	18,193	19,407	7%	Severe	Severe	No Change	No Change
34	Oxford Street (directly off Digbeth B4100)	Low	2,196	2,751	25%	Slight	Slight	No Change	No Change
35	Rea Street (directly off Digbeth B4100)	Low	10,082	10,401	3%	Moderate	Moderate	No Change	No Change
36	Milk Street (directly off High Street Deritend)	Low	8,110	1,327	-84%	Moderate	Slight	Major Beneficial	Moderate Beneficial
37	Floodgate Street (directly off High Street Deritend)	High	2,204	1,814	-18%	Slight	Slight	No Change	No Change
38	Heath Mill Lane (directly off High Street Deritend)	Medium	5,255	4,892	-7%	Slight	Slight	No Change	No Change
39	Alcester Street (directly off High Street Deritend)	Medium	9,772	9,035	-8%	Moderate	Moderate	No Change	No Change
40	Adderley Street (directly off High Street Deritend)	Low	3,934	4,958	26%	Slight	Slight	No Change	No Change
41A	Great Barr Street (at Heath Mill Lane / Liverpool Street junction)	Low	14,517	14,509	0%	Moderate	Moderate	No Change	No Change
41B	Liverpool Street (at Heath Mill Lane / Liverpool Street junction)	Low	3,137	7,324	133%	Slight	Slight	No Change	No Change

Link No.	Link name	Sensitivity receptor	2026 DM AADT	2026 DS AADT	% difference	DM DMRB severance assessment	DS DMRB severance assessment	Magnitude of impact	Significance of effect
41C	Heath Mill Lane (at Heath Mill Lane / Liverpool Street junction)	Low	7,744	7,800	1%	Slight	Slight	No Change	No Change
41D	Fazeley Street (at Heath Mill Lane / Liverpool Street junction)	Low	12,060	16,699	38%	Moderate	Severe	Moderate Adverse	Minor Adverse

- 2.8.4 No assessment was made for thirty six links where no change was reported in the categorisation of severance is forecast between the DM and DS scenarios following changes in AADT flow. The resulting impacts related to severance on all high, medium and low sensitivity receptors of relevance to these links is therefore deemed to not be significant.
- 2.8.5 The resulting impacts related to severance for the following link has been assessed to be major beneficial for the following low sensitivity receptors in 2026:
- Link 36 - Milk Street (directly off High Street Deritend).
- 2.8.6 This is therefore assessed as having a moderate beneficial effect for this link and is not deemed to be significant.
- 2.8.7 The resulting impacts related to severance for the following three links has been assessed to be moderate beneficial for all high, medium and low sensitivity receptors in 2026:
- Link 3 – Moor St Queensway (between Albert Street and Masshouse Lane)
 - Link 14 – High St Deritend (east of Milk St)
 - Link 15 – High St Deritend (east of Floodgate St)
- 2.8.8 This is therefore assessed as having a minor beneficial effect for link 15 and is not deemed to be significant. Links 3 and 14 have been assessed as having a major beneficial effect and are deemed to be significant.
- 2.8.9 The resulting impacts related to severance for the following link has been assessed to be moderate adverse for the low sensitivity receptors in 2026:
- Link 41D – Fazeley Street (at Heath Mill Lane/Liverpool Street junction)
- 2.8.10 This is therefore assessed as having a minor adverse effect for the low sensitivity receptors on this link and is not deemed to be significant.

Table 2.10: Change in 24 hour AADT between Do-Minimum and Do-Something scenario in 2031

Link No.	Link name	Sensitivity receptor	2031 DM AADT	2031 DS AADT	% difference	DM DMRB severance assessment	DS DMRB severance assessment	Magnitude of severance impact	Significance of effect
1	Lower Bull Street	High	1,046	1,372	31%	Slight	Slight	No Change	No Change
2	Albert St (DM) / New Alignment (DS)	Low	4,066	4,290	6%	Slight	Slight	No Change	No Change
3	Moor St Queensway (between Albert Street and Masshouse Lane)	High	8,719	5,573	-36%	Moderate	Slight	Moderate Beneficial	Major Beneficial
4	Moor St Queensway (between Albert Street and Carrs Lane)	High	5,620	4,635	-18%	Slight	Slight	No Change	No Change
5	New Canal St to Curzon Street	Medium	DS Link	327	N/A	N/A	Slight	N/A	N/A
6	New Canal St (north of junction with Fazeley St)	Medium	DS Link	327	N/A	N/A	Slight	N/A	N/A
7	New Canal St (south of junction with Fazeley St)	Low	5,727	5,442	-5%	Slight	Slight	No Change	No Change
8	New Canal St (north of junction with Bordesley St)	High	5,727	5,442	-5%	Slight	Slight	No Change	No Change
9	Meriden St (between Bordesley Street and Coventry Street)	High	4,651	5,510	18%	Slight	Slight	No Change	No Change
10	Meriden St (north of Digbeth B4100)	Low	4,844	5,375	11%	Slight	Slight	No Change	No Change
11	Digbeth B4100 (east of Meriden St)	Medium	21,199	20,021	-6%	Severe	Severe	No Change	No Change
12	Digbeth B4100 (west of Rea St)	Medium	20,452	19,487	-5%	Severe	Severe	No Change	No Change
13	High St Deritend (west of Milk St)	Medium	15,477	13,691	-12%	Moderate	Moderate	No Change	No Change
14	High St Deritend (east of Milk St)	High	23,594	14,474	-39%	Severe	Moderate	Moderate Beneficial	Major Beneficial
15	High St Deritend (east of Floodgate St)	Low	25,184	14,474	-43%	Severe	Moderate	Moderate Beneficial	Minor Beneficial
16	High Street Deritend (east of Heath Mill Lane)	Medium	26,098	17,535	-33%	Severe	Severe	No Change	No Change
17	High Street Deritend (east of Alcester St)	Medium	27,836	23,204	-17%	Severe	Severe	No Change	No Change
18	High St Deritend (east of Adderley St)	Low	27,318	20,924	-23%	Severe	Severe	No Change	No Change
19	PT Interchange (Do Something only)	High	DS Link	1,041	N/A	N/A	Slight	N/A	N/A
Minor and offline links									
25	Carrs Lane and High Street	High	2,814	2,679	-5%	Slight	Slight	No Change	No Change
26	Dale End	High	1,612	174	-89%	Slight	Slight	No Change	No Change
27	Moor Street Queensway (between Masshouse Lane and B4114 James Watt Queensway)	High	11,071	11,009	-1%	Moderate	Moderate	No Change	No Change
29	Jennens Road	High	6,730	6,730	0%	Slight	Slight	No Change	No Change
30	B4114 James Watt Queensway	High	11,137	11,526	3%	Moderate	Moderate	No Change	No Change
31	Park Street	High	4,395	4,394	0%	Slight	Slight	No Change	No Change
32	Masshouse Lane	Low	10,375	8,359	-19%	Moderate	Moderate	No Change	No Change
50	Fazeley St (east of junction with New Canal St)	Low	5,729	3,704	-35%	Slight	Slight	No Change	No Change
51	Fazeley St (west of junction with New Canal St)	Low	0	0	N/A	Slight	Slight	No Change	No Change
52	Bordesley St (east of junction with New Canal St)	High	2,853	5,623	97%	Slight	Slight	No Change	No Change
53	Bordesley St (west of junction with New Canal St)	High	2,091	4,244	103%	Slight	Slight	No Change	No Change
54	Coventry St (east of Meriden St)	Low	2,674	206	-92%	Slight	Slight	No Change	No Change
55	Coventry St (west of Meriden St)	Low	2,481	71	-97%	Slight	Slight	No Change	No Change
33	Digbeth (B4100) / Moat Lane Gyratory	Medium	18,500	14,458	-22%	Severe	Moderate	Minor Beneficial	Minor Beneficial
34	Oxford Street (directly off Digbeth B4100)	Low	2,184	2,745	26%	Slight	Slight	No Change	No Change
35	Rea Street (directly off Digbeth B4100)	Low	10,191	9,619	-6%	Moderate	Moderate	No Change	No Change
36	Milk Street (directly off High Street Deritend)	Low	8,744	1,489	-83%	Moderate	Slight	Major Beneficial	Moderate Beneficial
37	Floodgate Street (directly off High Street Deritend)	High	2,417	479	-80%	Slight	Slight	No Change	No Change
38	Heath Mill Lane (directly off High Street Deritend)	Medium	5,467	4,994	-9%	Slight	Slight	No Change	No Change
39	Alcester Street (directly off High Street Deritend)	Medium	10,496	9,308	-11%	Moderate	Moderate	No Change	No Change
40	Adderley Street (directly off High Street Deritend)	Low	4,150	5,108	23%	Slight	Slight	No Change	No Change
41A	Great Barr Street (at Heath Mill Lane / Liverpool Street junction)	Low	14,758	14,808	0%	Moderate	Moderate	No Change	No Change
41B	Liverpool Street (at Heath Mill Lane / Liverpool Street junction)	Low	3,454	7,630	121%	Slight	Slight	No Change	No Change

Link No.	Link name	Sensitivity receptor	2031 DM AADT	2031 DS AADT	% difference	DM DMRB severance assessment	DS DMRB severance assessment	Magnitude of severance impact	Significance of effect
41C	Heath Mill Lane (at Heath Mill Lane / Liverpool Street junction)	Low	8,044	8,138	1%	Moderate	Moderate	No Change	No Change
41D	Fazeley Street (at Heath Mill Lane / Liverpool Street junction)	Low	12,337	16,981	38%	Moderate	Severe	Moderate Adverse	Minor Adverse

- 2.8.11 No assessment was made for thirty five links where no change was reported in the categorisation of severance is forecast between the DM and DS scenarios following changes in AADT flow. The resulting impacts related to severance on all high, medium and low sensitivity receptors of relevance to these links is therefore deemed to not be significant.
- 2.8.12 The resulting impacts related to severance for the following link identified above in Table 2.10 has been assessed to be minor adverse for the low sensitivity receptors in 2031:
- Link 41D – Fazeley Street (at Heath Mill Lane / Liverpool Street junction)
- 2.8.13 This is therefore assessed as having a minor adverse effect for this link and is not deemed to be significant.
- 2.8.14 The resulting impacts related to severance for one link has been assessed to be minor beneficial for all high, medium and low sensitivity receptors in 2031:
- Link 33 – Digbeth (B4100) / Moat Lane Gyratory
- 2.8.15 This is therefore assessed as having a minor beneficial effect for this link and is not deemed to be significant.
- 2.8.16 The resulting impacts related to severance for three links has been assessed to be moderate beneficial for the following high and medium sensitivity receptors in 2031:
- Link 3 - Moor St Queensway (between Albert Street and Masshouse Lane);
 - Link 14 – High Street Deritend (east of Milk Street); and
 - Link 15 – High St Deritend (east of Floodgate St)
- 2.8.17 This is therefore assessed as having a major beneficial effect for Link 3 and Link 14 and is deemed to be significant. Impacts on Link 15 have been assessed to have a minor beneficial effect and is not deemed to be significant.
- 2.8.18 The resulting impacts related to severance for the following link has been assessed to be major beneficial for the following low sensitivity receptors in 2031:
- Link 36 - Milk Street (directly off High Street Deritend).
- 2.8.19 This is therefore assessed as having a moderate beneficial effect for this link and is not deemed to be significant.

Mitigation

- 2.8.20 No significant adverse effects of relevance to severance have been identified as part of the above assessment therefore no additional mitigation is proposed.

Residual effects

- 2.8.21 It has been assessed that there will be no significant adverse residual effects associated with severance which will result from the operation of BEE.
- 2.8.22 Table 2.11 below provides a summary of the significant beneficial residual effects associated with fear and intimidation which will result from the operation of BEE.

Table 2.11: Residual significant beneficial effects - Severance

Link No.	Link Name	Receptors	Year of Assessment(s)	Impact Assessment
Link 3	Moor St Queensway (between Albert Street and Masshouse Lane)	High	2026	Major beneficial
Link 14	High St Deritend (east of Milk St)	High	2026/2031	Major beneficial

Driver delay

Effects (without mitigation)

- 2.8.23 The IEMA guidance suggests that Driver Delay is only likely to be significant where the traffic on the network is likely to be at or close to the capacity of the system. Detailed junction assessments undertaken as part of the TA have allowed for a comparison of junction performance and associated capacity to be made between the Do-Minimum and Do-Something scenarios in both 2026 and 2031. For the purpose of this assessment, arms which report operational capacity in excess of 85% (Degree of Saturation, DoS) have been assessed to be close to or over capacity. This is due to the fact delay begins to increase exponentially once the DoS exceeds 85% (see Transport for London Modelling Principles 2.6.1.4, 2010).
- 2.8.24 The following junction has been assessed to have at least one arm reporting operational capacity in excess of 85% in the Do-Minimum scenario (either 2026 or 2031):
- Heath Mill Lane / Liverpool Street – All Scenarios
- 2.8.25 The following junction has been assessed to have at least one arm reporting operational capacity in excess of 85% in the Do-Something scenario (either 2026 or 2031):
- Heath Mill Lane / Liverpool Street – 2026 PM, 2031 PM
- 2.8.26 The junction modelling results have identified that the Heath Mill Lane / Liverpool Street junction will operate over-capacity on at least one arm in both the Do-Minimum and Do-Something scenarios. In the Do-Something scenario a signal reconfiguration is proposed that improves capacity and improves overall junction performance, resulting primarily in reduced queue lengths, however due an increased cycle time some queue lengths do increase slightly. In all instances, the Degree of Saturation is lower in the Do-Something compared to the Do-Minimum, except in the 2031 PM scenario for Fazeley Street, which increases from 86.6% DoS to 100.4% DoS, with a corresponding queue increase from 14.2 PCU's to 29.4 PCU's.
- 2.8.27 Results from the Do-Minimum and Do-Something junction modelling are shown in Table 2.12 and Table 2.13.

Table 2.12: Heath Mill Lane / Liverpool Street DM Results

	AM 2026		AM 2031		PM 2026		PM 2031	
Movement	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
Great Barr Street	95.1	14.2	102.1	22.9	121.8	58.3	130.8	72.3
Liverpool Street	92.0	7.0	88.9	6.0	105.5	12.4	117.4	20.6

	AM 2026		AM 2031		PM 2026		PM 2031	
Heath Mill Lane	95.4	9.8	97.7	11.2	112.9	35.4	137.0	67.8
Fazeley Street	93.0	9.2	89.6	8.2	118.6	69.9	86.6	14.2
Cycle Time (s)	54		54		69		69	
Practical Reserve Capacity (%)	-6.0		-13.5		-35.4		-52.2	

Table 2.13: Heath Mill Lane / Liverpool Street DS Results

	AM 2026		AM 2031		PM 2026		PM 2031	
Movement	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
Great Barr Street	82.1	15.5	84.9	16.7	93.4	17.8	103.0	33.1
Liverpool Street	80.4	14.2	84.2	15.6	61.2	9.8	67.7	10.9
Heath Mill Lane	71.3	7.3	68.8	7.2	73.7	10.4	98.1	18.6
Fazeley Street	49.5	6.2	51.7	6.6	93.5	20.9	100.4	29.4
Cycle Time (s)	90		90		90		90	
Practical Reserve Capacity (%)	9.6		6.0		-3.9		-14.5	

- 2.8.28 The improvement in capacity and the associated potential reduction in driver delay on Great Barr Street is considered to be minor beneficial for this low sensitivity link. This is therefore assessed as having a minor beneficial effect on vehicular traffic on link 41A and is not deemed to be significant.
- 2.8.29 On Liverpool Street there is a forecast increase in queue lengths in the AM peaks, but a decrease in queue lengths in the PM peaks. However, the Degree of Saturation is forecast to reduce in all time periods. On balance this is considered to be minor beneficial for this low sensitivity link. This is therefore assessed as having a minor beneficial effect on vehicular traffic on link 41B and is not deemed to be significant.
- 2.8.30 Heath Mill Lane is forecast to result in a reduction in queuing in all time periods and is considered to be minor beneficial for this low sensitivity link. This is therefore assessed as having a minor beneficial effect on vehicular traffic on link 41C and is not deemed to be significant.
- 2.8.31 Fazeley Street is forecast to result in a reduction in queuing in all time periods except 2031 PM, where there is forecast to be an increase in queue lengths and an increase in Degree of Saturation. On balance this is therefore considered to be negligible beneficial for this low sensitivity link, and is therefore assessed as having a minor beneficial effect on vehicular traffic on link 41D and is not deemed to be significant.

Mitigation

- 2.8.32 No significant adverse effects of relevance to driver delay have been identified as part of the above assessment therefore no additional mitigation is proposed.

Residual effects

- 2.8.33 It has been assessed that there will be no significant adverse or beneficial residual effects associated with driver delay which will result from the operation of BEE.

Pedestrian amenity

Effects (without mitigation)

2.8.34 Using indicative thresholds set out within IEMA guidance, that significant changes in pedestrian amenity can be attributed to changes in traffic flow and its lorry component where it is halved or doubled, this assessment has considered changes in 24-hour AADT total flow.

2.8.35 Table 2.14 summarises the links where total traffic flows are forecast to more than double or halve in 2026 between the Do-Minimum and Do-Something scenarios.

Table 2.14: 2026 links containing 24-hour AADT traffic flow changes of more than double or half.

Link No.	Link name	Sensitivity receptor	2026 DM AADT	2026 DS AADT	% difference	Magnitude of impact
3	Moor St Queensway (between Albert Street and Masshouse Lane)	High	8,634	4,323	-50%	Moderate Beneficial
26	Dale End	High	1,612	174	-89%	Major Beneficial
36	Milk Street (directly off High Street Deritend)	Low	8,110	1,327	-84%	Major Beneficial
41B	Liverpool Street (at Heath Mill Lane / Liverpool Street junction)	Low	3,137	7,324	133%	Major Adverse
53	Bordesley St (west of junction with New Canal St)	High	2,133	4,313	102%	Major Adverse
54	Coventry St (east of Meriden St)	Low	2,413	204	-92%	Major Beneficial
55	Coventry St (west of Meriden St)	Low	2,226	71	-97%	Major Beneficial

2.8.36 Based on the above changes in total 24-hour AADT traffic flows in 2026, the resulting impact on pedestrian amenity is considered to have a major beneficial impact on the following four links:

- Link 26 – Dale End
- Link 36 – Milk Street (directly off High Street Deritend)
- Link 54 – Coventry St (east of Meriden St)
- Link 55 – Coventry St (west of Meriden St)

2.8.37 Three of the above links (link 36, 54 and 55) have been assessed to contain low sensitivity receptors. This is therefore assessed as having a moderate beneficial effect on these links and is deemed to be significant. Link 26 has been assessed to contain high sensitivity receptors. This is therefore assessed as having a major beneficial effect on this link and is deemed to be significant.

2.8.38 Based on the above changes in total 24-hour AADT traffic flows in 2026, the following resulting impact on pedestrian amenity is considered to have a moderate beneficial impact on the following links:

- Link 3 – Moor Street Queensway (between Albert Street and Masshouse Lane)

2.8.39 This link has been assessed to contain high sensitivity receptors. This is therefore assessed as having a moderate beneficial effect on this link and is deemed to be significant.

- 2.8.40 Based on the above changes in total 24-hour AADT traffic flows in 2026, the resulting impact on pedestrian amenity is considered to have a major adverse impact on the following two links:
- Link 41B – Liverpool Street (at Heath Mill Lane / Liverpool Street Junction)
 - Link 53 – Bordesley Street (west of junction with New Canal Street)
- 2.8.41 Link 41B has been assessed to contain low sensitivity receptors, meanwhile Link 53 has been assessed to contain high sensitivity receptors due to the presence of a collision cluster. This is therefore assessed as having a moderate adverse effect on Link 41B, and a major adverse effect on Link 53, and in all cases is deemed to be significant. However, as previously noted, Link 53 is also found to have a moderate beneficial impact as a result of forecast reductions in HDV numbers. Additionally, the Bordesley Street / Canal Street junction, of relevance to Link 53, will be upgraded to a fully signalised junction, which should reduce the number of collisions at this location, improving road safety. The junction will also provide formal signalised pedestrian crossings, which will improve pedestrian amenity in this area.
- 2.8.42 Existing pedestrian amenity at the junction of Liverpool Street / Heath Mill Lane provides footpaths and dropped kerbs on both sides of the road and formal pedestrian crossing facilities on three of the junction arms that are incorporated into the signal timing of the junction. Whilst it is forecast that total traffic flows on Link 41B, Liverpool Street, will increase by 133% the presence of the aforementioned amenity at this junction provides pedestrians with sufficient separation from general traffic and the provision of formal crossing facilities supports the movement of pedestrians at this location.
- 2.8.43 Taking the above into account, the scheme is likely to result in overall benefits where changes are proposed to the local highway network in terms of pedestrian amenity, or existing amenity is sufficient for pedestrian needs and therefore the impacts on these links are not deemed to be significant.
- 2.8.44 Table 2.15 summarises the links where HDV traffic flows are forecast to more than double or halve in 2026 between the Do-Minimum and Do-Something scenarios.

Table 2.15: 2026 links containing 24-hour HDV AADT traffic flow changes of more than double or half.

Link No.	Link name	Sensitivity receptor	2026 DM HDV AADT	2026 DS HDV AADT	% difference	Magnitude of impact
3	Moor St Queensway (between Albert Street and Masshouse Lane)	High	6,309	1,954	-69%	Major Beneficial
7	New Canal St (south of junction with Fazeley St)	Low	37	0	-100%	Major Beneficial
8	New Canal St (north of junction with Bordesley St)	High	37	0	-100%	Major Beneficial
9	Meriden St (between Bordesley Street and Coventry Street)	High	1	5	346%	Major Adverse
26	Dale End	High	1,612	174	-89%	Major Beneficial
36	Milk Street (directly off High Street Deritend)	Low	121	35	-71%	Major Beneficial
37	Floodgate Street (directly off High Street Deritend)	High	35	0	-100%	Major Beneficial

Link No.	Link name	Sensitivity receptor	2026 DM HDV AADT	2026 DS HDV AADT	% difference	Magnitude of impact
50	Fazeley St (east of junction with New Canal St)	Low	37	0	-100%	Major Beneficial
53	Bordesley St (west of junction with New Canal St)	High	61	27	-55%	Moderate Beneficial
54	Coventry St (east of Meriden St)	Low	35	9	-74%	Major Beneficial
55	Coventry St (west of Meriden St)	Low	19	0	-99%	Major Beneficial

2.8.45 Based on the above changes in 24-hour HDV AADT traffic flows in 2026, the resulting impact on pedestrian amenity is considered to have a major beneficial impact on the following nine links:

- Link 3 - Moor St Queensway (between Albert Street and Masshouse Lane)
- Link 7 - New Canal St (south of junction with Fazeley St)
- Link 8 - New Canal St (north of junction with Bordesley St)
- Link 26 – Dale End
- Link 36 - Milk Street (directly off High Street Deritend)
- Link 37 - Floodgate Street (directly off High Street Deritend)
- Link 50 - Fazeley St (east of junction with New Canal St)
- Link 54 - Coventry St (east of Meriden St)
- Link 55 - Coventry St (west of Meriden St)

2.8.46 All of the above links have been assessed to contain low, medium or high sensitivity receptors. This impact is therefore assessed as having a moderate to major beneficial effect on these links and is deemed to be significant.

2.8.47 Based on the above changes in 24-hour HDV AADT traffic flows in 2026, the resulting impact on pedestrian amenity is considered to have a moderate beneficial impact on the following link:

- Link 53 – Bordesley Street (west of junction with New Canal Street)

2.8.48 Link 53 has been assessed to contain high sensitivity receptors. This is therefore assessed as having a moderate beneficial effect on this link and is deemed to be significant.

2.8.49 Based on the above changes in 24-hour HDV AADT traffic flows in 2026, the resulting impact on pedestrian amenity is considered to have a major adverse impact on the following link:

- Link 9 – Meriden St (between Bordesley Street and Coventry Street)

2.8.50 Link 9 has been assessed to contain high sensitivity receptors. This is therefore assessed as having a major adverse effect on this link and is deemed to be significant. However, due to the low number of HDV reported in the Do Minimum scenario (1 HDV) the increase to five HDV is low in absolute terms and so the impact of this change has therefore been reassessed as negligible. This is therefore assessed as having a minor adverse effect on this link and is not deemed to be significant.

2.8.51 Table 2.16 summarises the links where total traffic flows are forecast to more than double or halve in 2031 between the Do-Minimum and Do-Something scenarios.

Table 2.16: 2031 links containing 24-hour AADT traffic flow changes of more than double or half

Link No.	Link name	Sensitivity receptor	2031 DM AADT	2031 DS AADT	% difference	Magnitude of severance impact
26	Dale End	High	1,612	174	-89%	Major Beneficial
52	Bordesley St (east of junction with New Canal St)	High	2,853	5,623	97%	Major Adverse
53	Bordesley St (west of junction with New Canal St)	High	2,091	4,244	103%	Major Adverse
54	Coventry St (east of Meriden St)	Low	2,674	206	-92%	Major Beneficial
55	Coventry St (west of Meriden St)	Low	2,481	71	-97%	Major Beneficial
36	Milk Street (directly off High Street Deritend)	Low	8,744	1,489	-83%	Major Beneficial
37	Floodgate Street (directly off High Street Deritend)	High	2,417	479	-80%	Major Beneficial
41B	Liverpool Street (at Heath Mill Lane / Liverpool Street junction)	Low	3,454	7,630	121%	Major Adverse

2.8.52 Based on the above changes in total 24-hour AADT traffic flows in 2031, the resulting impact on pedestrian amenity is considered to have a major beneficial impact on the following five links:

- Link 26 – Dale End
- Link 37 – Floodgate Street (Directly off High Street Deritend)
- Link 36 – Milk Street (Directly off High Street Deritend)
- Link 54 – Coventry Street (East of Meriden Street)
- Link 55 – Coventry Street (West of Meriden Street)

2.8.53 All of the above links have been assessed to contain low or high sensitivity receptors. This is therefore assessed as having a moderate to major beneficial effect on these links and is deemed to be significant.

2.8.54 Based on the above changes in total 24-hour AADT traffic flows in 2031, the resulting impact on pedestrian amenity is considered to have a major adverse impact on the following three links:

- Link 41B – Liverpool Street (at Heath Mill Lane / Liverpool Street Junction)
- Link 52 – Bordesley Street (east of junction with New Canal St)
- Link 53 – Bordesley Street (west of junction with New Canal Street)

2.8.55 Link 41B has been assessed to contain low sensitivity receptors, meanwhile Link 52 and 53 has been assessed to contain high sensitivity receptors due to the presence of a collision cluster. This is therefore assessed as having a moderate adverse effect on Link 41B, and a major adverse effect on Link 52 and 53, and in all cases is deemed to be significant. However, as

noted below, Link 53 is also found to have a moderate beneficial impact as a result of forecast reductions in HDV numbers. Additionally, the Bordesley Street / Canal Street junction, of relevance to Link 52 and 53, will be upgraded to a fully signalised junction, which should reduce the number of collisions at this location, improving road safety. The junction will also provide formal signalised pedestrian crossings, which will improve pedestrian amenity in this area.

- 2.8.56 Existing pedestrian facility at the junction of Liverpool Street / Heath Mill Lane provides footpaths and dropped kerbs on both sides of the road and formal pedestrian crossing facilities on three of the junction arms that are incorporated into the signal timing of the junction. Whilst it is forecast that total traffic flows on Link 41B, Liverpool Street, will increase by 133% the presence of the aforementioned facility at this junction provides pedestrians with sufficient separation from general traffic and the provision of formal crossing facilities supports the movement of pedestrians at this location.
- 2.8.57 Taking the above into account, the scheme is likely to result in overall benefits where changes are proposed to the local highway network in terms of pedestrian amenity, or existing amenity is sufficient for pedestrian's needs and therefore the impacts on these links are not deemed to be significant.
- 2.8.58 Table 2.17 summarises the links where HDV traffic flows are forecast to more than double or halve in 2031 between the Do-Minimum and Do-Something scenarios.

Table 2.17: 2031 links containing 24-hour HDV AADT traffic flow changes of more than double or half

Link No.	Link name	Sensitivity receptor	2031 DM AADT	2031 DS AADT	% difference	Magnitude of impact
3	Moor St Queensway (between Albert Street and Masshouse Lane)	High	6,317	1,955	-69%	Major Beneficial
9	Meriden St (between Bordesley Street and Coventry Street)	High	1	2	102%	Major Adverse
7	New Canal St (south of junction with Fazeley St)	Low	39	- 0	-100%	Major Beneficial
8	New Canal St (north of junction with Bordesley St)	High	39	- 0	-100%	Major Beneficial
26	Dale End	High	1,612	174	-89%	Major Beneficial
36	Milk Street (directly off High Street Deritend)	Low	127	36	-71%	Major Beneficial
37	Floodgate Street (directly off High Street Deritend)	High	36	-	-100%	Major Beneficial
50	Fazeley St (east of junction with New Canal St)	Low	39	-	-100%	Major Beneficial
53	Bordesley St (west of junction with New Canal St)	High	63	26	-58%	Moderate Beneficial
54	Coventry St (east of Meriden St)	Low	35	9	-73%	Major Beneficial
55	Coventry St (west of Meriden St)	Low	19	0	-99%	Major Beneficial

- 2.8.59 Based on the above changes in 24-hour HDV AADT traffic flows in 2031, the resulting impact on pedestrian amenity is considered to have a major beneficial impact on the following nine links:
- Link 3 - Moor St Queensway (between Albert Street and Masshouse Lane)
 - Link 7 - New Canal St (south of junction with Fazeley St)
 - Link 8 - New Canal St (north of junction with Bordesley St)
 - Link 26 – Dale End
 - Link 36 - Milk Street (directly off High Street Deritend)
 - Link 37 - Floodgate Street (directly off High Street Deritend)
 - Link 50 - Fazeley St (east of junction with New Canal St)
 - Link 54 - Coventry St (east of Meriden St)
 - Link 55 - Coventry St (west of Meriden St)
- 2.8.60 All of the above links have been assessed to contain low or high sensitivity receptors. This impact is therefore assessed as having a moderate to major beneficial effect on these links and is deemed to be significant.
- 2.8.61 Based on the above changes in 24-hour HDV AADT traffic flows in 2031, the resulting impact on pedestrian amenity is considered to have a moderate beneficial impact on the following links:
- Link 53 – Bordesley Street (west of junction with New Canal Street)
- 2.8.62 This link has been assessed to contain high sensitivity receptors. This is therefore assessed as having a moderate beneficial effect on this link and is deemed to be significant.
- 2.8.63 Based on the above changes in 24-hour HDV AADT traffic flows in 2031, the resulting impact on pedestrian amenity is considered to have a major adverse impact on the following link:
- Link 9 – Meriden St (between Bordesley Street and Coventry Street)
- 2.8.64 The above link has been assessed to contain high sensitivity receptors. This is therefore assessed as having a major adverse effect on this link and is deemed to be significant. However, due to the low number of HDVs reported in the Do Minimum scenario (one HDV) the increase to two HDV is low in absolute terms and so the impact of this change has therefore been reassessed to be negligible. This is therefore assessed as having a minor adverse effect on this link and is not deemed to be significant.
- 2.8.65 Also of relevance to the consideration of potential impacts on pedestrian amenity within the study area are locations where footpath widths are required to be narrowed in order to accommodate the centre line running of the tram. Section 11.4.4 of the TA shows the Pedestrian Comfort Level (PCL) of the proposed footway widths once the BEE is implemented.
- 2.8.66 There are no specific criteria set out in the IEMA guidance relating to the assessment of pedestrian amenity (apart from consideration of whether traffic flows change by +/- 50%). The assessment of proposed footway widths is therefore based upon the Transport for London (TfL) Pedestrian Comfort Guidance (2010) document which categorises the comfort level of a footway from the calculated pedestrians per minute across a width of clear footway (see section 11.4.4 of ES Volume 2 Technical Appendix L2 for more detail).
- 2.8.67 The assessment concludes that all but one of the proposed footway widths to operate with an acceptable PCL (as set out in the TfL, 2010 guidance). The pedestrian footway on the eastern side of High Street has a PCL rating 'B', which indicates normal walking speed is still possible but conflicts are becoming more frequent, and in retail areas people start to consider avoiding the area. The footway width at this location is unable to be significantly widened due to physical

constraints of the delta junction. There is significant pedestrian amenity in this location though to offset this impact, with several wide signalised pedestrian crossings and wide footways on the opposite side of the track alignment.

- 2.8.68 The resulting impact on pedestrian amenity as a result of changes in footway width is considered to be negligible adverse for all high, medium and low sensitivity links where these changes occur. This impact is therefore assessed as having a minor adverse effect on pedestrians and is not deemed to be significant.

Mitigation

- 2.8.69 No further significant adverse effects of relevance to driver delay have been identified as part of the above assessment therefore no additional mitigation is proposed.

Residual effects

- 2.8.70 It has been assessed that there will be no significant adverse residual effects associated with pedestrian amenity which will result from the operation of BEE.
- 2.8.71 Table 2.18 below provides a summary of the significant beneficial residual effects associated with pedestrian amenity which will result from the operation of BEE.

Table 2.18: Residual significant beneficial effects – Pedestrian Amenity

Link No.	Link Name	Receptors	Year of Assessment(s)	Magnitude of Impact
Link 36	Milk Street (directly off High Street Deritend)	Low	2026/2031	Major beneficial
Link 54	Coventry St (east of Meriden St)	Low	2026/2031	Major beneficial
Link 55	Coventry St (west of Meriden St)	Low	2026/2031	Major beneficial
Link 3	Moor St Queensway (between Albert Street and Masshouse Lane)	High	2026/2031	Moderate beneficial
Link 7	New Canal St (south of junction with Fazeley St)	Low	2026/2031	Major beneficial
Link 8	New Canal St (north of junction with Bordesley St)	High	2026/2031	Major beneficial
Link 26	Dale End	High	2026/2031	Major beneficial
Link 37	Floodgate Street (directly off High Street Deritend)	High	2026/2031	Major beneficial
Link 50	Fazeley St (east of junction with New Canal St)	Low	2026/2031	Major beneficial
Link 53	Bordesley St (west of junction with New Canal St)	High	2031	Moderate beneficial

Fear and intimidation

Effects (without mitigation)

- 2.8.72 Table 2.19 reports changes in 18-hour AAWT traffic flow and composition between the 2026 Do-Minimum and 2026 Do-Something scenarios and assesses the potential impact on pedestrian's perception and experience of fear and intimidation based on the criteria identified above.
- 2.8.73 An assessment of the magnitude of impact for each link has been based on either changes in total flow over an average hour or changes in HGV% over an 18-hour week day, which has allowed the final assessment of effect to be based on a robust case scenario.
- 2.8.74 With reference to the average speeds on links over 18-hour week days, the majority - if not all links would have an average vehicle speed in excess of 20mph, which would be considered an extreme hazard for all links within this study area. For this reason, no consideration will be given to changes in vehicles speeds and their impact on fear and intimidation for links within the study area in order to be consistent with the 2016 ES assessment.

Table 2.19: Change in 18-hour AAWT (2026) between DM and DS and magnitude of fear and intimidation impact.

							Do Minimum Degree of Hazard Assessment		Do Something Degree of Hazard Assessment		Magnitude of Impact		% change between Do Minimum and Do Something	
Link No.	Link name	Link sensitivity	2026 DM two way average hour	2026 DS two way average hour	2026 DM 18 hour AAWT (HGV)	2026 DS 18 hour AAWT (HGV)	Average traffic flow over 18 hour day (vehicle/hour)	Total 18 hour HGV flow	Average traffic flow over 18 hour day (vehicle/hour)	Total 18 hour HGV flow	Average traffic flow over 18 hour day (vehicle/hour)	Total 18 hour HGV flow	Average traffic flow over 18 hour day (vehicle/hour)	Total 18 hour HGV flow
			(18 hour week day)	(18 hour week day)										
1	Lower Bull Street	High	50	67	899	1,211	Small	Small	Small	Moderate	No Change	Moderate Adverse	35%	35%
2	Albert St (DM) / New Alignment (DS)	Low	217	229	1,425	1,588	Small	Moderate	Small	Moderate	No Change	No Change	5%	11%
3	Moor St Queensway (between Albert Street and Masshouse Lane)	High	439	234	5,427	1,680	Small	Extreme	Small	Moderate	No Change	Major Beneficial	-47%	-69%
4	Moor St Queensway (between Albert Street and Carers Lane)	High	269	221	4,834	3,987	Small	Extreme	Small	Extreme	No Change	No Change	-18%	-18%
5	New Canal St to Curzon Street	Medium	DS Link	17	DS Link	312	n/a	n/a	Small	Small	n/a	n/a	N/A	N/A
6	New Canal St (north of junction with Fazeley St)	Medium	DS Link	17	DS Link	312	n/a	n/a	Small	Small	n/a	n/a	N/A	N/A
7	New Canal St (south of junction with Fazeley St)	Low	339	351	32	0	Small	Small	Small	Small	No Change	No Change	3%	-100%
8	New Canal St (north of junction with Bordesley St)	Low	339	351	32	0	Small	Small	Small	Small	No Change	No Change	3%	-100%
9	Meriden St (between Bordesley Street and Coventry Street)	Low	276	329	1	4	Small	Small	Small	Small	No Change	No Change	19%	359%
10	Meriden St (north of Digbeth B4100)	Low	287	337	14	12	Small	Small	Small	Small	No Change	No Change	17%	-15%
11	Digbeth B4100 (east of Meriden St)	Medium	1177	1212	4,643	4,554	Moderate	Extreme	Great	Extreme	Negligible Adverse	No Change	3%	-2%
12	Digbeth B4100 (west of Rea St)	Medium	1140	1196	4,031	4,246	Moderate	Extreme	Moderate	Extreme	No Change	No Change	5%	5%
13	High St Deritend (west of Milk St)	Medium	816	850	3,222	3,412	Moderate	Extreme	Moderate	Extreme	No Change	No Change	4%	6%
14	High St Deritend (east of Milk St)	High	1255	781	3,327	3,442	Great	Extreme	Moderate	Extreme	Moderate Beneficial	No Change	-38%	3%
15	High St Deritend (east of Floodgate St)	Low	1335	781	3,357	3,442	Great	Extreme	Moderate	Extreme	Moderate Beneficial	No Change	-41%	3%
16	High Street Deritend (east of Heath Mill Lane)	Medium	1426	965	2,603	2,448	Great	Great	Moderate	Great	Moderate Beneficial	No Change	-32%	-6%
17	High Street Deritend (east of Alcester St)	Medium	1559	1299	2,876	2,813	Great	Great	Great	Great	No Change	No Change	-17%	-2%
18	High St Deritend (east of Adderley St)	Low	1555	1184	2,148	2,046	Great	Great	Moderate	Great	Minor Beneficial	No Change	-24%	-5%
19	PT Interchange (Do Something only)	High	DS Link	51	DS Link	927	n/a	n/a	Small	Small	n/a	n/a	N/A	N/A
Minor and offline Links														
25	Carrs Lane and High Street	High	134	132	2,421	1,986	Small	Great	Small	Moderate	No Change	Minor Beneficial	-2%	-18%
26	Dale End	High	77	8	1,386	150	Small	Moderate	Small	Small	No Change	Major Beneficial	-89%	-89%
27	Moor Street Queensway (between Masshouse Lane and B4114 James Watt Queensway)	High	601	611	3,055	3,086	Moderate	Extreme	Moderate	Extreme	No Change	No Change	2%	1%
28	Priory Queensway	Low	107	107	1,918	1,918	Small	Moderate	Small	Moderate	No Change	No Change	0%	0%
29	Jennens Road	High	366	366	2,082	2,081	Small	Great	Small	Great	No Change	No Change	0%	0%
30	B4114 James Watt Queensway	High	624	654	1,391	1,365	Moderate	Moderate	Moderate	Moderate	No Change	No Change	5%	-2%
31	Park Street	High	225	225	2,283	2,282	Small	Great	Small	Great	No Change	No Change	0%	0%

							Do Minimum Degree of Hazard Assessment		Do Something Degree of Hazard Assessment		Magnitude of Impact		% change between Do Minimum and Do Something	
32	Masshouse Lane	Low	544	516	4,523	3,908	Small	Extreme	Small	Extreme	No Change	No Change	-5%	-14%
50	Fazeley St (east of junction with New Canal St)	Low	339	334	32	0	Small	Small	Small	Small	No Change	No Change	-2%	-100%
51	Fazeley St (west of junction with New Canal St)	Low					Small	Small	Small	Small	No Change	No Change		
52	Bordesley St (east of junction with New Canal St)	Low	172	333	21	28	Small	Small	Small	Small	No Change	No Change	94%	31%
53	Bordesley St (west of junction with New Canal St)	Low	126	256	52	24	Small	Small	Small	Small	No Change	No Change	103%	-55%
54	Coventry St (east of Meriden St)	Low	143	12	30	8	Small	Small	Small	Small	No Change	No Change	-92%	-74%
55	Coventry St (west of Meriden St)	Low	132	4	17	0	Small	Small	Small	Small	No Change	No Change	-97%	-99%
33	Digbeth (B4100) / Moat Lane Gyratory	Medium	1022	1095	4,315	4,237	Moderate	Extreme	Moderate	Extreme	No Change	No Change	7%	-2%
34	Oxford Street (directly off Digbeth B4100)	Low	130	163	38	48	Small	Small	Small	Small	No Change	No Change	25%	28%
35	Rea Street (directly off Digbeth B4100)	Low	581	600	1,302	1,274	Small	Moderate	Moderate	Moderate	Negligible Adverse	No Change	3%	-2%
36	Milk Street (directly off High Street Deritend)	Low	480	78	104	30	Small	Small	Small	Small	No Change	No Change	-84%	-71%
37	Floodgate Street (directly off High Street Deritend)	High	130	108	30	0	Small	Small	Small	Small	No Change	No Change	-17%	-100%
38	Heath Mill Lane (directly off High Street Deritend)	Medium	302	281	757	683	Small	Small	Small	Small	No Change	No Change	-7%	-10%
39	Alcester Street (directly off High Street Deritend)	Medium	576	531	323	369	Small	Small	Small	Small	No Change	No Change	-8%	14%
40	Adderley Street (directly off High Street Deritend)	Low	230	291	232	230	Small	Small	Small	Small	No Change	No Change	26%	-1%
41A	Great Barr Street (at Heath Mill Lane / Liverpool Street junction)	Low	851	853	799	646	Moderate	Small	Moderate	Small	No Change	No Change	0%	-19%
41B	Liverpool Street (at Heath Mill Lane / Liverpool Street junction)	Low	185	433	74	104	Small	Small	Small	Small	No Change	No Change	134%	41%
41C	Heath Mill Lane (at Heath Mill Lane / Liverpool Street junction)	Low	456	461	256	184	Small	Small	Small	Small	No Change	No Change	1%	-28%
41D	Fazeley Street (at Heath Mill Lane / Liverpool Street junction)	Low	709	984	530	570	Moderate	Small	Moderate	Small	No Change	No Change	39%	7%

- 2.8.75 Of the forty-five links assessed, thirty two reported no change in the Degree of Hazard classification for both the average hour 18-hour AAWT and 18-hour AAWT HDV categories following the introduction of BEE as shown in Table 2.19. The resulting impacts of relevance to fear and intimidation are not deemed to be significant for all high, medium and low sensitivity pedestrian receptors on these links.
- 2.8.76 For the remaining links that report a change in Degree of Hazard classification, the following two links have reported a minor beneficial change in one of more categories for the Degree of Hazard classification:
- Link 18 – High St Deritend (east of Adderley St)
 - Link 25 – Carrs Lane and High Street
- 2.8.77 The resulting impact of relevance to fear and intimidation is considered to be minor beneficial for the low and high sensitivity receptors. This is therefore assessed as having a minor beneficial effect on these links and is not deemed to be significant.
- 2.8.78 The resulting impact on fear and intimidation is considered to have a moderate beneficial impact on the following three links:
- Link 14 - High St Deritend (east of Milk St)
 - Link 15 - High St Deritend (east of Floodgate St)
 - Link 16 - High Street Deritend (east of Heath Mill Lane)
- 2.8.79 The resulting impact of relevance to fear and intimidation is considered to be moderate beneficial for the low sensitivity receptors associated with Link 15. This is therefore assessed as having a minor beneficial effect on this link and is not deemed to be significant.
- 2.8.80 The resulting impact of relevance to fear and intimidation is considered to be moderate beneficial for the medium and high sensitivity receptors associated with links 14 and 16. This is therefore assessed as having a moderate beneficial effect on these links and is deemed to be significant.
- 2.8.81 The resulting impact on fear and intimidation is considered to have a moderate beneficial impact on the following two links:
- Link 3 - Moor St Queensway (between Albert Street and Masshouse Lane)
 - Link 6 - New Canal St (north of junction with Fazeley St)
- 2.8.82 The resulting impact of relevance to fear and intimidation is considered to be major beneficial for the medium and high sensitivity receptors associated with Link 3 and 6. This is therefore assessed as having a major beneficial effect on these links and is deemed to be significant.
- 2.8.83 The resulting impact on fear and intimidation is considered to have a negligible adverse impact on the following two links:
- Link 11 – Digbeth B4100 (east of Meriden St)
 - Link 35 – Rea Street (directly off Digbeth B4100)
- 2.8.84 The resulting impact of relevance to fear and intimidation is considered to be negligible adverse for the low and medium sensitivity receptors associated with these links. This is therefore assessed as having a negligible or minor adverse effect on these links and is not deemed to be significant.
- 2.8.85 Link 1, at Lower Bull Street reports an overall adverse change in the Degree of Hazard classification has been reported as a result of changes in total 18-hour HGV flow associated

with BEE. The classification for this link reports a change from a Small to a Moderate Degree of Hazard, with a 35% increase in HDVs being forecast associated with the introduction of trams along this link.

- 2.8.86 The existing pedestrian amenity of Lower Bull Street provides pedestrians with wide footways which are segregated from the existing bus and taxi only highway. Uncontrolled pedestrian crossing points are provided along Lower Bull Street with a controlled crossing provided at the junction with Corporation Street. As part of the proposals to introduce BEE along this road pedestrians will continue to be provided with footways on both sides of the highway and will see the introduction of an additional controlled crossing point near to the Lower Bull Street junction with High Street. Pedestrian amenity will remain broadly unchanged along this section of road and as a result it is considered probable that the increases in HDVs associated with new tram movements will have a very minor impact on pedestrian perception of journey pleasantness, particularly as the link is currently already dominated buses. The resulting impact of relevance to fear and intimidation is therefore considered to be minor adverse for high sensitivity receptors associated with Link 1. This is therefore assessed as having a minor adverse effect on this link and is not deemed to be significant.
- 2.8.87 Table 2.20 reports changes in 18-hour AAWT traffic flow, composition and vehicle speed between the 2031 Do-Minimum and 2031 Do-Something scenarios and assesses the potential impact on pedestrian's perception and experience of fear and intimidation based on the criteria identified above.

Table 2.20: Change in 18-hour AAWT (2031) between DM and DS and magnitude of fear and intimidation impact

			Do Minimum Degree of Hazard Assessment				Do Something Degree of Hazard Assessment		Do Minimum vs Do Something Degree of Hazard Assessment		% change between Do Minimum and Do Something			
Link No.	Link name	Link sensitivity	2031 DM two way average hour	2031 DS two way average hour	2031 DM 18 hour AAWT (HGV)	2031 DS 18 hour AAWT (HGV)	Average traffic flow over 18 hour day (vehicle/hour)	Total 18 hour HGV flow	Average traffic flow over 18 hour day (vehicle/hour)	Total 18 hour HGV flow	Average traffic flow over 18 hour day (vehicle/hour)	Total 18 hour HGV flow	Average traffic flow over 18 hour day (vehicle/hour)	Total 18 hour HGV flow
			(18 hour week day)	(18 hour week day)										
1	Lower Bull Street	High	50	67	899	1,211	Small	Small	Small	Moderate	No Change	Moderate Adverse	35%	35%
2	Albert St (DM) / New Alignment (DS)	Low	222	235	1,431	1,589	Small	Moderate	Small	Moderate	No Change	No Change	6%	11%
3	Moor St Queensway (between Albert Street and Masshouse Lane)	High	444	308	5,433	1,681	Small	Extreme	Small	Moderate	No Change	Major Beneficial	-31%	-69%
4	Moor St Queensway (between Albert Street and Carrs Lane)	High	269	222	4,834	3,987	Small	Extreme	Small	Extreme	No Change	No Change	-18%	-18%
5	New Canal St to Curzon Street	Medium	DS Link	17	DS Link	312	n/a	n/a	Small	Small	n/a	n/a	n/a	n/a
6	New Canal St (north of junction with Fazeley St)	Medium	DS Link	17	DS Link	312	n/a	n/a	Small	Small	n/a	n/a	n/a	n/a
7	New Canal St (south of junction with Fazeley St)	Low	340	321	33	0	Small	Small	Small	Small	No Change	No Change	-5%	-100%
8	New Canal St (north of junction with Bordesley St)	High	340	321	33	0	Small	Small	Small	Small	No Change	No Change	-5%	-100%
9	Meriden St (between Bordesley Street and Coventry Street)	High	276	325	1	2	Small	Small	Small	Small	No Change	No Change	18%	115%
10	Meriden St (north of Digbeth B4100)	Low	287	317	15	10	Small	Small	Small	Small	No Change	No Change	10%	-32%
11	Digbeth B4100 (east of Meriden St)	Medium	1196	1129	4,659	4,564	Moderate	Extreme	Moderate	Extreme	No Change	No Change	-6%	-2%
12	Digbeth B4100 (west of Rea St)	Medium	1160	1102	4,046	4,246	Moderate	Extreme	Moderate	Extreme	No Change	No Change	-5%	5%
13	High St Deritend (west of Milk St)	Medium	875	769	3,243	3,422	Moderate	Extreme	Moderate	Extreme	No Change	No Change	-12%	6%
14	High St Deritend (east of Milk St)	High	1355	815	3,352	3,453	Great	Extreme	Moderate	Extreme	Moderate Beneficial	No Change	-40%	3%
15	High St Deritend (east of Floodgate St)	Low	1449	815	3,383	3,453	Great	Extreme	Moderate	Extreme	Moderate Beneficial	No Change	-44%	2%
16	High Street Deritend (east of Heath Mill Lane)	Medium	1514	1008	2,621	2,457	Great	Great	Moderate	Great	Moderate Beneficial	No Change	-33%	-6%
17	High Street Deritend (east of Alcester St)	Medium	1613	1339	2,905	2,844	Great	Great	Great	Great	No Change	No Change	-17%	-2%
18	High St Deritend (east of Adderley St)	Low	1592	1214	2,163	2,077	Great	Great	Great	Great	No Change	No Change	-24%	-4%
19	PT Interchange (Do Something only)	High	DS Link	52	DS Link	927	n/a	n/a	Small	Small	n/a	n/a	n/a	n/a
Minor and offline Links														
25	Carrs Lane and High Street	High	135	132	2,421	1,986	Small	Great	Small	Moderate	No Change	Minor Beneficial	-2%	-18%
26	Dale End	High	77	8	1,386	150	Small	Moderate	Small	Small	No Change	Major Beneficial	-89%	-89%

							Do Minimum Degree of Hazard Assessment		Do Something Degree of Hazard Assessment		Do Minimum vs Do Something Degree of Hazard Assessment		% change between Do Minimum and Do Something	
27	Moor Street Queensway (between Masshouse Lane and B4114 James Watt Queensway)	High	616	612	3,068	3,094	Moderate	Extreme	Moderate	Extreme	No Change	No Change	-1%	1%
28	Priory Queensway	Low	107	107	1,918	1,918	Small	Moderate	Small	Moderate	No Change	No Change	0%	0%
29	Jennens Road	High	371	371	2,088	2,088	Small	Great	Small	Great	No Change	No Change	0%	0%
30	B4114 James Watt Queensway	High	642	666	1,404	1,374	Moderate	Moderate	Moderate	Moderate	No Change	No Change	4%	-2%
31	Park Street	High	230	230	2,289	2,289	Small	Great	Small	Great	No Change	No Change	0%	0%
32	Masshouse Lane	Low	555	444	4,530	3,915	Small	Extreme	Small	Extreme	No Change	No Change	-20%	-14%
50	Fazeley St (east of junction with New Canal St)	Low	340	220	33	0	Small	Small	Small	Small	No Change	No Change	-35%	-100%
51	Fazeley St (west of junction with New Canal St)	Low	0	0	0	0	Small	Small	Small	Small	No Change	No Change	n/a	n/a
52	Bordesley St (east of junction with New Canal St)	High	169	333	22	25	Small	Small	Small	Small	No Change	No Change	97%	13%
53	Bordesley St (west of junction with New Canal St)	High	123	252	54	22	Small	Small	Small	Small	No Change	No Change	104%	-58%
54	Coventry St (east of Meriden St)	Low	158	12	30	8	Small	Small	Small	Small	No Change	No Change	-92%	-73%
55	Coventry St (west of Meriden St)	Low	147	4	17	0	Small	Small	Small	Small	No Change	No Change	-97%	-99%
33	Digbeth (B4100) / Moat Lane Gyratory	Medium	1040	802	4,329	4,161	Moderate	Extreme	Moderate	Extreme	No Change	No Change	-23%	-4%
34	Oxford Street (directly off Digbeth B4100)	Low	129	162	38	60	Small	Small	Small	Small	No Change	No Change	26%	56%
35	Rea Street (directly off Digbeth B4100)	Low	587	554	1,307	1,287	Small	Moderate	Small	Moderate	No Change	No Change	-6%	-2%
36	Milk Street (directly off High Street Deritend)	Low	518	88	109	31	Small	Small	Small	Small	No Change	No Change	-83%	-71%
37	Floodgate Street (directly off High Street Deritend)	High	143	28	31	0	Small	Small	Small	Small	No Change	No Change	-80%	-100%
38	Heath Mill Lane (directly off High Street Deritend)	Medium	314	287	763	687	Small	Small	Small	Small	No Change	No Change	-9%	-10%
39	Alcester Street (directly off High Street Deritend)	Medium	619	547	335	391	Moderate	Small	Small	Small	Minor Beneficial	No Change	-12%	17%
40	Adderley Street (directly off High Street Deritend)	Low	243	300	231	233	Small	Small	Small	Small	No Change	No Change	23%	1%
41A	Great Barr Street (at Heath Mill Lane / Liverpool Street junction)	Low	865	870	826	667	Moderate	Small	Moderate	Small	No Change	No Change	1%	-19%
41B	Liverpool Street (at Heath Mill Lane / Liverpool Street junction)	Low	204	452	77	98	Small	Small	Small	Small	No Change	No Change	121%	28%
41C	Heath Mill Lane (at Heath Mill Lane / Liverpool Street junction)	Low	474	481	264	189	Small	Small	Small	Small	No Change	No Change	1%	-28%
41D	Fazeley Street (at Heath Mill Lane / Liverpool Street junction)	Low	725	1000	548	581	Moderate	Small	Moderate	Small	No Change	No Change	38%	6%

- 2.8.88 Of the forty-five links assessed, thirty four reported no change in the Degree of Hazard classification for both the average hour 18-hour AAWT and 18-hour AAWT HDV categories following the introduction of BEE as shown in Table 2.20. The resulting impacts of relevance to fear and intimidation are not considered significant for all high, medium and low sensitivity pedestrian receptors on these links.
- 2.8.89 For the remaining links that report a change in Degree of Hazard classification, the following seven links have reported a beneficial change in either one of more categories for the Degree of Hazard classification:
- Link 3 – Moor St Queensway (between Albert Street and Masshouse Lane)
 - Link 14 – High St Deritend (east of Milk St)
 - Link 15 – High St Deritend (east of Floodgate St)
 - Link 16 – High Street Deritend (east of Heath Mill Lane)
 - Link 25 – Carrs Lane and High Street
 - Link 26 – Dale End
 - Link 39 – Alcester Street (directly off High Street Deritend)
- 2.8.90 All of the above links report between a reduction in either average hour 18-hour AAWT or total 18-hour HGV flow of between 12 and 89%.
- 2.8.91 The resulting impact of relevance to fear and intimidation is considered to be minor beneficial for high sensitivity receptors associated with Link 25 and the medium sensitivity receptors associated with Link 39. This is therefore assessed as having a minor beneficial effect on these links and is not deemed to be significant.
- 2.8.92 The resulting impact of relevance to fear and intimidation is considered to be major beneficial for high sensitivity receptors associated with Link 26. This is therefore assessed as having a minor beneficial effect on these links and is deemed to be significant.
- 2.8.93 The resulting impact of relevance to fear and intimidation is considered to be moderate beneficial for the low, medium and high sensitivity receptors associated with Links 14, 15 and 16. This is therefore assessed as having a moderate beneficial effect on Links 14 and 16 and is deemed to be significant, with Link 15 being assessed as having a minor beneficial effect and is not deemed to be significant.
- 2.8.94 The resulting impact of relevance to fear and intimidation is considered to be minor beneficial for the medium sensitivity receptors associated with Link 39. This is therefore assessed as having a minor beneficial effect on this link and is not deemed to be significant.
- 2.8.95 The resulting impact of relevance to fear and intimidation is considered to be major beneficial for high sensitivity receptors associated with Link 3. This is therefore assessed as having a major beneficial effect on Link 3 and is deemed to be significant.
- 2.8.96 Link 1, at Lower Bull Street, is the only link to be assessed where an overall adverse change in the Degree of Hazard classification has been reported as a result of changes in total 18-hour HGV flow associated with BEE. The classification for this link reports a change from a Small to a Moderate Degree of Hazard, with a 38% increase in HGVs being forecast associated with the introduction of trams along this link.
- 2.8.97 As described for the analysis of changes in 2026, pedestrian amenity will remain broadly unchanged along this section of road and as a result it is considered probable that the increases in HGVs associated with new tram movements will have a very minor impact on pedestrian

perception of journey pleasantness, particularly as the link is currently already dominated buses. The resulting impacts of relevance to fear and intimidation is considered to be minor adverse for high sensitivity receptors associated with Link 1. This is therefore assessed as having a minor adverse effect on this link and is not deemed to be significant.

Mitigation

- 2.8.98 As detailed above, it is assessed that the retention of existing amenity will be sufficient to ensure that no pedestrians are not adversely effected as a result of changes in traffic composition of Lower Bull Street and no further mitigation is required.
- 2.8.99 No further significant adverse effects of relevance to fear and intimidation have been identified as part of the above assessment therefore no additional mitigation is proposed.

Residual effects

- 2.8.100 It has been assessed that, following mitigation, there will be no significant adverse residual effects associated with fear and intimidation during the construction period.
- 2.8.101 Table 2.21 below provides a summary of the significant beneficial residual effects associated with fear and intimidation which will result from the operation of BEE.

Table 2.21: Residual significant beneficial effects – Fear and intimidation

Link No.	Link Name	Receptors	Year of Assessment(s)	Magnitude of Impact
Link 14	High St Deritend (east of Milk St)	High	2026	Moderate beneficial
Link 16	High Street Deritend (east of Heath Mill Lane)	Medium	2026	Moderate beneficial
Link 3	Moor St Queensway (between Albert Street and Masshouse Lane)	High	2026/2031	Major beneficial
Link 6	New Canal St (north of junction with Fazeley St)	Medium	2026	Major beneficial
Link 26	Dale End	High	2031	Major beneficial

Accidents and safety

Effects (without mitigation)

- 2.8.102 Where existing collision clusters have been identified consideration has been given to whether changes in AADT traffic flow between the Do-Minimum and Do-Something could have the potential to have an adverse or beneficial impact on accidents and safety. Consideration has also been given to the causation factors associated with these collisions and whether changes to junction form or traffic flow composition will have an impact on accidents and safety.
- 2.8.103 Changes in 24-hour AADT total traffic flow for links relevant to the existing collision cluster identified at Moor Street Queensway/Park Street are summarised in Table 2.22 below.

Table 2.22: Change in AADT between DM and DS in 2026 and 2031 at Moor Street Queensway/ Park Street

Link No.	Link description	2026 DM to DS % change in 24 hr AADT	Absolute change 2026 (vehicles)	2031 DM to DS % change in 24 hr AADT	Absolute change 2031 (vehicles)
27	Moor Street Queensway (between Masshouse Lane and Park Street)	2%	177	-1%	-62
29	A47 Jennens Road	0%	-9	0%	0
30	B4114 James Watt Queensway	5%	510	3%	389
31	B4114 Park Street	0%	-8	0%	-1

- 2.8.104 The changes in AADT reveal that the introduction of the BEE at the junction of Moor Street Queensway/Park Street will result in a minor increase in traffic flows passing through the junction in between the DM and DS scenarios in 2026 and 2031. The majority of collisions at this cluster can be attributed to slight collisions or driver error. The potential impact on this pattern of collision causation is unlikely to be altered significantly as a result of small changes in total AADT arriving at this junction, which represent a 2% increase in total junction flow in 2026, and a 1% increase in 2031.
- 2.8.105 The resulting impact on safety and accidents on the existing collision cluster at Moor Street Queensway/Park Street is considered to be minor adverse for these high sensitivity links. This is therefore assessed as having a negligible adverse effect on Links 27, 29, 30 and 31 and is not deemed to be significant.
- 2.8.106 Changes in 24-hour AADT total traffic flow for links relevant to the existing collision cluster identified at Moor Street Queensway/Albert Street are summarised in Table 2.23 below.

Table 2.23: Change in AADT between DM and DS in 2026 and 2031 at Moor Street Queensway/Albert Street

Link No.	Link Description	2026 DM to DS % change in 24 hr AADT	Absolute change 2021 (vehicles)	2031 DM to DS % change in 24 hr AADT	Absolute change 2031 (vehicles)
3	Moor St Queensway (between Albert Street and Masshouse Lane)	-50%	-4,312	-36%	-3,146
4	Moor St Queensway (between Albert Street and Carrs Lane)	-18%	-985	-18%	-985

- 2.8.107 As a result of the introduction of the BEE, Moor Street Queensway near its junction with Albert Street will experience a moderate reduction in AADT as a result of proposals to make Moor Street Queensway bus only between Carrs Lane and Albert Street in 2026. The impact of the tram also reduces capacity around this junction and traffic is seen to re-route as a result.
- 2.8.108 This reduction in traffic flow may not, however, alter the pattern of collision causation in this area which was mainly attributed to either pedestrians or drivers failing to look properly and is not necessarily influenced by the junction form or the level of traffic in this area.

- 2.8.109 The resulting impact on accidents and safety on the existing collision cluster at Moor Street Queensway/Albert Street is considered to be minor beneficial for these high sensitivity links. This is therefore assessed as having a minor beneficial effect on links 3 and 4 and is not deemed to be significant.
- 2.8.110 Changes in 24-hour AADT total traffic flow for links relevant to the existing collision cluster identified at the Bordesley Street/New Canal Street/Meriden Street junction are summarised in Table 2.24 below.

Table 2.24: Change in AADT between DM and DS in 2026 and 2031 at Bordesley Street/New Canal Street/Meriden Street

Link No.	Link Description	2026 DM to DS % change in 24 hr AADT	Absolute change 2021 (vehicles)	2031 DM to DS % change in 24 hr AADT	Absolute change 2031 (vehicles)
8	New Canal St (north of junction with Bordesley St)	4%	227	-5%	-285
9	Meriden St (between Bordesley Street and Coventry Street)	20%	929	18%	859
52	Bordesley St (east of junction with New Canal St)	94%	2722	97%	2770
53	Bordesley St (west of junction with New Canal St)	102%	2180	103%	2153

- 2.8.111 Changes in flow and distribution at this junction will see traffic levels increase by 39% in 2026 and 36% in 2031. The Bordesley Street / Canal Street junction will, however, be upgraded to a fully signalised junction, which should reduce the number of collisions at this location, improving road safety. The junction will also provide formal signalised pedestrian crossings, which will improve pedestrian amenity in this area. Taking this into consideration, the scheme is likely to result in overall benefits to the local highway network at this location in terms of accidents and safety.
- 2.8.112 For other links within the study area which were not identified to contain collision cluster, the implementation of the BEE is not expected to detrimentally impact highway safety.
- 2.8.113 Although there have been a number of collisions recorded on the BEE alignment and at nearby offline junctions during the assessment period, the majority of these were caused by driver error and gross negligence. Measures have been included within the scheme design to minimise the detrimental impact on road safety, such as re-location of signalised pedestrian crossings and signalisation of problem junctions to remove safety issues.
- 2.8.114 The resulting impact on safety and accidents on links within the study area without existing collision clusters is considered to be negligible for all high, medium and low sensitivity links. This is therefore assessed as having a minor effect on these links and is not deemed to be significant.

Mitigation

- 2.8.115 No significant adverse effects of relevance to accidents and safety have been identified as part of the above assessment therefore no additional mitigation is proposed.

Residual effects

- 2.8.116 It has been assessed that there will be no significant adverse or beneficial residual effects associated with accidents and safety as a result of the operation of BEE.

2.9 Cumulative Assessment

- 2.9.1 Cumulative effects can be defined as “the impacts of the environment which result from incremental impacts of the action when added to past, present and reasonable foreseeable future actions, regardless of what agency or person undertakes other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time” (IEMA, 2004).

Inter-scheme

- 2.9.2 The ‘committed developments’ relevant to the cumulative effect assessment for the purpose of this update are shown in the Birmingham City Centre Model Traffic Forecasting Report which can found in the updated Transport Assessment.

Cumulative effects during the BEE construction

- 2.9.3 At the start of the BEE construction in 2020, it is assumed that Exchange Square (Phases 1 and 2), Bull Ring Trading Estate, Beorma Quarter (Phases 2 and 3) and Smithfields will be under construction.
- 2.9.4 It has been assumed that the construction of these additional schemes will be carried out in line with best practice, and will involve contractors producing Construction Management Plans which will reduce potential impacts associated with additional construction traffic on the surrounding area during this period. As such there is no separate inter-scheme traffic and transport cumulative assessment for the construction phase of the BEE.

Cumulative effects during the BEE operation

- 2.9.5 Committed developments and funded transport schemes are included in the BCC SATURN Model which has been agreed with BCC. As such there is no separate inter-scheme traffic and transport cumulative assessment for the operational phase of the BEE.

Intra-scheme

- 2.9.6 Relevant Intra-project cumulative impacts include the impact of traffic on noise and local air quality which have been addressed in the Noise and Vibration and Air Quality chapters in this document.

2.10 Conclusion

- 2.10.1 It can be concluded that the embedded mitigation associated with the scheme design and proposed construction is sufficient to ensure that no adverse significant effects are forecast in either 2026 or 2031. A total of thirteen links are forecast to experience beneficial significant effects as a result of the operation of BEE as previously summarised in Tables 2.11, 2.18, and 2.21 above.
- 2.10.2 There are no links that are forecast to experience adverse temporary or permanent significant effects as a result of either the construction or operation of BEE.
- 2.10.3 Following the reassessment of the potential impacts associated with the scheme following the introduction of mitigation, locations where the permanent residual effects are deemed to significant are summarised in Table 2.25 below.

Table 2.25: Permanent residual significant effects resulting from the operation of BEE

Link No.	Link Name	Receptors	Year of Assessment(s)	Level and Significance of effect
Link 3	Moor St Queensway (between Albert Street and Masshouse Lane)	High	2026/2031	Major beneficial significant effect
Link 6	New Canal St (north of junction with Fazeley St)	Medium	2026	Major beneficial significant effect
Link 7	New Canal St (south of junction with Fazeley St)	Low	2026/2031	Moderate beneficial significant effect
Link 8	New Canal St (north of junction with Bordesley St)	High	2026/2031	Major beneficial significant effect
Link 14	High St Deritend (east of Milk St)	High	2026/2031	Major beneficial significant effect
Link 16	High Street Deritend (east of Heath Mill Lane)	Medium	2026/2031	Moderate beneficial significant effect
Link 26	Dale End	High	2026/2031	Major beneficial significant effect
Link 36	Milk Street (directly off High Street Deritend)	Low	2026/2031	Major beneficial significant effect
Link 37	Floodgate Street (directly off High Street Deritend)	High	2026/2031	Major beneficial significant effect
Link 50	Fazeley St (east of junction with New Canal St)	Low	2026/2031	Moderate beneficial significant effect
Link 53	Bordesley St (west of junction with New Canal St)	High	2031	Moderate beneficial significant effect
Link 54	Coventry St (east of Meriden St)	Low	2026/2031	Major beneficial significant effect
Link 55	Coventry St (west of Meriden St)	Low	2026/2031	Major beneficial significant effect

2.11 Comparison to 2016 ES

2.11.1

Compared to the 2016 ES, no significant adverse effects are now predicted during the operation of the BEE where previously two significant adverse effects were identified related to driver delay at the junction of Heath Mill Lane/Liverpool Street and High Street Deritend (east of Alcester Street). Of the significant effects identified these are all now predicted to be beneficial, with the following 6 links continuing to be assessed as having significant beneficial effects:

- New Canal St (north of junction with Bordesley St)
- New Canal Street (north of junction with Fazeley Street)
- High Street Deritend (east of Milk Street)
- High Street Deritend (east of Heath Mill Lane)

- Dale End
- Milk Street (directly off High Street Deritend)

2.11.2 Significant beneficial effects are no longer predicted to occur on the following 2 links:

- Heath Mill Lane (directly off High Street Deritend); and
- Fazeley Street (west of junction with New Canal Street).

2.11.3 New significant beneficial effects are now predicted on the following 7 links:

- Moor St Queensway (between Albert Street and Masshouse Lane)
- New Canal St (south of junction with Fazeley St)
- Floodgate Street (directly off High Street Deritend)
- Fazeley St (east of junction with New Canal St)
- Bordesley St (west of junction with New Canal St)
- Coventry St (east of Meriden St)
- Coventry St (west of Meriden St)

3 Noise and Vibration

3.1 Introduction

3.1.1 This chapter provides an update to the assessment of likely noise and vibration impacts presented in the 2016 ES. The updates reflect changes due to:

- The policies introduced by the Birmingham Development Plan 2013 on health and sustainable transport;
- new SATURN traffic model data described the previous chapters – this has changed the road traffic noise estimates both with and without the scheme which has in turn changed the study area and the predictions of road traffic noise;
- distances to receptors used in construction noise and ground-borne noise calculations – previously the approximate distance to the centre line of the BEE route was estimated from aerial photography but where the tracks are widely separated this has the potential to underestimate both noise and vibration impacts on nearby receptors. The distance to the centre of the nearest track from the closest façade of any given building has now been determined from detailed drawings;
- ground-borne noise – this was previously estimated using a generic methodology that was not specific to BEE and involved extrapolation of data based on distances from 25 feet (approximately 7.6m) to 300 feet (approximately 91m). As some receptors are closer to the track than this additional survey work has been undertaken leading to a revised model for ground-borne noise; and
- definition of LOAEL and SOAEL for ground-borne noise – no explicit values were provided previously and the 2016 ES only addressed compliance with WMCA's policy on this. The update includes values for LOAEL and SOAEL, sets out criteria for significant adverse impacts for residential receptors and an assessment against these.

3.2 Summary of the Changes to the 2016 ES

3.2.1 Table 3.1 Summary of Updates to Noise and Vibration ES Chapter Table 3.1 provides a summary of changes to the 2016 ES Noise and Vibration chapter.

Table 3.1 Summary of Updates to Noise and Vibration ES Chapter

Section of Noise and Vibration chapter in ES	Updates
10.1 Introduction	Birmingham Development Plan 2031 is introduced.
10.2 Methodology	Table 10.2 calculation method summary: tram ground borne noise calculation method updated as set out below Paragraph 10.2.74 and Table 10.3 concerned with direct and indirect impact classifications deleted Paragraph 10.2.77 and figure 10.1 updated for new study area for new SATURN traffic model Table 10.4 (distances to receptors) updated Criteria for significance of ground borne noise have been introduced
10.3 Consultation with BCC	No update required
10.4 Assumptions and Limitations	No update required.
10.5 Baseline Information	No update required.
10.6 Construction Likely Significant Effects	Table 10.15 updated with new construction noise levels reflecting change in distance to receptors.

Section of Noise and Vibration chapter in ES	Updates
10.7 Operation Likely Significant Effects	Tables that show long-term and short-term effects updated in accordance with new traffic data. Case of DMOY with tram no longer considered as incorporated into DSOY. Table 10.19 updated and now also shows number of adverse effects by street in lieu of simply stating that some receptors on a given street were adversely affected. Table 10.21 updated to reflect change in distance to receptors and new estimation methodology for ground borne noise.
10.8 Mitigation	Table 10.22 updated to reflect change in distance to receptors. Mitigation for curve squeal introduced.
10.9 Cumulative Effects	No update required.
10.10 Summary	10.10.4 changed to report that there are no operational significant adverse effects.

- 3.2.2 It is noted that the study area has changed and now contains 2,098 residential receptors and 1,924 non-residential receptors compared to the 5,796 residential receptors and 6,304 non-residential receptors in the 2016 ES.
- 3.2.3 The number and nature of residential receptors subject to adverse and significant adverse impacts due to construction noise is broadly similar.
- 3.2.4 There are substantial changes to operational noise impacts: the previous ES noted large numbers of daytime and night-time significant adverse impacts in both the short-term and the long-term. With the revised SATURN traffic model there are no longer any significant adverse impacts.
- 3.2.5 Values for LOAEL, SOAEL and criteria for significant adverse impacts have been introduced for ground-borne noise. There is a low risk that the trams will exceed these criteria for residential receptors. However, a new, more conservative methodology has been applied for the calculation of ground-borne noise and this has increased the number of receptors that are indicated as at risk of exceeding the WMCA's ground-borne noise criteria.
- 3.2.6 Mitigation suggestions to address curve squeal have been introduced.
- 3.2.7 Table 3.2 provides a summary of changes to the 2016 ES Noise and Vibration technical appendix.

Table 3.2 Summary of Updates to Noise and Vibration ES Technical Appendix

Section of Noise and Vibration technical appendix in ES	Updates
1.1 Introduction	No update required
1.2 Noise important areas	No update required.
1.3 Conversion between metrics	No update required
1.4 Construction noise and vibration	No update required
1.5 Tram operational noise	Method to calculate ground borne noise updated
1.6 Baseline	No update required
1.7 Noise contour maps	Updated to reflect new traffic model

3.3 Details of the changes

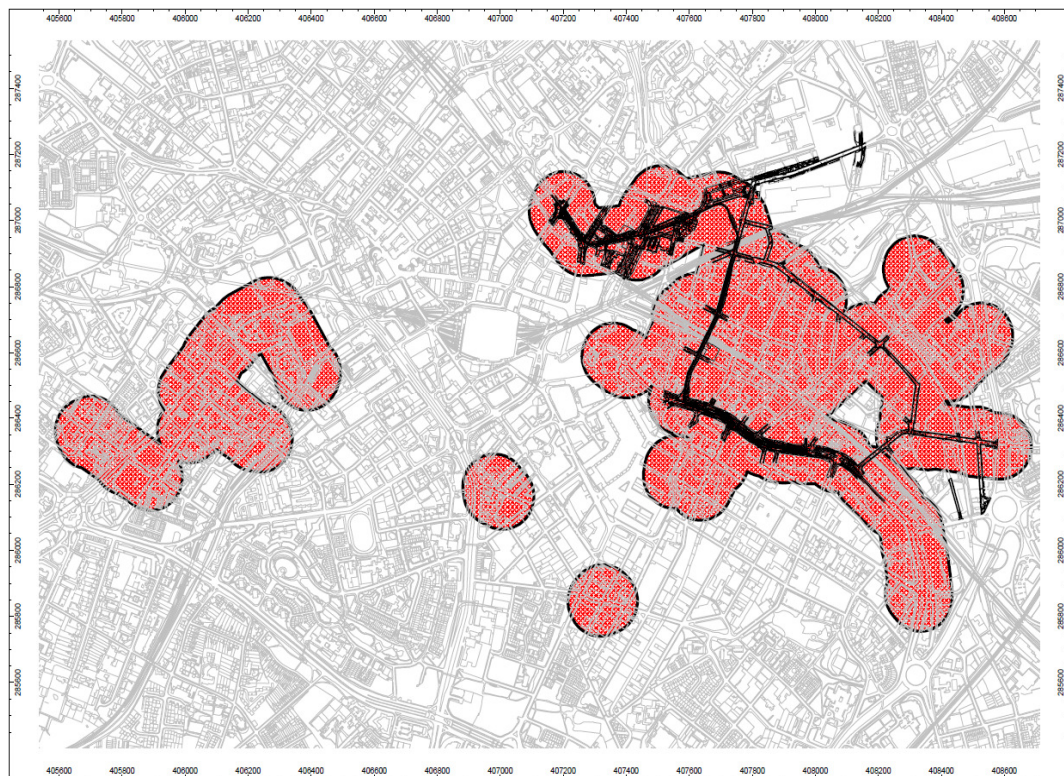
Birmingham Development Plan 2031

- 3.3.1 The Birmingham Development Plan 2031 (BDP) is the City's statutory planning framework guiding decisions on all development and regeneration activity to 2031. It was adopted by Birmingham City Council on 10th January 2017 and sets out a vision and a strategy for the sustainable growth of the City.
- 3.3.2 Policy TP37 on health states "*The City Council is committed to reducing health inequalities, increasing life expectancy and improving quality of life by:*" inter alia "*seeking to improve air quality and reduce noise within the City.*"
- 3.3.3 Policy TP38 refers to sustainable transport. The accompanying notes state "*TravelWise is a national campaign to encourage people to think about the impact that their daily journeys have on the environment, their community and on their own health. TravelWise schemes can also help people to look for more environmentally friendly alternatives to driving alone, such as car sharing, using public transport, walking or cycling. People can save money and improve their health whilst helping to reduce congestion, air and noise pollution and the negative effects of road traffic.*"
- 3.3.4 There are no other specific references to transportation noise in the Development Plan.

Operational noise study area

- 3.3.5 The methodology to determine the study area as set out in paragraphs 10.2.75 to 10.2.77 of the 2016 ES has not changed but because the traffic model has changed, the study area itself as previously shown in Figure 10.1 of the ES has changed. The revised operational noise study area is presented in Figure 3.1 below. It comprises an area that is about a 1.5km square around the BEE route and three separate areas where the traffic changes have produced a change of 1dB or more and where flow exceeds 50 vehicles per hour. However as presented in the introduction, consultation with BCC has identified that the activated links in the Broad Street area are not as a result of the BEE and are therefore not considered further in this assessment.

Figure 3.1: Operational noise study area



Receptor locations and distance from the BEE

- 3.3.6 The 2016 ES reported the approximate distance from receptors to the BEE based on aerial photography and used the centre line between the two tracks as the datum. As both the construction noise calculations and the ground-borne noise calculations depend on the distance from the nearest track, the table of approximate distances has been revised and is now derived from the BEE drawings. The revised table is reproduced in Table 3.3 below.

Table 3.3: Receptor Locations

Receptor	Nature of use	Distance [m]
Staybridge Hotel 44 - 80 Corporation Street (R1)	Hotel	60
84 Bull Street (R2)	Offices	11
The Priory Rooms, 40 Bull Street (R3)	Offices	67
Birmingham Civil Justice Centre (R4)	Offices/court rooms	7
57 High Street (R5)	Offices	30
Albert street Offices (R6)	Offices	9
Travelodge - Carrs Lane (R7)	Hotel	34
St Michael's Church, Moor Street (R8)	Church/Place of Worship	20
Hotel LaTour/Albert Street (R9)	Hotel	12
2 Mass House Lane (R10)	Residential Receptor	25

Receptor	Nature of use	Distance [m]
15 Bartholomew Row/Birmingham Uni (R11)	Education/College	95
Student Accommodation, 250 Jennens Rd (R12)	Residential Receptor	124
The Woodman, New Canal Street (R13)	Office/Public House/Residential Receptor	73
Curzon Street Station, New Canal Street (R14)	Unknown	86
Digbeth Hall, 117 New Canal Street (R15)	Venue	7
New Bartholomew Street (R16)	Offices	48
8A Bordesley Street (R17)	Residential Receptor	85
17 New Canal Street (R18)	Residential Receptor	5
90 Meriden Street (R19)	Residential Receptor	4
6 Coventry Street (R20)	Venue	15
99 Coventry Street (R21)	Residential Receptor	4
South City College - Fusion centre, High Street (R22)	Education/College	15
82-84 Digbeth (R23)	Residential Receptor	8
South City Collee Fusion 2 Centre (R24)	Education/College	42
Bus Station, Digbeth (R25)	Offices/Bus Station	13
90 Digbeth (R26)	Residential Receptor	13
89 Digbeth (R27)	Residential Receptor	13
81 Digbeth (R28)	Residential Receptor	13
77 Digbeth (R29)	Residential Receptor	16
Birmingham College - Digbeth Campus (R30)	Education/College	15

Source: Mott MacDonald

Construction noise

- 3.3.7 Table 10.15 in the ES showed the construction noise levels without mitigation. These depend on both the baseline noise conditions (which have not changed) and the distances to the receptors from the BEE route which have changed in accordance with paragraph 3.3.6. Table 3.4 presents the revised unmitigated construction noise estimates and Table 3.5 presents the revised calculations for mitigated construction noise with the mitigation as set out in the Section 10.8 of the 2016 ES.
- 3.3.8 Some nineteen of the representative receptors were subject to adverse or significant adverse impacts for the unmitigated case in the previous version of the ES whereas Table 3.4 now shows that sixteen of the representative receptors will be subject to adverse or significant adverse impacts.
- 3.3.9 With mitigation, the 2016 ES showed that eight receptors were subject to adverse impacts and of these five were subject to a significant adverse impact. Table 3.5 shows that seven receptors will be subject to an adverse impact and of these four will be subject to a significant adverse impact
- 3.3.10 There is therefore little difference between the overall impact of construction noise between the 2016 ES and this update.
- 3.3.11 It is noted that the construction noise LOAEL and SOAEL in the 2016 ES were made with reference to external free-field noise and not to noise levels inside buildings and that the

significance criteria did not include reference to the duration of the works. The criteria for significance can be extended to include a duration term. BS5228 provides example criteria such as "a period of 10 days or more in any 15 consecutive days or for a total of 40 in any consecutive six months." An additional mitigation measure for residential receptors is then to ensure that SOAEL is not exceeded for the given period, or that noise insulation, or the reasonable costs thereof, or temporary rehousing will be offered to owners or occupiers once full details of the plant that will be used are known.

Table 3.4: Baseline noise levels and predicted baseline + construction pre-mitigation noise levels, dB L_{eq}

Receptor	Baseline, Leq	Task1, Leq	Task2, Leq	Task3, Leq	Task4, Leq	Task5, Leq	Task, 6 Leq	Task7, Leq	Task8, Leq	Task9, Leq
R1	61	68	66	79	70	65	65	64	63	62
R4	61	86	82	71	87	81	82	79	63	62
R7	67	73	71	71	75	70	71	69	67	76
R8	67	77	74	69	79	73	74	72	68	72
R9	58	81	77	67	83	77	77	74	62	60
R10	67	75	72	69	77	72	72	71	68	67
R11	67	69	68	68	69	68	68	67	67	67
R12	67	68	68	67	68	67	67	67	67	67
R13	67	69	68	68	70	68	68	68	67	67
R15	70	86	82	72	88	82	82	79	72	70
R17	70	71	71	70	71	70	70	70	71	70
R18	58	88	85	68	90	84	85	82	68	62
R19	58	90	87	69	92	86	87	84	73	63
R21	69	90	87	70	92	86	87	84	71	71
R22	75	80	78	84	82	78	78	77	75	75
R23	75	85	82	75	87	81	82	80	75	75
R24	75	76	76	75	77	75	76	75	75	76
R26	73	81	78	75	83	78	78	76	73	76
R27	73	80	76	76	81	76	76	74	70	70
R28	73	81	78	73	83	78	78	76	73	73
R29	73	80	77	73	81	77	77	75	73	73
R30	70	80	76	76	81	76	76	74	70	70

Yellow = adverse effect, orange = significant adverse effect

Source: Mott MacDonald

Table 3.5: Baseline noise levels and predicted baseline + construction noise levels with mitigation, dB L_{eq}

Receptor	Baseline, Leq	Task1, Leq	Task2, Leq	Task3, Leq	Task4, Leq	Task5, Leq	Task, 6 Leq	Task7, Leq	Task8, Leq	Task9, Leq
R1	61	63	62	70	63	62	62	62	61	61
R4	61	76	72	64	78	72	72	70	61	61
R7	67	68	68	68	69	67	68	67	67	69
R8	67	70	68	67	71	68	68	68	67	68
R9	58	71	68	60	73	67	68	65	59	58
R10	67	69	68	67	70	68	68	68	67	67
R11	67	67	67	67	67	67	67	67	67	67
R12	67	67	67	67	67	67	67	67	67	67
R13	67	67	67	67	67	67	67	67	67	67
R15	70	77	74	70	78	74	74	73	70	70
R17	70	70	70	70	70	70	70	70	70	70
R18	58	79	75	61	80	74	75	72	61	59
R19	58	80	77	62	82	76	77	74	64	59
R21	69	81	77	69	82	77	77	75	69	69
R22	75	76	75	77	76	75	75	75	75	75
R23	75	78	76	75	79	76	76	76	75	75
R24	75	75	75	75	75	75	75	75	75	75
R26	73	75	74	73	76	74	74	73	73	73
R27	73	73	71	71	73	71	71	71	70	70
R28	73	75	74	73	76	74	74	73	73	73
R29	73	74	74	73	75	74	74	73	73	73
R30	70	73	71	71	73	71	71	71	70	70

Yellow = adverse effect, orange = significant adverse effect

Source: Mott MacDonald

Operational noise

- 3.3.12 Operational noise calculations discussed in 10.4 of the 2016 ES have been repeated with the new traffic data within the new study area. The Leq noise levels at sensitive receptors have been calculated for the following scenarios where DM indicates Do-minimum (i.e. without BEE), DS indicates Do-something (i.e. with BEE), OY indicates opening year (2026 in the traffic model) and DY indicates the design year (2031 in the traffic model):
- DMOY day;
 - DMOY night;
 - DSOY day;
 - DSOY night;
 - DSDY day;
 - DSDY night;
- 3.3.13 As in the 2016 ES, comparisons between these noise levels are used to calculate noise impacts which may be increases or decreases. The tables below show a summary of these impacts, grouped using the levels corresponding to the impact magnitude criteria set out in Table 10.1 of the 2016 ES. The tables show:
- the impact of the BEE including noise impacts due to traffic changes in the short-term, (DSOY compared with DMOY, day and night) shown in Table 3.6; and
 - the impact of the BEE including noise impacts due to traffic changes in the long-term (DSDY compared with DMOY, day and night) shown in Table 3.7.
- 3.3.14 In all the tables (which correspond to the new study area) there are 2098 residential receptors and 1924 non-residential receptors. The tables show the numbers of receptors that are subject to a noise increase, no change in noise level or a noise decrease in the daytime and at night. The band ranges used for the noise increases and decreases correspond to the bands used to define the magnitude of impact (as negligible, minor, moderate or major) as set out in Table 10.1 of the 2016 ES and, as previously, these bands differ between the short-term (as used for the opening year comparisons) and the long-term (as used for the design year comparisons).

Table 3.6: Change of noise level for scenario DSOY vs DMOY

Scenario: DSOY vs DMOY					
Change in noise level		Daytime		Night-time	
		Number of dwellings	Number of other sensitive receptors	Number of dwellings	Number of other sensitive receptors
Increase in noise level, Leq,T	0.1-0.9	500	253	873	251
	1.0-2.9	378	17	389	19
	3.0-4.9	0	4	0	0
	5.0+	0	0	0	0
No change	0	64	88	81	237
Decrease in noise level, Leq,T	0.1-0.9	917	843	522	1019
	1.0-2.9	206	314	208	194
	3.0-4.9	32	129	25	111
	5.0+	1	276	0	93
		2098	1924	2098	1924

Source: Mott MacDonald

3.3.15 Table 3.6 shows the impact of tram noise in the short-term. It shows that in the daytime 500 residential receptors are subject to (negligible) noises increase below 1dB due to the BEE and 378 residential receptors are subject to (minor) increases of more than 1dB; no residential receptors are subject to noise increases of more than 3dB. At night 873 residential receptors are subject to noise increases below 1dB and 389 receptors subject to noise increases of more than 1dB; no residential receptors are subject to noise increases of more than 3dB. There are only negligible or minor impacts for residential receptors in the daytime and in the night-time and there are no moderate or major impacts for residential receptors at any time.

Table 3.7: Change of noise level for scenario DSDY vs DMDY

Scenario: DSDY vs DMOY

Change in noise level		Daytime		Night-time	
		Number of dwellings	Number of other sensitive receptors	Number of dwellings	Number of other sensitive receptors
Increase in noise level, Leq,T	0.1-2.9	1780	925	1809	445
	3.0-4.9	27	35	13	18
	5.0-9.9	0	0	0	0
	10.0+	0	1	0	1
No change	0	70	311	61	892
Decrease in noise level, Leq,T	0.1-2.9	8	319	6	292
	3.0-4.9	181	23	199	171
	5.0-9.9	32	309	10	104
	10.0+	0	1	0	1
		2098	1924	2098	1924

Source: Mott MacDonald

3.3.16 The long-term indirect impact of traffic growth with the BEE is shown in Table 3.7. It shows that in the daytime 1780 residential receptors are subject to a (negligible) noise increase below 3dB due to operation of the tram and twenty-seven receptors are subject to (minor) increases of more than 3dB; no residential receptors are subject to noise increases of more than 5dB. At night 1809 residential receptors are subject to a noise increase below 3dB and thirteen receptors are subject to a (minor) increase of more than 3dB; no residential receptors are subject to noise increases of more than 5dB. There are only negligible or minor impacts for residential receptors in the daytime and at night-time. There are no moderate or major impacts for residential receptors at any time.

3.3.17 While the results in Table 3.6 and Table 3.7 show the number of increases (and decreases) in noise levels at receptors, for the determination of significance it is also necessary to consider the noise levels with respect to LOAEL and SOEAL. Paragraph 10.2.137 of the 2016 ES set out the criteria for adverse and significant adverse impacts as follows:

- A significant adverse impact is one for which noise level changes by at least 1 dB and where SOAEL (Table 10.11 of the 2016 ES) is exceeded.
- An adverse impact is one for which the noise level changes of 1dB in the short-term or 3dB in the long-term and where LOAEL (Table 10.11 of the 2016 ES) is exceeded but SOAEL is not exceeded.

3.3.18 Table 3.8 shows the number of receptors that are subject to adverse and significant adverse impacts in the short-term and in the long-term for both daytime and night-time. The first row

gives the total number of receptors subject to adverse or significant adverse impacts under the given circumstances. The table also shows the number of receptors subject to adverse impacts for each street that contributes to the total.

- 3.3.19 For example, there are three hundred and seventy eight receptors subject to an adverse impact in the short-term daytime. All but three of these are on Granville Square or Granville Street
- 3.3.20 It will be noted that there are no significant adverse effects in the short-term or the long-term in the daytime or at night.
- 3.3.21 The number of adverse and significant adverse effects differs markedly from the number presented in Table 10.19 of the 2016 ES which had large numbers of significant adverse impacts due to noise in particular. The difference between the numbers of significant adverse effects now and in the 2016 ES is due to the differences between the traffic model used for the 2016 ES and the SATURN model.

Table 3.8: Numbers of residential receptors subject to operational adverse affects

	Short Term Daytime Significant Adverse	Short Term Daytime Adverse	Short Term Night-time Significant Adverse	Short Term Night-time Adverse	Long Term Daytime Significant Adverse	Long Term Daytime Adverse	Long Term Night-time Significant Adverse	Long Term Night-time Adverse
Total	0	378	0	389	0	0	0	0
Adderley Street		1		1				
Bordesley Street		1						
Granville Square		268		268				
Granville Street		107		107				
Ryland Street				12				
Upper William Street		1		1				

Source: Mott MacDonald

Ground-borne noise

- 3.3.22 The 2016 ES presented the WMCA's policy for ground-borne noise (GBN) in paragraph 10.2.65. A model described in the 2016 ES Volume 2 Technical Appendix M1: Noise and Vibration Technical Information was used to determine the risk of non-compliance with the receptor type-dependent criteria for GBN for each receptor. In all but one case the risk of non-compliance was identified as low – the exception being Digbeth Hall which was identified as venue with a GBN criterion of 25dB and which was classified as at medium risk of exceeding the criteria.
- 3.3.23 The 2016 ES did not provide values for the lowest observable adverse effect level (LOAEL) or significant observable adverse effect level (SOAEL) for GBN or any criteria for a significant adverse effect due to GBN. The ES for the HS2 project has presented LOAEL and SOAEL values for residential receptors for GBN as 35dB L_{Amax} and 45dB L_{Amax} respectively. However, the 2009 WHO Night Noise Guidelines proposes a No Observable Adverse Effect Level of 42dB L_{Amax} for transportation noise and this value has therefore been adopted as LOAEL for BEE. These values of LOAEL and SOAEL are reproduced in Table 3.9, below.

Table 3.9: LOAEL and SOAEL values for ground-borne noise

Adverse effect level	L_{Amax} [dB]	Source
LOAEL	42	WHO NOAEL for GBN
SOAEL	45	HS2 ES SOAEL for GBN

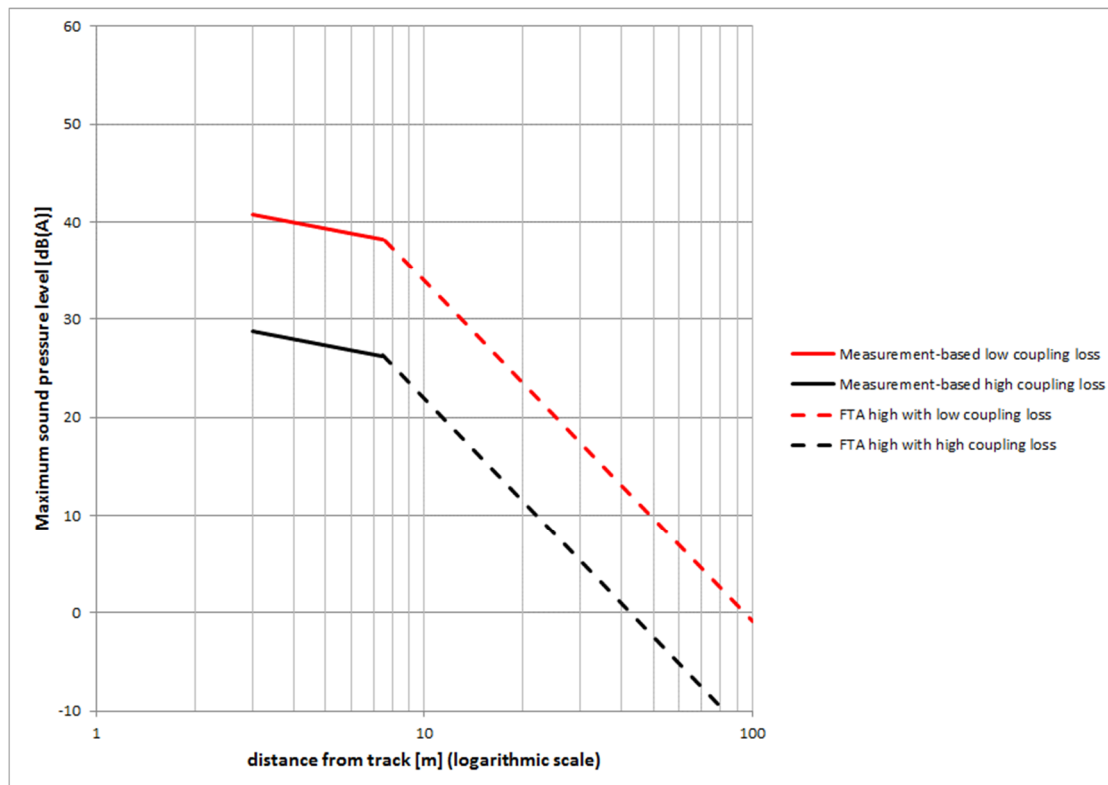
Source: Mott MacDonald

- 3.3.24 A significant adverse impact for GBN for BEE arises when SOAEL is exceeded at a residential receptor due to the passage of a tram.
- 3.3.25 The model used to calculate GBN levels in the 2016 ES was derived from the FTA manual. It was based on a calculation of the force density produced by interaction of the trams with the tracks, a transmission of vibration through the ground and associated attenuation dependent on distance, a factor to account for ground–building foundation interaction and the attenuation of vibration amplitudes as vibration propagates through buildings, and a conversion from vibration into sound. The FTA method presents data at distances of 25 feet (approximately 7.6m to 300 feet (91m). In the previous ES estimates for GBN at shorter distances than 7.6m were extrapolated from the FTA data.
- 3.3.26 A risk associated with extrapolated data is that it may not be representative outside its domain of validity. In the case of the BEE, supplementary measurements of vibration in proximity to operating trams have been made to determine expected noise levels at distances that are less than 7.6m.
- 3.3.27 Measurements were made of the vibration level close to the tracks at three locations in Birmingham City Centre in the form of calibrated WAV recordings. Noise levels were obtained using Welch's modified periodogram with Hanning windows of 4096 samples and 50% overlap, from the 6000 samples/per second WAV signal, to generate a time series of spectra. Each spectrum was A-weighted over the frequency range 10-250Hz to produce a time series of L_{Amax} levels. The influence of time constant was studied by subjecting the WAV file signal to infinite impulse response A-weighted filtering and by exponential averaging. It was found that frequencies above 250Hz were strongly affected by the influence of the time constant, but as these would be attenuated in transmission to and into the receptor, it was considered that the time series from the overlapping 1.47s window samples (producing a level every 0.73s) reasonably matched the S (slow) time constant with exponential averaging. The analysis to estimate sound levels assumed that the coupling loss factor over the range 10-250Hz will be equal and opposite to building amplification. The dependency between sound level with

distance was obtained by finding the coefficient which minimised the RMS error in the ensemble of results for each location.

- 3.3.28 The chart below shows predicted L_{Amax} values combining the FTA method and predictions based on measurements. For distances above 7.5m (which are within the domain of the FTA method) the chart has used the 'FTA high' curve from the previous ES (black dashed line) but removing the factor, C_{build} , associated with ground–building foundation interaction and attenuation of vibration amplitudes as vibration propagates through buildings to produce the red dashed line. This is to align with the red solid line derived from the analysis of the measured data for distances below 7.5m and which has the assumption that any coupling loss factor and building amplification are equal and opposite. The two independent sets of data produce the same value where they intersect at 7.5m. The black solid line introduces the C_{build} factor for distances below 7.5m. Depending on building type the GBN level is likely to fall between the black and red lines.
- 3.3.29 The vibration data in the WAV recordings showed a dependency with tram speed. The assumed speed for the charts presented in Figure 2 is 16km/h. The dependency with speed indicates that levels would increase by approximately 5dB for every doubling of speed and reduced by approximately 5dB for each halving of speed although the speed range for which this is applicable is limited by the speed range of the measurements which was approximately 10km/h to 25km/h giving a speed correction from -3dB to +3dB, approximately.
- 3.3.30 The zero C_{build} factor (red) lines from the chart in Figure 2 have been used to estimate L_{Amax} for the BEE and to compare these with the WMCA's receptor-dependent policy criteria. The results of this comparison are shown in Table 3.10.
- 3.3.31 Neither SOAEL or LOAEL is exceeded at any residential receptor and there are therefore no adverse or significant adverse impacts due to ground-borne noise.
- 3.3.32 However, Table 3.10 does show that there is a high risk of non-compliance with the ground-borne noise policy criteria for three receptors: The Birmingham Civil Justice Centre (R4) which has a policy criterion of 35dB and a predicted L_{Amax} of 38dB; Digbeth Hall that has a policy criterion of 25dB and a predicted L_{Amax} of 38dB; and 6 Coventry Street that has a policy criterion of 25dB and a predicted L_{Amax} of 28dB. There are a further four receptors that are at a moderate risk of exceeding the ground-borne noise policy criteria because the predicted level is less than the criterion, but within 5dB of it.
- 3.3.33 The previous version of the ES identified only one receptor that was at risk of exceeding the GBN policy criteria. The predominant reason for the increase in the number of receptors that are predicted to exceed the criteria is the introduction of the more conservative estimated prediction of GBN that does not include the attenuation provided by the ground–building foundation interaction and attenuation of vibration amplitudes as vibration propagates through buildings.
- 3.3.34 Although there are no adverse or significant adverse impacts for residential receptors due to GBN, consideration should be given to track formation and support in the vicinity of the receptors where there is a moderate or high likelihood of exceeding the ground-borne noise policy criteria.

Figure 3.2: Predicted Ground-borne Noise



Source: Mott MacDonald

Table 3.10 Predicted compliance with ground-borne noise policy criteria

Receptor	Nature of use	Criterion Lmax, slow	Risk of non-compliance
Staybridge Hotel 44 - 80 Corporation Street (R1)	Hotel	40	low
84 Bull Street (R2)	Offices	45	low
The Priory Rooms, 40 Bull Street (R3)	Offices	45	low
Birmingham Civil Justice Centre (R4)	Offices/court rooms	35	high
57 High Street (R5)	Offices	45	low
Albert street Offices (R6)	Offices	45	low
Travel Lodge - Carrs Lane (R7)	Hotel	40	low
St Michael's Church, Moor Street (R8)	Church/Place of Worship	35	low
Hotel LaTour/Albert Street (R9)	Hotel	40	low
2 Mass House Lane (R10)	Residential Receptor	40	low
15 Bartholomew Row/Birmingham Uni (R11)	Education/College	40	low
Student Accommodation, 250 Jennens Rd (R12)	Residential Receptor	40	low

Receptor	Nature of use	Criterion Lmax, slow	Risk of non-compliance
The Woodman, New Canal Street (R13)	Office/Public House/Residential Receptor	40	low
Curzon Street Station, New Canal Street (R14)	Unknown	45	low
Digbeth Hall, 117 New Canal Street (R15)	Venue	25	high
New Bartholomew Street (R16)	Offices	45	low
8A Bordesley Street (R17)	Residential Receptor	40	low
17 New Canal Street (R18)	Residential Receptor	40	moderate
90 Meriden Street (R19)	Residential Receptor	40	moderate
6 Coventry Street (R20)	Venue	25	high
99 Coventry Street (R21)	Residential Receptor	40	moderate
South City College - Fusion centre, High Street (R22)	Education/College	40	low
82-84 Digbeth (R23)	Residential Receptor	40	moderate
South City Collee Fusion 2 Centre (R24)	Education/College	40	low
Bus Station, Digbeth (R25)	Offices/Bus Station	45	low
90 Digbeth (R26)	Residential Receptor	40	low
89 Digbeth (R27)	Residential Receptor	40	low
81 Digbeth (R28)	Residential Receptor	40	low
77 Digbeth (R29)	Residential Receptor	40	low
Birmingham College - Digbeth Campus (R30)	Education/College	40	low

Source: Mott MacDonald

Curve squeal

- 3.3.35 Paragraph 10.2.4 of the 2016 ES identified curve squeal as a potential source of noise but provided no information on candidate mitigation methods.
- 3.3.36 It is noted that wheel squeal is best managed at source as far as possible. In the first instance, this is best dealt with by avoiding curves with low radii. For on street-running tram systems, the existing highway layout and the need to avoid demolitions and highway changes becomes a major constraint, enforcing tight curves at certain locations. A second step is to deploy friction modifiers to reduce the instances and levels of squeal as far as reasonably practical. These may be deployed on either the vehicle or on the infrastructure. So far, vehicle-borne solutions have given limited results compared to the results achieved from manual application directly on the infrastructure. The Promotor will continue to explore both options. It is noted that on the short CSQ extension, just 650m in length, the design includes eight trackside lubricators (four per direction) to minimise squeal in a particularly sensitive area.

3.4 Conclusions

- 3.4.1 A fundamental requirement of NPPF and NPPG is to avoid significant adverse effects.
- The indicated potential significant adverse effects due to construction may be mitigated though a combination of:
 - phasing of works to avoid exceeding SOAEL for 10 days or more in any 15 days or 40 days in 6 months.

- providing noise barriers or alternative plant that attenuate noise by more than the 10dB used in the calculation of the mitigated noise levels in Table 3.5.
- providing noise insulation for affected receptors.
- Table 3.8 shows that there are no significant adverse effects due to operational noise for the scheme
- The newly introduced significance criteria for ground borne noise are not exceeded and there are no significant adverse effects due to GBN.

3.4.2 It follows and the BEE meets the policy objectives in NPPF and NPPG for noise.

3.4.3 The criteria within the Promotor's policy for GBN are exceeded at some receptors and consideration needs to be given to track supports to mitigate this.

3.4.4 Curve squeal may be an issue for the curves on BEE with low radii and consideration need to be given to the introduction of mitigation such as friction modifiers to control this source of noise.

3.5 Comparison to 2016 ES

3.5.1 With regard to the conclusion of the 2016 ES, there is no change to the significant adverse effect previously identified, as summarised in Table 6.1 in the Conclusion.

4 Air Quality

4.1 Introduction

- 4.1.1 This chapter updates the air quality assessment for the BEE reported in the 2016 ES.
- 4.1.2 The updated air quality assessment has been produced to incorporate new traffic data that has been made available for the BEE following updates to the SATURN model that was used to inform the assessment. Since the submission of the 2016 ES in October 2016, new baseline air quality data is available and this has been presented within this chapter. There are no updates to the 2016 construction phase assessment undertaken for the 2016 ES as there have been no changes to the Scheme alignment and therefore the conclusions of this remain unchanged.
- 4.1.3 Table 4.1 provides a summary of changes to the 2016 ES Air Quality Chapter and technical appendix.

Table 4.1: Summary of Updates to ES Chapter and technical appendix

Section of Air Quality chapter in ES	Equivalent section of Air Quality technical appendix	Updates
11.1 Introduction	Background	No update required
11.2 Methodology – Legislation, Guidance, Best Practice and Policy	Legislation, Policy, Guidance and Best Practice	All key legislation and guidance remains unchanged. Since submissions of the ES, the UK plan for tackling roadside NO ₂ concentrations was published and the BCC adopted the Birmingham Development Plan (2031). This was adopted in January 2017 and a summary is included below.
11.2 Methodology – All technical, spatial and approach elements related to construction phase	Methodology – construction phase	There are no updates to the construction phase assessment.
11.2 Methodology – All technical, spatial and approach elements related to operational phase	Methodology – operational phase	No changed to methodology approach. However, the revised assessment has taken account of changes in input data and tools available which affect the study area and receptor locations assumed in the assessment. These are described in full in in this chapter.
11.3 Consultation	N/A	No update required
11.4 Assumptions and limitations	Methodology – operational phase	Assumptions and limitations remain the same. As a result of the change in SATURN model base year, the air quality model verification which manages uncertainty has been updated and presented within an appendix.
11.5 Baseline Information	Baseline conditions	Section updated to reflect the most recent conditions in the area incorporating 2016 data and 2016 annualisation factors and bias adjustment.
11.6 Embedded Mitigation Measures	N/A	No update required.

Section of Air Quality chapter in ES	Equivalent section of Air Quality technical appendix	Updates
11.7 Construction – Likely Significant Effects	Results	No update required.
11.8 Operation – Likely Significant Effects	Operational Results	Section updated to reflect results of the updated assessment.
11.9 Cumulative Effects	N/A	No updates
11.10 Summary	Summary	This section has been updated in line with the results of the operational phase assessment.

4.2 Methodology

Defra Air Quality Plan for Nitrogen Dioxide (2017)

- 4.2.1 The latest plan for tackling roadside NO₂ concentrations was published by Defra in July 2017 and details the government's plan to reduce NO₂ concentrations within statutory limits within the shortest possible time. Within this plan, BCC is named as one of the local authorities with exceedances of the NO₂ limit values and therefore is required to undertake a local assessment to consider the best options to achieve compliance with this limit value. An initial plan is required to be submitted by BCC by March 2018.
- 4.2.2 The local assessment submitted by BCC should identify effective measures to reduce NO₂ and could include measures such as:
- Implementation of a Clean Air Zone;
 - Changing road layouts at congestion and air pollution pinch points;
 - Encouraging public and private uptake of Ultra Low Emission Vehicles (ULEVs);
 - Using innovative retrofitting technologies and new fuels; and,
 - Encouraging the use of public transport.

Regional and Local Planning Policy

- 4.2.3 The Birmingham Development Plan 2031 was formally adopted by BCC on 10 January 2017. This plan replaced the Birmingham Unitary Development Plan 2005 with the exception of a small number of policies that will remain in force until the Council adopts the proposed development management plan document. There are no policies relating to air quality retained from the Unitary Development Plan. The policies of relevance to the air quality assessment from the Birmingham Development Plan are presented below.
- 4.2.4 Policy TP37 – Health states:
- "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".*
- 4.2.5 Policy TP38 – A Sustainable Transport Network states:
- "The development of a sustainable, high quality, integrated transport system, where the most sustainable mode choices also offer the most convenient means of travel, will be supported.*

The delivery of a sustainable transport network will require:

- *The facilitation of modes of transport that reduce carbon emissions and improve air quality.*
- *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.*
- *In some circumstances, the re-allocation of existing roadspace to more sustainable transport modes."*

4.2.6 Policy TP44 – Traffic and Congestion Management states:

"The optimum use of existing highway infrastructure across all modes will be encouraged and priority investment in the highway network to support the city's sustainable transport network and development agenda will be promoted.

The efficient, effective and safe use of the existing transport network will be promoted through the following:

- *Targeted investments, including the provision of new connections, which reduce the negative impacts of road traffic, for example congestion, air pollution and road accidents."*

Operational Phase methodology

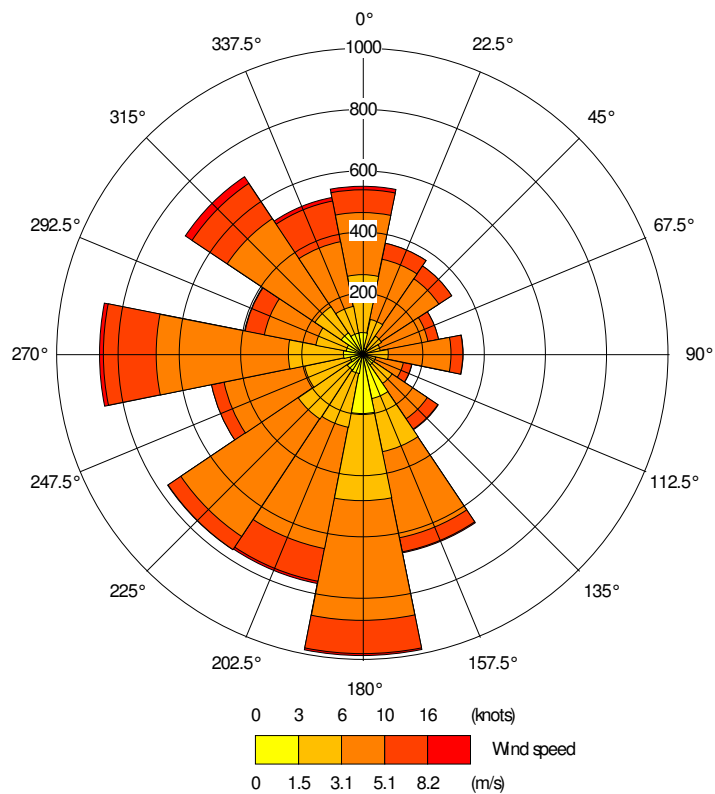
Model

The updated air quality assessment has taken account of the most recent version of the 'ADMS-Roads' dispersion model (version 4.1).

Meteorological data

- 4.2.7 The updated air quality assessment has used an additional year of meteorological data from Birmingham Elmdon meteorological station for 2016 to coincide with the traffic model base year of 2016 and the most recent baseline air quality monitoring data that is available. Figure 4.1 presents a wind rose of the 2016 meteorological data.

Figure 4.1: 2016 Wind rose from Birmingham Elmdon meteorological station



Traffic data and modelled scenarios

4.2.8 Traffic data for the updated air quality assessment has been provided for the following scenarios:

- 2016 Base Year;
- 2026 Future Year Do-Minimum;
- 2026 Future Year Do-Something;
- 2031 Future Year Do-Minimum; and
- 2031 Future Year Do-Something.

4.2.9 Outputs from the updated Transport Assessment and SATURN traffic model have been used for this assessment and supplemented with data derived from additional analysis based on traffic counts and LinSig modelling data produced for detailed junction design along the route of BEE. Traffic flow data on vehicle movements, speeds and a breakdown of 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).

- 4.2.10 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.
- 4.2.11 The following scenarios have been considered for the operational air quality assessment:
- 2016 base year
 - Do-Minimum (DM) Scenario (without the BEE) 2022 opening year; and
 - Do-Something (DS) Scenario (with the BEE) 2022 opening year.
- 4.2.12 Traffic data from the 2016 base year in the traffic model has been used to verify the air quality model against monitoring data. Pollutant concentrations predicted in the opening year Do-Minimum and Do-Something scenarios of the BEE have then been compared to ascertain the effect of the BEE on local air quality.
- 4.2.13 Traffic data from the traffic model which represents 2026 has been used to determine air quality effects which have been predicted for the opening year of the BEE. This is a conservative approach because the traffic data produced for 2026 includes additional growth that would occur between 2022 and 2026 and therefore flows assumed in the assessment will be higher than in the BEE opening year.
- 4.2.14 As per the 2016 ES, no future year has been assessed beyond 2022 as Defra projections indicate that baseline air quality and vehicle emissions are expected to improve in future years and therefore 2022 emission factors assume the worst case, especially when considering that they have been combined with flows derived for 2026. In addition, a sensitivity analysis has been undertaken to determine the sensitivity of modelled results to assumptions regarding future baseline air quality. Further details of this sensitivity analysis can be found in section 4.4.14.

Study area

- 4.2.15 The affected road network (ARN) for the updated air quality assessment and therefore the study area has been updated based on the revised traffic. The criteria in the DMRB (2007) used to determine the affected road network as per the 2016 assessment has been used to define the study area.
- 4.2.16 Appendix B Figure 4.2 presents the Scheme's ARN and therefore the updated operational air quality study area. It should be noted that the Do-Something traffic model includes the BEE Scheme along with additional tram schemes which are also not included in the Do-Minimum traffic model. Therefore, the ARN also includes areas around Broad Street to the west of the BEE Scheme. Inclusion of these Schemes in the traffic model represents a future cumulative scenario and therefore is considered to represent a worst case.

Human health receptors

- 4.2.17 Revised sensitive receptors have been selected to account for the updated air quality study area. Receptors have been selected in accordance with the methodology described in the 2016 ES and technical appendix. A total of twenty-one receptors have been selected and they are presented in Table 4.2 and Appendix B Figure 4.3.

Table 4.2: Human health receptors for updated study area

Receptor ID	Site Description	National Grid Reference		Height of Receptor (m)
		X	Y	
1	Masshouse Plaza	407537.4	287072.3	4.5
2	Travelodge (ST)	407325.6	286910.3	4.5
3	Allison Street	407610.4	286749.9	4.5
4	Coventry Street	407635.8	286595.4	4.5
5	Digbeth 1	407413.2	286589.3	4.5
6	Upper Dean Street	407271.9	286399.6	4.5
7	Digbeth 2	407498	286499.4	4.5
8	Rea Street	407716.3	286376.6	4.5
9	High Street	408059.5	286303	4.5
10	Digbeth 3	407762.9	286389.7	4.5
11	Farmacre	408577	286541.6	1.5
12	Hawthorn Close	408626	286356.3	1.5
13	Adderley Street	408279.3	286350.4	4.5
14	Bradford Street 1	408317.3	285869.9	4.5
15	Bradford Street 2	407988.8	286066.2	1.5
16	Fazeley Street	408103.6	286707.3	1.5
17	Pershore Street	407241.6	286295.7	1.5
18	Trinity Court	408398.3	285760.8	4.5
19	Hotel Latour (ST)	407485.8	286982.5	4.5
20	Floodgate Street	408150.4	286656.4	4.5
21	Barford Street (ST)	407577.6	286255.6	4.5

Note: ST – short term receptor for comparison with short term (one hour) averaging periods

Ecological Receptors

- 4.2.18 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 updated ARN and therefore ecological receptors have not been considered further.

Background concentrations

- 4.2.19 The background concentrations used in the assessment at each of the identified sensitive receptors derived from the Defra background maps have been updated to take account of the new receptor locations and changes in the assessment years.
- 4.2.20 The background maps have 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.
- 4.2.21 The raw DEFRA background concentrations are presented in Table 4.9.

Compliance with the EU Directive on Ambient Air Quality

- 4.2.22 Following the submission of the 2016 ES, Defra have updated the Pollution Climate Mapping (PCM) model outputs for the compliance road network following the submission of the latest Air Quality Plan for the achievement of EU limit values of NO₂.

- 4.2.23 The compliance risk road assessment for the Scheme has been updated following the same methodology as outlined in the 2016 ES taking account of the latest PCM model data released by Defra in August 2017.

Model Verification

- 4.2.24 The air quality model verification has been updated to take account of the new SATURN data, which has a base year 2016. The updated verification follows the same methodology as described in the 2016 ES and is presented in Appendix A.

4.3 Baseline Information

Overview

- 4.3.1 The baseline has been updated to present data available for 2016 to reflect the most recent pollutant concentrations within the study area. To provide context to the additional 2016 monitoring data, the relevant sections which the data relates to have been reproduced within this report.
- 4.3.2 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

- 4.3.3 There have been no changes to declarations of air quality management areas (AQMAs) since the submission of the 2016 ES.

Local Authority Automatic Monitoring

Nitrogen Dioxide

- 4.3.4 BCC currently undertakes air quality monitoring for NO₂ at seven continuous monitoring stations within its boundary. Table 4.3 presents the latest automatic NO₂ monitoring results available for all of these stations.
- 4.3.5 The monitoring results show that background concentrations are below the annual mean NO₂ objective and have fallen by an average of 2.7µg/m³ between 2014 and 2016, highlighting an overall improvement in NO₂ concentrations.
- 4.3.6 Roadside concentrations have remained largely the same or have shown an overall improvement between 2014 and 2016, with the exception of Moor Street Queensway. Moor Street shows an increase of 7 µg/m³ from the 2014 annual mean, which was already in exceedance of the NO₂ annual mean objective. The Moor Street Queensway automatic monitor is the station closest to the proposed BEE, located approximately 100m away, however there is no relevant public exposure for the annual mean air quality objective at this location. It should be noted that an additional continuous monitoring station was installed by DEFRA on Keeley Street in September 2016, however as no complete calendar year of data is available, monitored concentrations have not been presented.

Table 4.3: BCC continuous monitoring data for NO₂ 2014-2016

Site ID	Site Classification	National Grid Reference		Distance from the BEE (km)	Annual Mean Concentrations (µg/m ³)		
		X	Y		2014	2015	2016
Birmingham Tyburn Roadside	Roadside	411577	290491	5.1	42	43	43^(a)
Birmingham Tyburn	Urban Background	411592	290440	5.1	31	30	29
New Hall	Urban Background	414574	296724	11.8	17	16	16
Stratford Road	Urban Roadside	408820	284591	2.0	36	33	37
Bristol Road	Roadside	404545	283020	4.5	34	29	25
Moor Street Queensway	Roadside	407435	286891	0.1	43	45	50
Acocks Green	Urban Background	411649	282207	5.6	37 ^(b)	18	21

Source: BCC, Defra.

Note: Bold indicates exceedance of objective

^(a) Data capture only 68%. Concentration not annualised by BCC

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

Particulate Matter (PM₁₀)

4.3.7 BCC currently undertakes air quality monitoring for PM₁₀ at two continuous monitoring stations within its administrative boundary. Table 4.4 presents the latest automatic PM₁₀ monitoring results available for these stations and Appendix B Figure 4.3 presents the locations of these sites.

4.3.8 The monitoring results show that background concentrations are below the annual mean PM₁₀ objective and have fallen each year between 2014 and 2016 for Roadside and Urban Background concentrations at the Tyburn monitoring site, highlighting an overall improvement in PM₁₀ concentrations.

Table 4.4: BCC continuous monitoring data for PM₁₀ 2014-2016

Site ID	Site Classification	National Grid Reference		Distance from the BEE (km)	Annual Mean Concentration (µg/m ³)		
		X	Y		2014	2015	2016
Birmingham Tyburn	Roadside	411577	290491	5.1	20	17	18 ^(a)
Birmingham Tyburn	Urban Background	411592	290440	5.1	19	15	16

Source: DEFRA AIR

Note: Bold indicates exceedance of objective

^(a) Data capture is 52%. Concentration not annualised by BCC.

Particulate Matter (PM_{2.5})

4.3.9 BCC currently undertakes air quality monitoring for PM_{2.5} at three continuous monitoring stations within its administrative boundary. Table 4.5 presents the latest automatic PM_{2.5} monitoring results available for these stations between 2014 and 2016. The results indicate concentrations are well below the objectives.

Table 4.5: BCC Continuous Monitoring Data for PM_{2.5} 2014-2016

Site ID	Site Classification	National Grid Reference		Distance from the BEE (km)	Annual Mean Concentration (µg/m ³)		
		X	Y		2014	2015	2016
Birmingham Tyburn	Roadside	411577	290491	5.1	14	12	12
Birmingham Tyburn	Urban Background	411592	290440	5.1	13	10	11
Acocks Green	Urban Background	411649	282207	5.6	12 ^(a)	9	10

Source: Defra AIR

Note: Bold indicates exceedance of objective

^(a) Data capture less than 75%

Local Authority Diffusion Tube Monitoring

4.3.10 BCC undertakes diffusion tube monitoring at multiple sites within its administrative boundary. Table 4.6 presents the latest results for NO₂ diffusion tubes relevant to the study area and Appendix B Figure 4.4 presents the locations of the diffusion tubes. Since the original assessment in 2016, BCC has changed the locations of diffusion tubes within the area. As such, some diffusion tube locations have no data for 2016 and others have no data prior to 2016.

4.3.11 The data illustrates that NO₂ concentrations are above the annual mean objective at the majority of sites in 2016 and NO₂ concentrations generally increase between 2015 and 2016.

Table 4.6: BCC NO₂ Diffusion Tube Data for 2014-2016

Site ID	Site Classification	National Grid Reference		Distance from the BEE (m)	Annual Mean Concentration (µg/m ³)		
		X	Y		2014 ^(a)	2015 ^(a)	2016 ^(a)
1	Roadside	407060	286868	160	36	33	^(b)
2	Roadside	407060	286868	160	37	36	^(b)
3	Roadside	407114	286906	105	31	30	38
4	Roadside	407177	286996	15	36	32	42
5	Roadside	407205	287065	25	50	46	54
6	Roadside	407154	287104	70	30	29	^(b)
7	Roadside	407217	287132	90	53	51	^(b)
8	Roadside	407259	287110	95	47	42	54
9	Roadside	407407	287092	130	50	49	63
10	Roadside	407399	287078	120	55	50	66
11	Roadside	407548	287107	100	45	42	53
12	Roadside	407611	287110	80	45	43	54
13	Roadside	407628	287121	85	48	46	55
14	Roadside	407603	287033	10	55	54	^(b)
15	Roadside	407547	287050	45	58	59	^(b)
16	Roadside	407488	287023	40	56	49	58
17	Roadside	407510	286963	20	45	44	^(b)
18	Roadside	407455	286989	20	49	47	54
19	Roadside	407433	286922	35	58	55	69
20	Roadside	407439	286886	70	52	51	^(b)

Site ID	Site Classification	National Grid Reference		Distance from the BEE (m)	Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)		
		X	Y		2014 ^(a)	2015 ^(a)	2016 ^(a)
21	Roadside	407372	286844	105	57	56	^(b)
22	Roadside	407355	286769	175	57	54	64
23	Roadside	407320	286756	185	56	52	68
24	Roadside	407348	286722	220	66	61	75
25	Roadside	407377	286896	55	43	41	55
26	Roadside	407242	286822	120	38	33	^(b)
27	Roadside	407255	286862	75	46	43	^(b)
28	Roadside	407278	286931	10	47	47	^(b)
29	Roadside	407233	286982	5	45	41	^(b)
32	Roadside	407509	287226	225	33	36	41
2016-3	Roadside	408586	286455	630	^(c)	^(c)	28
2016-4	Roadside	407582	287020	10	^(c)	^(c)	55
2016-5	Roadside	407547	287047	50	^(c)	^(c)	77
2016-6	Roadside	407446	286478	140	^(c)	^(c)	65

Note: ^(a) Data via BCC Annual Status Report 2016 and via email with BCC. All values are bias adjusted

^(b) Diffusion tube no longer located at this site

^(c) Diffusion tube site introduced in 2016.

Bold indicates exceedance of objective

BEE specific diffusion tube monitoring

4.3.12

Mott MacDonald undertook a six month NO₂ diffusion tube monitoring survey at nine sites between 30 November 2015 and 8 June 2016. The results have been annualised to 2016 following the method outlined in TG16. Table 4.7 below shows the 2016 annualisation factor and Table 4.8 shows the updated monitoring results.

Table 4.7: Annualisation factor

Monitoring station	Period mean NO ₂ ($\mu\text{g}/\text{m}^3$) ^(a)	2016 annual mean NO ₂ ($\mu\text{g}/\text{m}^3$) ^(b)
Birmingham Acocks Green	20.8	21.3
Coventry Allesley	22.7	22.6
Leamington Spa	20.7	21.4
Walsall Woodlands	18.9	18.4
Annualisation Factor		1.01

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

^(b) Annual average for 2016

Table 4.8: BEE specific NO₂ diffusion tube data

Site ID ^(a)	Site Classification	X	Y	Annual mean concentration (2016) ($\mu\text{g}/\text{m}^3$) ^(b)
Site 1A/1B	Roadside	407472	287307	36.5
Site 2A/2B	Roadside	407757	287365	35.3
Site 3A/3B	Roadside	407995	287174	35.2
Site 5A/5B	Roadside	408222	286171	39.7
Site 6A/6B	Roadside	408570	286261	57.5

Site ID ^(a)	Site Classification	X	Y	Annual mean concentration (2016) ($\mu\text{g}/\text{m}^3$) ^(b)
Site 7A/7B	Background	407677	286987	36.9
Stop 1A/1B	Roadside	407527	286989	39.2
Stop 4A/4B	Roadside	407854	286335	36.7
MSQ A/B/C	Roadside	407432	286884	45.0

Note: ^(a) Site 4 ID unused

^(b) Monitoring data annualised following DEFRA TG16 methodology (DEFRA, 2016).

Bold indicates exceedance of objective. Bias Adjustment factor of 0.87 used (National Diffusion Tube Bias Adjustment Factor spreadsheet v06/17)

Defra Projected Background Concentrations

4.3.13 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 4.9 presents Defra projected background concentrations for the study area.

Table 4.9: Defra Projected Background Concentrations of NO_x, NO₂, PM₁₀ and PM_{2.5} for the study area

Grid Square (national grid reference)		2016				2022			
X	Y	NO _x	NO ₂	PM ₁₀	PM _{2.5}	NO _x	NO ₂	PM ₁₀	PM _{2.5}
407500	285500	45.6	28.4	18.1	12.9	34.8	22.8	17.4	12.2
408500	285500	48.3	29.6	18.4	13.1	37.3	24	17.7	12.4
405500	286500	46.1	28.7	17.8	12.8	35.2	23.1	17	12
406500	286500	58.2	34.2	19.2	13.8	45.8	28.3	18.2	12.8
407500	286500	54.3	32.3	18.7	13.4	43.1	26.9	17.8	12.6
408500	286500	50.8	30.8	18.8	13.4	39.2	25	18.1	12.7
407500	287500	55.9	33.3	19.6	14	42.5	26.8	18.7	13.1

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

Background Concentrations Used Within Assessment

4.3.14 In the absence of continuous background monitoring data within the study area, the background concentrations used within the assessment have been taken from Defra projected background concentrations.

4.4 Operation – Likely Significant Effects

Nitrogen Dioxide (NO₂) Concentrations

4.4.1 Table 4.10 presents the annual mean NO₂ concentrations and impact descriptors for all modelled receptors in the Do-Minimum and Do-Something scenarios.

4.4.2 Concentration changes predicted as a result of the BEE are 'negligible' or 'slight beneficial' at all receptors and modelled concentrations of NO₂ are predicted to be below the annual mean

objective in the Do-Minimum and Do-Something scenarios. The greatest improvement is predicted at Digbeth 3 (receptor 10) where a reduction in annual mean NO₂ of 1.0µg/m³ (-2.5% relative to the AQ objective) is predicted. This corresponds to a 'slight beneficial' impact.

4.4.3 The greatest increase in annual NO₂ is predicted at Fazeley Street (receptor 16), where an increase of 0.9µg/m³ (2.3% relative to the AQ objective) is predicted. The highest predicted annual mean NO₂ concentration (32.7µg/m³ in the Do-Something scenario) is predicted at Masshouse Plaza (receptor 1). Nonetheless, the impact of the BEE on NO₂ concentrations at both these receptors is classified as 'negligible' in accordance with the IAQM significance criteria adopted for this assessment. This indicates that the BEE will not have a significant effect on air quality in terms of NO₂ concentrations.

4.4.4 As annual mean concentrations are predicted to be well below 60µg/m³ at all receptors, no exceedances of the hourly objective are predicted as a result of the BEE.

Table 4.10: 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
		2016	2022 DM	2022 DS		
1	Masshouse Plaza	48.3	32.9	32.7	-0.6	Negligible
2	Travelodge (ST)	37.2	27.9	27.7	-0.6	Negligible
3	Allison Street	34.6	27.3	27.5	0.5	Negligible
4	Coventry Street	35.9	28.4	28.1	-0.9	Negligible
5	Digbeth 1	49.9	32.2	32.2	0.0	Negligible
6	Upper Dean Street	35.8	27.9	27.8	-0.3	Negligible
7	Digbeth 2	42.8	30.6	30.8	0.4	Negligible
8	Rea Street	40.6	30.0	29.9	-0.2	Negligible
9	High Street	36.9	28.2	27.7	-1.2	Negligible
10	Digbeth 3	41.1	30.9	29.9	-2.5	Slight Beneficial
11	Farmacre	39.3	29.2	29.3	0.4	Negligible
12	Hawthorn Close	37.1	28.1	28.3	0.5	Negligible
13	Adderley Street	32.9	26.5	26.7	0.5	Negligible
14	Bradford Street 1	35.3	27.3	27.0	-0.7	Negligible
15	Bradford Street 2	37.1	29.0	28.8	-0.5	Negligible
16	Fazeley Street	34.4	28.3	29.2	2.3	Negligible
17	Pershore Street	35.6	28.6	28.8	0.6	Negligible
18	Trinity Court	36.1	27.6	27.8	0.6	Negligible
19	Hotel Latour (ST)	41.3	29.7	29.5	-0.6	Negligible
20	Floodgate Street	33.2	27.0	27.5	1.4	Negligible
21	Barford Street (ST)	34.7	27.9	28.1	0.5	Negligible

Note: ST – short term receptor for comparison with short term (one hour) averaging periods, DM – Do-Minimum scenario, DS – Do-Something scenario
% change relative to AQ objective refers to change between DM and DS in 2022

Particulate Matter (PM₁₀) Concentrations

- 4.4.5 Table 4.11 presents the annual mean PM₁₀ concentrations and impact descriptors for all modelled receptors in the Do-Minimum and Do-Something scenarios.
- 4.4.6 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 Do-Minimum and Do-Something scenarios. This indicates that the BEE will not have a significant effect on air quality in terms of PM₁₀ concentrations. Daily mean PM₁₀ concentrations are also well below the objective and have therefore not been presented.
- 4.4.7 The greatest improvement is predicted at Digbeth 3 (receptor 10) where a reduction in annual mean PM₁₀ of 0.2µg/m³ (-0.6% relative to the AQ objective) is predicted.
- 4.4.8 The greatest increase in annual PM₁₀ is predicted at Fazeley Street (receptor 16), where an increase of 0.2µg/m³ (0.5% relative to the AQ objective) is predicted. The highest predicted annual mean PM₁₀ concentration (19.6µg/m³ in the Do-Something scenario) is predicted at Masshouse Plaza (receptor 1).

Table 4.11: 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
		2016	2022 DM	2022 DS		
1	Masshouse Plaza	20.8	19.6	19.6	-0.1	Negligible
2	Travelodge (ST)	18.9	18.1	18.1	0.0	Negligible
3	Allison Street	18.8	18.0	18.1	0.1	Negligible
4	Coventry Street	18.9	18.3	18.2	-0.1	Negligible
5	Digbeth 1	20.2	18.8	18.8	0.0	Negligible
6	Upper Dean Street	18.9	18.2	18.1	-0.1	Negligible
7	Digbeth 2	19.6	18.7	18.7	0.1	Negligible
8	Rea Street	19.5	18.6	18.6	0.0	Negligible
9	High Street	19.8	19.1	18.9	-0.4	Negligible
10	Digbeth 3	19.6	18.9	18.7	-0.6	Negligible
11	Farmacre	20.1	19.2	19.2	0.1	Negligible
12	Hawthorn Close	19.7	18.9	18.9	0.1	Negligible
13	Adderley Street	19.1	18.4	18.5	0.1	Negligible
14	Bradford Street 1	19.1	18.5	18.4	-0.2	Negligible
15	Bradford Street 2	19.0	18.4	18.3	-0.1	Negligible
16	Fazeley Street	19.3	18.9	19.1	0.5	Negligible
17	Pershore Street	18.9	18.3	18.4	0.2	Negligible
18	Trinity Court	19.4	18.6	18.7	0.1	Negligible
19	Hotel Latour (ST)	19.4	18.5	18.4	-0.1	Negligible
20	Floodgate Street	19.1	18.6	18.7	0.3	Negligible
21	Barford Street (ST)	18.8	18.2	18.3	0.1	Negligible

Note: ST – short term receptor for comparison with short term (one hour) averaging periods are not relevant for PM₁₀ as no one hour standards exist, DM – Do-Minimum scenario, DS – Do-Something scenario
% change relative to AQ objective refers to change between DM and DS in 2022

Particulate Matter (PM_{2.5}) Concentrations

- 4.4.9 Table 4.12 presents the annual mean PM_{2.5} concentrations and impact descriptors for all modelled receptors in the Do-Minimum and Do-Something scenarios.
- 4.4.10 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 Do-Minimum and Do-Something scenarios. This indicates that the BEE will not have a significant effect on air quality in terms of PM_{2.5} concentrations.
- 4.4.11 The greatest improvement is predicted at Digbeth 3 (receptor 10) where a reduction in annual mean PM_{2.5} of 0.1µg/m³ (-0.6% relative to the AQ objective) is predicted.
- 4.4.12 The greatest increase in annual PM_{2.5} is predicted at Fazeley Street (receptor 16), where an increase of 0.1µg/m³ (0.5% relative to the AQ objective) is predicted. The highest predicted annual mean PM_{2.5} concentration (13.5µg/m³ in the Do-Something scenario) is predicted at Masshouse Plaza (receptor 1).

Table 4.12: 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
		2016	2022 DM	2022 DS		
1	Masshouse Plaza	14.7	13.6	13.5	-0.1	Negligible
2	Travelodge (ST)	13.4	12.7	12.6	0.0	Negligible
3	Allison Street	13.3	12.6	12.6	0.1	Negligible
4	Coventry Street	13.4	12.7	12.7	-0.1	Negligible
5	Digbeth 1	14.2	13.0	13.0	0.0	Negligible
6	Upper Dean Street	13.4	12.7	12.7	0.0	Negligible
7	Digbeth 2	13.8	13.0	13.0	0.1	Negligible
8	Rea Street	13.8	13.0	13.0	0.0	Negligible
9	High Street	13.9	13.2	13.1	-0.4	Negligible
10	Digbeth 3	13.8	13.1	13.0	-0.6	Negligible
11	Farmacre	14.1	13.2	13.3	0.1	Negligible
12	Hawthorn Close	13.9	13.1	13.1	0.1	Negligible
13	Adderley Street	13.5	12.8	12.9	0.1	Negligible
14	Bradford Street 1	13.5	12.8	12.8	-0.2	Negligible
15	Bradford Street 2	13.5	12.8	12.8	-0.1	Negligible
16	Fazeley Street	13.6	13.1	13.2	0.5	Negligible
17	Pershore Street	13.4	12.8	12.8	0.1	Negligible
18	Trinity Court	13.6	12.9	12.9	0.1	Negligible
19	Hotel Latour (ST)	13.8	12.9	12.9	-0.1	Negligible
20	Floodgate Street	13.5	12.9	13.0	0.3	Negligible
21	Barford Street (ST)	13.4	12.7	12.8	0.1	Negligible

Note: ST – short term receptor for comparison with short term (one hour) averaging periods are not relevant for PM_{2.5} as no one hour standards exist, DM – Do-Minimum scenario, DS – Do-Something scenario
% change relative to AQ objective refers to change between DM and DS in 2022

Compliance Risk Assessment

- 4.4.13 A compliance risk analysis for the PCM links in the Compliance Risk Road Network (CRRN) is required when pollutant concentrations at the worst affected receptor adjacent to the CRRN is predicted to experience an increase of more than $0.4\mu\text{g}/\text{m}^3$ in annual mean NO_2 . There are no increases greater than $0.4\mu\text{g}/\text{m}^3$ at any receptors adjacent to the CRRN. Therefore, no further assessment is required and there is a low risk of the BEE affecting the UK's reported ability to comply with the EU Air Quality Directive.

Sensitivity analysis

- 4.4.14 A sensitivity analysis was carried out to determine the sensitivity of modelled results to assumptions regarding future baseline air quality. The sensitivity analysis presents concentrations of NO_2 , PM_{10} and $\text{PM}_{2.5}$ at receptors with 2022 modelled DM and DS emissions and 2016 background pollutant concentrations (i.e. it assumes there is no improvement in future background pollutant concentrations between 2016 and 2022).

NO_2 concentrations

- 4.4.15 The results for the sensitivity analysis for annual mean NO_2 are presented in Table 4.13. The sensitivity analysis assumes that there is no improvement in background pollutant concentrations from the 2016 base year.
- 4.4.16 The concentration changes predicted in the sensitivity analysis at modelled receptors are 'negligible', 'slight beneficial' or 'slight adverse'. Modelled concentrations of NO_2 are predicted to be below the annual mean objective in the Do-Minimum and Do-Something scenarios. The greatest improvement is predicted at Digbeth 3 (receptor 10) where a reduction in annual mean NO_2 of $1.0\mu\text{g}/\text{m}^3$ (-2.5% relative to the AQ objective) is predicted. This corresponds to a 'slight beneficial' impact.
- 4.4.17 The greatest increase in annual NO_2 is predicted at Fazeley Street (receptor 16), where an increase of $0.9\mu\text{g}/\text{m}^3$ (2.2% relative to the AQ objective) is predicted, which corresponds to a 'slight adverse' impact. Nonetheless, the Do-Something concentration at this receptor ($34.5\mu\text{g}/\text{m}^3$) is below the annual mean NO_2 objective. The highest predicted annual mean NO_2 concentration ($39.0\mu\text{g}/\text{m}^3$ in the Do-Something scenario) is predicted at Masshouse Plaza (receptor 1) yet a 'slight beneficial' impact is predicted at this receptor.
- 4.4.18 Overall the results from this sensitivity analysis indicates that even with no future in improvement in background air quality, the BEE will not have a significant effect on air quality in terms of NO_2 concentrations.

Table 4.13: Annual mean NO_2 predicted concentrations ($\mu\text{g}/\text{m}^3$)

Receptor ID	Receptor name	Annual mean NO_2 concentration $\mu\text{g}/\text{m}^3$ (2016 backgrounds)			% change relative to AQ objective	Impact descriptor
		2016	2022 DM	2022 DS		
1	Masshouse Plaza	48.3	39.2	39.0	-0.5	Slight Beneficial
2	Travelodge (ST)	37.2	32.7	32.4	-0.6	Negligible
3	Allison Street	34.6	32.0	32.2	0.5	Negligible
4	Coventry Street	35.9	33.1	32.8	-0.8	Negligible
5	Digbeth 1	49.9	36.8	36.8	0.0	Negligible
6	Upper Dean Street	35.8	32.7	32.6	-0.3	Negligible

Receptor ID	Receptor name	Annual mean NO ₂ concentration µg/m ³ (2016 backgrounds)			% change relative to AQ objective	Impact descriptor
		2016	2022 DM	2022 DS		
7	Digbeth 2	42.8	35.3	35.4	0.4	Negligible
8	Rea Street	40.6	34.7	34.6	-0.2	Negligible
9	High Street	36.9	33.5	33.0	-1.2	Negligible
10	Digbeth 3	41.1	35.5	34.5	-2.5	Slight Beneficial
11	Farmacre	39.3	34.4	34.6	0.4	Negligible
12	Hawthorn Close	37.1	33.4	33.6	0.4	Negligible
13	Adderley Street	32.9	31.8	32.0	0.5	Negligible
14	Bradford Street 1	35.3	32.7	32.5	-0.7	Negligible
15	Bradford Street 2	37.1	33.7	33.5	-0.5	Negligible
16	Fazeley Street	34.4	33.6	34.5	2.2	Slight Adverse
17	Pershore Street	35.6	33.3	33.5	0.6	Negligible
18	Trinity Court	36.1	33.0	33.3	0.6	Negligible
19	Hotel Latour (ST)	41.3	34.4	34.1	-0.6	Negligible
20	Floodgate Street	33.2	32.3	32.8	1.3	Negligible
21	Barford Street (ST)	34.7	32.7	32.9	0.5	Negligible

Note: ST – short term receptor for comparison with short term (one hour) averaging periods, DM – Do-Minimum scenario, DS – Do-Something scenario
% change relative to AQ objective refers to change between DM and DS

PM₁₀ concentrations

4.4.19 The results for the sensitivity analysis for annual mean PM₁₀ are presented in Table 4.14.

4.4.20 The PM₁₀ impacts are predicted to be ‘negligible’ at all receptors and predicted concentrations remain below the relevant air quality objectives. The overall impact descriptions for PM₁₀ in the sensitivity analysis are unchanged from the main assessment. This indicates that with conservative assumptions, the BEE will not have a significant effect on air quality in terms of PM₁₀ concentrations.

Table 4.14: Annual mean PM₁₀ predicted concentrations (µg/m³)

Receptor ID	Receptor name	Annual mean PM ₁₀ concentration µg/m ³ (2016 backgrounds)			% change relative to AQ objective	Impact descriptor
		2016	2022 DM	2022 DS		
1	Masshouse Plaza	20.8	20.5	20.5	-0.1	Negligible
2	Travelodge (ST)	18.9	18.7	18.7	0.0	Negligible
3	Allison Street	18.8	18.7	18.7	0.1	Negligible
4	Coventry Street	18.9	18.9	18.8	-0.1	Negligible
5	Digbeth 1	20.2	19.4	19.4	0.0	Negligible
6	Upper Dean Street	18.9	18.8	18.8	-0.1	Negligible
7	Digbeth 2	19.6	19.3	19.3	0.1	Negligible
8	Rea Street	19.5	19.3	19.3	0.0	Negligible

Receptor ID	Receptor name	Annual mean PM ₁₀ concentration µg/m ³ (2016 backgrounds)			% change relative to AQ objective	Impact descriptor
		2016	2022 DM	2022 DS		
9	High Street	19.8	19.7	19.6	-0.4	Negligible
10	Digbeth 3	19.6	19.5	19.3	-0.6	Negligible
11	Farmacre	20.1	19.8	19.9	0.1	Negligible
12	Hawthorn Close	19.7	19.6	19.6	0.1	Negligible
13	Adderley Street	19.1	19.1	19.2	0.1	Negligible
14	Bradford Street 1	19.1	19.1	19.1	-0.2	Negligible
15	Bradford Street 2	19.0	19.0	19.0	-0.1	Negligible
16	Fazeley Street	19.3	19.5	19.8	0.5	Negligible
17	Pershore Street	18.9	19.0	19.0	0.2	Negligible
18	Trinity Court	19.4	19.3	19.4	0.1	Negligible
19	Hotel Latour (ST)	19.4	19.1	19.1	-0.1	Negligible
20	Floodgate Street	19.1	19.2	19.3	0.3	Negligible
21	Barford Street (ST)	18.8	18.9	18.9	0.1	Negligible

Note: ST – short term receptor for comparison with short term (one hour) averaging periods are not relevant for PM₁₀ as no one hour standards exist, DM – Do-Minimum scenario, DS – Do-Something scenario
% change relative to AQ objective refers to change between DM and DS

PM_{2.5} concentrations

4.4.21 The results for the sensitivity analysis for annual mean PM_{2.5} are presented in Table 4.15.

4.4.22 The PM_{2.5} impacts are predicted to be ‘negligible’ at all receptors and predicted concentrations remain below the relevant air quality objectives. The overall impact descriptions for PM_{2.5} in the sensitivity analysis are unchanged from the main assessment. This indicates that with conservative assumptions, the BEE will not have a significant effect on air quality in terms of PM_{2.5} concentrations.

Table 4.15: Annual mean PM_{2.5} predicted concentrations (µg/m³)

Receptor ID	Receptor name	Annual mean PM _{2.5} concentration µg/m ³ (2016 backgrounds)			% change relative to AQ objective	Impact descriptor
		2016	2022 DM	2022 DS		
1	Masshouse Plaza	14.7	14.5	14.4	-0.1	Negligible
2	Travelodge (ST)	13.4	13.3	13.3	0.0	Negligible
3	Allison Street	13.3	13.2	13.3	0.1	Negligible
4	Coventry Street	13.4	13.4	13.3	-0.1	Negligible
5	Digbeth 1	14.2	13.7	13.7	0.0	Negligible
6	Upper Dean Street	13.4	13.3	13.3	0.0	Negligible
7	Digbeth 2	13.8	13.6	13.6	0.1	Negligible
8	Rea Street	13.8	13.6	13.6	0.0	Negligible
9	High Street	13.9	13.8	13.8	-0.4	Negligible
10	Digbeth 3	13.8	13.7	13.6	-0.6	Negligible
11	Farmacre	14.1	13.9	13.9	0.1	Negligible
12	Hawthorn Close	13.9	13.7	13.8	0.1	Negligible

Receptor ID	Receptor name	Annual mean PM _{2.5} concentration µg/m ³ (2016 backgrounds)			% change relative to AQ objective	Impact descriptor
		2016	2022 DM	2022 DS		
13	Adderley Street	13.5	13.5	13.5	0.1	Negligible
14	Bradford Street 1	13.5	13.5	13.4	-0.2	Negligible
15	Bradford Street 2	13.5	13.4	13.4	-0.1	Negligible
16	Fazeley Street	13.6	13.7	13.8	0.5	Negligible
17	Pershore Street	13.4	13.4	13.5	0.1	Negligible
18	Trinity Court	13.6	13.5	13.6	0.1	Negligible
19	Hotel Latour (ST)	13.8	13.5	13.5	-0.1	Negligible
20	Floodgate Street	13.5	13.6	13.6	0.3	Negligible
21	Barford Street (ST)	13.4	13.4	13.4	0.1	Negligible

Note: ST – short term receptor for comparison with short term (one hour) averaging periods are not relevant for PM_{2.5} as no one hour standards exist, DM – Do-Minimum scenario, DS – Do-Something scenario
% change relative to AQ objective refers to change between DM and DS

4.5 Comparison with 2016 ES air quality assessment

- 4.5.1 The overall conclusions of this report are the same as those of the air quality assessment in the 2016 ES. The impacts are described as not significant and there is a low risk of the scheme affecting compliance with the EU Air Quality Directive.
- 4.5.2 The main difference in the results is that overall effects are lower than the 2016 ES. The 2016 ES concluded that the impacts associated with BEE ranged from ‘moderate beneficial’ to ‘moderate adverse’ while this report concludes that most receptors will experience a ‘negligible’ impact and none will experience an adverse effect.

4.6 Summary

- 4.6.1 This chapter provides an updated air quality assessment for the BEE. The assessment has been updated in line with traffic data supplied from BCC’s updated SATURN traffic model.
- 4.6.2 There have been no updates to the construction phase assessment conducted and presented in the 2016 ES.
- 4.6.3 The air quality effects of the operation of the BEE have been considered at receptors, using an atmospheric dispersion model. The model has been verified against air quality monitoring data and has been used to estimate the air quality effects of the BEE using detailed traffic forecasts covering all periods of the day.
- 4.6.4 The assessment shows that, even with conservative assumptions regarding vehicle numbers and background pollutant concentrations, there are no significant air quality effects and there is a low risk of the BEE affecting the UK’s reported ability to comply with the EU Air Quality Directive.
- 4.6.5 As a result, the BEE is not considered to conflict with any national, regional or local planning policy within BCC.

4.7 Comparison to 2016 ES

- 4.7.1 The overall conclusions of this report match those that were reported in the 2016 ES.

5 Greenhouse Gases

5.1 Introduction

- 5.1.1 The Greenhouse Gas (GHG) chapter of this report provides an update to the Chapter 12 and Technical Appendix O of the 2016 ES. Updates have been provided where new publicly available information has been published, and with new traffic data as outlined in Chapter 1. A summary of the updates to the GHG assessment are presented in Table 5.1 below.

Table 5.1: Summary of updates to 2016 ES

Section	Change in ES	Change in Technical Appendix O
Introduction/Background	No change	No change
BEE design in context of carbon effects	No Change	No change
Legislation, guidance and best practice	No change	No change
Spatial scope	Paragraph 12.2.10 amended otherwise no change	Paragraph 1.3.2 amended otherwise no change
Temporal scope	No change	Paragraph 1.3.6 amended otherwise no change
Sensitive receptors	No change	No change
Desk study	Paragraph 12.2.18 amended otherwise no change	No change
Data sources	N/A	Paragraph 1.3.16, table 1.3, paragraph 1.3.18, paragraph 1.3.19, and table 1.4 amended otherwise no change
Assessment Criteria	No change	No change
Consultation	No change	N/A
Assumptions and Limitations	Paragraph 12.4.4 amended otherwise no change	N/A
Baseline Information	All paragraphs and tables amended	Paragraph 1.4.3, table 1.5, table 1.6, paragraph 1.4.6, table 1.7, and table 1.8 amended otherwise no change
Embedded Mitigation	No change	N/A
Construction – Likely Significant Effects	Table 12.3 amended otherwise no change	Table 1.9 amended otherwise no change
Operation – Likely Significant Effects	All paragraphs and tables amended	All paragraphs and tables amended
Cumulative Effects	Paragraph 12.9.2 amended otherwise no change	N/A
Summary	Paragraph 12.10.4 amended otherwise no change	N/A

- 5.1.2 Where an update has been made, the full paragraph or table has been presented in the relevant section below. It is recommended that this section is read in conjunction with Chapter 12 of the ES and Technical Appendix O.

5.2 Introduction/Background

- 5.2.1 *No changes have been made to this section from the 2016 ES chapter.*

5.3 BEE design in context of carbon effects

- 5.3.1 *No changes have been made to this section from the 2016 ES chapter.*

5.4 Legislation, guidance and best practice

5.4.1 *No changes have been made to this section from the 2016 ES chapter.*

5.5 Spatial scope

5.5.1 *No changes have been made to this section from the 2016 ES chapter other than the changes presented below.*

Paragraph 12.2.10 in the ES

5.5.2 The assessment of the GHG emissions during the operational phase includes the route of the BEE itself, as well as the scope of the transport network model detailed in Chapter 2.

Paragraph 1.3.2 in Technical Appendix O

5.5.3 The BEE has the potential to create GHG emission due to the redistribution of traffic on the affected road network, as presented in Chapter 9 of the 2016 ES. Emissions of GHG from road vehicles are a function of the engine size, speed and fuel type. At a network level, emissions are dependent on overall traffic flows and the relative mix of different vehicle classes. The BEE has the potential to affect a combination of these functions, leading to a change in overall GHG emissions. The assessment of the GHG emissions from the transport network therefore considers the changes within the transport network, details of the modelling of this network can be found in Chapter 2.

5.6 Temporal scope

5.6.1 *No changes have been made to this section from the 2016 ES chapter other than the changes presented below.*

Paragraph 1.3.6 in Technical Appendix O

5.6.2 As a realistic 'worst case' scenario, the carbon assessment has quantified changes in GHG emissions from the road network for the opening year (2022) based on the traffic data detailed in Chapter 2. Traffic flows have been modelled for the years of 2026 and 2031. For 2022, the 2026 flows have been used on the basis that these are likely to be greater than those in 2022. The assessment has also considered how the operational carbon emissions may change in the future, based on projected changes to the electricity grid, which would affect the rate at which carbon is produced per unit of energy consumed. Given existing trends, 2022 is considered to be a representative realistic worst case, however, predictions have also been made for 2032 (opening year plus 10 years) to provide additional context.

5.7 Sensitive receptors

5.7.1 *No changes have been made to this section from the 2016 ES chapter.*

5.8 Desk study

5.8.1 *No changes have been made to this section from the 2016 ES chapter other than the changes presented below.*

Paragraph 12.2.18 in the ES

5.8.2 The methodology for calculating the GHG emissions associated with each of the sources outlined in Paragraph 12.2.16 is detailed Technical Appendix O or the 2016 ES and in this report. For construction emissions, which are a one-off source of emissions, information associated with the use of materials, plant and transport have been used in conjunction with

emission factors in order to quantify the total emissions associated with this construction phase. In the operational phase, information from traction power modelling and the traffic model have been used to compare the base case in the opening year (2022) with the situation following the introduction of the BEE in order to assess the potential changes due to the BEE.

5.9 Data sources

5.9.1 *No changes have been made to this section from the 2016 ES chapter other than the changes presented below.*

Paragraph 1.3.16 in Technical Appendix O

5.9.2 The BEE will lead to small adjustments in the flow of vehicles on the road network (source 6). Following the overarching approach set out in Design Manual for Roads and Bridges (DMRB), modelled flows for the baseline and BEE cases have been used, which are broken down in to the number of vehicles of mode type and speed. Emissions have been estimated using the Defra (2016) Emissions Factor Toolkit v7.0. The toolkit estimates emissions of GHG for each modelled road based on the flow, composition and speed of the traffic. This information has been obtained from the traffic data derived from the transport network model (further information in Chapter 2). Emission factor profiles for 2022 and 2030 (the closest year to the 2032 scenario) have been used).

Table 1.3 in the TA

5.9.3 This is replaced by Table 5.2 below.

Table 5.2: Summary of construction transport emission factors

Activity	Value	Unit
HDV Transport (all HDV, per km, fully laden)	0.9854	kgCO ₂ e/km
Workers (3.5t van equivalent, per km, unknown fuel)	0.2577	kgCO ₂ e/km

Paragraph 1.3.18 in Technical Appendix O

5.9.4 For electricity use, the Greenhouse Gas Reporting Conversion Factors have been used, which were published in August 2017. Emission factors change from year-to-year. Government policy suggests that emissions from electricity and transport will decrease in the future in order to meet targets set out in the Climate Change Act. This implicitly means that emission factors associated with electricity use in the future would be lower than those presently.

Paragraph 1.3.19 in Technical Appendix O

5.9.5 For this assessment present day emission factors have been used to estimate the impacts of the BEE as a conservative assumption and the value is taken from the latest emission factor dataset published by Department for Business, Energy and Industrial Strategy (DBEIS) as part of the Greenhouse Gas Reporting Conversion Factors. An additional calculation has been made of the impact based on projected emissions factors as sensitivity. Future emission factors are published by DECC as part of the Green Book (published March 2017). This provides factors for all years up to 2100. The grid-average factors for 2022 and 2032 are based on 'Industrial' classification has been used as the basis of comparison. The emission factors used are presented in Table 5.3 below.

Table 1.4 in Technical Appendix O

5.9.6 This is replaced by Table 5.3 below.

Table 5.3: Summary of grid electricity emission factors

Activity	Value	Unit
Present day (2016, generated, plus grid losses)	0.384	tCO ₂ e/MWh
Future emission factor (2022, Industrial, consumption)	0.170	tCO ₂ e/MWh
Future emission factor (2032, Industrial, consumption)	0.088	tCO ₂ e/MWh

5.10 Assessment Criteria

5.10.1 *No changes have been made to this section from the 2016 ES chapter.*

5.11 Consultation

5.11.1 *No changes have been made to this section from the 2016 ES chapter.*

5.12 Assumptions and Limitations

5.12.1 *No changes have been made to this section from the 2016 ES chapter other than the changes presented below.*

Paragraph 12.4.4 in the ES

- 5.12.2 Energy demand for the BEE has been determined from traction power modelling undertaken as part of the BEE development (source 4). This has been used to quantify emissions associated with the trams. The power demand modelling has assumed that the network operates at ten trams per hour in peak periods (6am to 8pm each day) and four trams per hour in off peak periods (8pm-1am weekdays, 8pm-3am weekends).
- 5.12.3 The modelled year is 2022 and it is assumed that operations are the same for 2032. For the base case the power modelling scenario includes all committed Midland Metro network extensions that will be implemented before the BEE (i.e. Wolverhampton Station extension, Centenary Square extension, Edgbaston extension) and as such represents the predicted baseline energy use of the Midland Metro network. The modelled power use conservatively assumes that each tram is fully laden with passengers at all times; auxiliary loads (heating and cooling) are also included. The model further accounts for regenerative braking (which reduces electricity demand). The total annual electricity demand is then calculated by the model.
- 5.12.4 Wider transport effects have been estimated from the transport network model (source 6). The assessment has considered the changes in traffic flows within the Birmingham city area, calculating emissions using the Emission Factor Toolkit (EFT) v7.0 (released in July 2016 by the Department for Transport). The traffic model is based on predicted flows for year 2026 and included in the base case all committed developments other than the Edgbaston Extension which was excluded from the Do-Minimum scenario but was included in the Do-Something scenario (further information on the transport network model is provided in Chapter 2).
- 5.12.5 For calculation of the GHG emissions, the year 2022 has been applied to be consistent with the assessment of other emissions sources. The EFT has a predefined set of emission factors for 2022 which are calculated based on the traffic data. For 2032, traffic data was used based on 2031 as per the Transport Assessment and the 2030 emission factors from the EFT have been used, the closest year available. In the EFT, all links have been defined as Urban (non-London) with the A38(M) defined as a motorway. Figure 4.2 in the Appendix outlines the extent of the model considered, which is consistent with the consideration given to air pollutant emissions (Chapter 11 in the 2016 ES). The model is presented as a series of links and the model produces information on vehicle flows for each link. Flows are split between light duty vehicles

(LDVs) and HDVs. The model also contains information on vehicle speeds. This is used to estimate emissions relating to source 6. The traffic model also includes information on the length of each part of the road network which is also part of the calculation process used in the EFT.

5.13 Baseline Information

5.13.1 *No changes have been made to this section from the 2016 ES chapter other than the changes presented below.*

Baseline Information in the ES

5.13.2 Estimates of emissions of GHG, by local authority area, were published by the Department for Energy and Climate Change (DECC) now the Department for Business, Energy and Industrial Strategy. This data shows that in general, total GHG emissions in the Birmingham area have declined between 2011 and 2015 (the latest data available), despite an increase in the overall population in Birmingham. Emissions from the transport sector have also declined although these are at a level of 1.4-1.5mtCO₂ per year. The declining trend is supported by data from the Department for Transport (DfT, Transport Statistics Great Britain: 2016, Chapter 3: Energy and environment, data tables, December, 2016) which shows that at the national level GHG emissions of all road vehicles except light vans have declined in recent years, with cars and taxis contributing most to the GHG emissions. Rail and light vans are the only transport modes whose emissions have increased during the same period, which is also reflected in the data for the Birmingham area, representing an overall increase in the use of public transport.

5.13.3 Based on project data, estimates of baseline GHG emissions have been created for BEE. For source 4, this represents the predicted GHG emissions due to the operation of the Midland Metro network in 2022 and 2032 without the BEE in place. Similarly, for source 6, the baseline represents predicted GHG emissions from the rest of road transport network in 2022 and 2032 without the BEE in operation. These have been used as the basis for the assessment of BEE and are presented in Table 5.4 and Table 5.5.

Table 5.4: Baseline emissions from traction energy use (source 4)

Activity	Value	Unit
Calculated emissions 2022 (2016 emission factor)	1.88	ktCO ₂ e
Calculated emissions 2022 (2022 emission factor)	0.83	ktCO ₂ e
Calculated emissions 2032 (2032 emission factor)	0.43	ktCO ₂ e

Table 5.5: Baseline emissions from road transport network (source 6)

Activity	Value	Unit
Baseline emissions of the road transport network, 2022	84.1	ktCO ₂ e
Baseline emissions of the road transport network, 2032	81.6	ktCO ₂ e

Paragraph 1.4.3 in Technical Appendix O

5.13.4 Table 5.6 presents a subset of the statistics for the BCC's administrative area published by DECC for the period 2005 to 2015. The dataset is split into four main categories by end-user (rather than source): industry and commercial, domestic, road transport and land use change and forestry (LULUCF). They are broken down further by specific uses. The breakdown by end user pertinent to transport (and this assessment) is shown in Table 5.6.

Table 1.5 in in Technical Appendix O

5.13.5 This is replaced by Table 5.6 below.

Table 5.6: Emissions in Birmingham by end user, '000 of tonnes of CO₂ equivalent (ktCO₂e/yr)

Year	2011	2012	2013	2014	2015	% change 2011/2015
Industry and commercial	2,083.0	2,232.8	2,139.7	1,778.0	1,578.0	-24
Domestic energy	1,871.5	2,011.9	1,956.4	1,627.0	1,540.1	-18
Transport total	1,482.3	1,465.4	1,427.1	1,457.3	1,447.2	-2
- A-Roads	406.9	402.6	385.2	386.4	393.6	-3
- Motorways	176.9	175.0	170.8	185.4	186.7	+6
- Minor Roads	843.0	831.2	814.8	828.3	812.1	-4
- Diesel railway	32.1	33.3	32.7	33.0	30.0	-6
- Transport Other	23.5	23.3	23.6	24.2	24.7	+5
LULUCF (net)	5.1	4.5	4.2	3.6	3.2	-37
Grand Total	5,442.0	5,714.6	5,527.3	4,865.8	4,568.5	-16
Population ('000s)	1,074.3	1,085.4	1,092.3	1,101.4	1,111.3	+3
Per Capita Emissions (t)	5.1	5.3	5.1	4.4	4.1	-19

Source: Local and Regional CO₂ Emissions Estimates for 2005-2015, produced by AEA for DECC, 2017

Table 1.6 in in Technical Appendix O

5.13.6 This is replaced by Table 5.7 below.

Table 5.7: UK GHG emissions from the transport sector by source, million tonnes of CO₂ equivalent (mtCO₂e)

Mode	2010	2011	2012	2013	2014	% change 2010/2014
Road Transport Total	110.3	108.9	108.6	107.8	109.3	--1
- Cars and taxis	70.2	69.4	69.1	68.0	68.5	-2
- Heavy goods vehicles (HGVs)	18.6	18.2	18.2	18.3	18.6	-<1
- Light vans	16.1	16.2	16.4	16.6	17.3	+7
- Buses and coaches	4.3	4.0	3.8	3.9	3.8	-11
- Motorcycles and mopeds	0.6	0.5	0.5	0.5	0.5	-6
- Other (road vehicle engines)	0.6	0.5	0.5	0.5	0.5	-5
Rail	2.0	2.0	2.0	2.0	2.0	+2
Domestic aviation	1.8	1.7	1.6	1.7	1.5	-13
Domestic shipping	2.6	2.5	2.4	2.3	2.4	-8
Other (military aircraft and shipping, aircraft support vehicles)	3.4	3.3	3.0	2.8	2.6	-24
Grand Total	120.1	118.3	117.7	116.6	117.9	-2

Source: DfT, Transport Statistics Great Britain: 2016, Chapter 3: Energy and environment, data tables, December 2016

Paragraph 1.4.6 in Technical Appendix O

5.13.7 Estimates of baseline conditions have additionally been produced. This is based on the predicted GHG emissions due to the operation of the Midland Metro network in 2022 (for source 6 emissions this is based on the 2026 modelled data) and 2032 (for source 6 emissions this is based on the 2031 modelled data) without the BEE is in place. The traction modelling, and as such the traction baseline, includes all committed tram extensions on the Midland Metro network that will be in operation before the BEE (i.e. Wolverhampton Station extension, Centenary Square extension). However, the transport modelling does not include Edgbaston extension in

the Do-Minimum Scenario, but does in the Do-Something Scenario. The transport modelling (see Chapter 2) has been used to provide estimates of the total GHG emissions from the road transport network in 2022 and 2032 without the BEE in operation. These have been used as the basis for the assessment of BEE and are presented in Table 5.8 and Table 5.9.

Table 1.7 in Technical Appendix O

5.13.8 This is replaced by Table 5.8 below.

Table 5.8: Baseline emissions from traction energy use (source 4)

Activity	Value	Unit
Predicted baseline 2022 electricity consumption of Metro	4,891	MWh
Calculated emissions 2022 (2016 emission factor)	1.88	ktCO ₂ e
Calculated emissions 2022 (2022 emission factor)	0.83	ktCO ₂ e
Calculated emissions 2032 (2032 emission factor)	0.43	ktCO ₂ e

Table 1.8 in Technical Appendix O

5.13.9 This is replaced by Table 5.9 below.

Table 5.9: Baseline emissions from road transport network (source 6)

Activity	Value	Unit
Baseline emissions of the road transport network, 2022	84.1	ktCO ₂ e
Baseline emissions of the road transport network, 2032	81.6	ktCO ₂ e

5.14 Embedded Mitigation

5.14.1 *No changes have been made to this section from the 2016 ES chapter.*

5.15 Construction – Likely Significant Effects

5.15.1 *No changes have been made to this section from the 2016 ES chapter other than the changes presented below.*

Table 12.3 in the ES

5.15.2 This is replaced by Table 5.10 below.

Table 5.10: GHG emissions associated with construction phase

Element	ktCO ₂ e
-Source 1: Construction Materials	8.16
-Source 2: Construction Transport	0.83
-Source 3: Construction Plant	0.93

Table 1.9 in Technical Appendix O

5.15.3 This is replaced by Table 5.11 below.

Table 5.11: GHG emissions associated with construction phase

Element	ktCO ₂ e
-Source 1: Construction Materials	8.16
-Source 2: Construction Transport	0.83
-Source 3: Construction Plant	0.93

5.16 Operation – Likely Significant Effects

ES Section 12.8 (Paragraphs 12.8.1 to 12.8.4 are replaced by 5.16.1 below)

- 5.16.1 Emissions associated with the BEE have been calculated according to the method and assumptions stated previously. Table 5.12 and Table 5.13 summarise the emissions from each aspect of the BEE in the years 2022 and 2032 respectively.

Table 5.12: GHG emissions associated with the operational phase - 2022

Element	ktCO ₂ e per year	Change from baseline
-Source 4: Traction power use		
Present day emission factor (2016)	2.2	17%
Future emission factor (2022)	0.97	17%
-Source 6: Transport network effects	84.0	-0.16%

Table 5.13: GHG emissions associated with the operational phase - 2032

Element	ktCO ₂ e per year	Change from baseline
-Source 4: Traction power use		
Present day emission factor (2016)	2.2	17%
Future emission factor (2032)	0.50	17%
-Source 6: Transport network effects	81.2	-0.42%

- 5.16.2 GHG emissions resulting from the tram system itself (source 4) are calculated to be between 0.14 and 0.32ktCO₂e (depending on the emission factor used) in 2022 and less in 2032. This increase is in proportion to the increase in the length of the route that the BEE introduces, increasing the electricity demand of the system by 838MWh per year. While there is predicted to be an increase in GHG emissions, it represents a very small increase compared to the existing sources of transport related GHG emissions in the Birmingham area which currently amount to annual emissions of 1.4mtCO₂e (the Metro as a whole being well below 1% and BEE being responsible for around one-fifth of that). Therefore the increase in emissions associated with the BEE's traction power use is not considered to be significant. As presented in the assessment the future grid electricity emission factor is expected to decline between 2022 and 2032 reducing emissions. In line with government policy this emission factor is expected to continue to reduce after 2032, meaning the emissions associated with BEE traction energy would also reduce.
- 5.16.3 Based on the traffic model, a decrease of 0.13ktCO₂e is calculated in the opening year of 2022, and a reduction in emissions of 0.34ktCO₂e by 2032. This is due to small changes in vehicle flows and vehicles speeds following the introduction of BEE in the opening year; between the two assessment years, the effects of committed developments such as HS2 affect the number of vehicles, the distance travelled and vehicle speeds such that the effect of BEE on the network changes between 2022 and 2032. In both 2022 and 2032, these changes are very small and the BEE is broadly considered to have a neutral impact on the road transport network in terms of total GHG emissions in the Birmingham area.
- 5.16.4 As noted in paragraph 12.6.7 of the ES some energy saving techniques will be implemented on the trams to minimise the energy consumption of the BEE. These techniques are predicted to lower the energy demand of the system by around 20%, and represent savings in source 4 emissions of around by 0.04 ktCO₂e per year for the BEE section in 2022 (i.e. using the present day emission factors, the change from the baseline would be 0.08 ktCO₂e if regenerative braking was not part of BEE).

Technical Appendix O Section 1.6 (Paragraphs 1.6.1 to 1.6.5 are replaced by 5.16.5 below)

5.16.5 Emissions associated with the BEE have been calculated according to the method and BEE stated above. Table 5.14 and Table 5.15 summarise the emissions from each aspect of the BEE.

Table 5.14: GHG emissions associated with the operational phase - 2022

Element	ktCO ₂ e per year	Change from baseline
-Source 4: Traction power use		
Present day emission factor (2016)	2.2	17%
Future emission factor (2022)	0.97	17%
-Source 6: Transport network effects	84.0	-0.16%

Table 5.15: GHG emissions associated with the operational phase - 2032

Element	ktCO ₂ e per year	Change from baseline
-Source 4: Traction power use		
Present day emission factor (2016)	2.2	17%
Future emission factor (2032)	0.50	17%
-Source 6: Transport network effects	81.2	-0.42%

5.16.6 Based on the information from the power demand modelling undertaken for the BEE, the predicted emissions increase resulting from the tram system itself (source 4) is calculated to be between 0.14 and 0.32ktCO₂e (depending on the emission factor used) in 2022 and by less in 2032. This increase is in proportion to the increase in the length of the route that the BEE introduces, increasing the electricity demand of the system by 838MWh per year. While there is predicted to be an increase in GHG emissions, it represents a very small increase compared to the existing sources of transport related GHG emissions in the Birmingham area which currently amount to annual emissions of 1.4mtCO₂e (the Metro as a whole being well below 1% and BEE being responsible for around one-fifth of that). Therefore the increase in emissions associated with the BEE's traction power use is not considered to be significant.

5.16.7 Based on the traffic model, a decrease of 0.13ktCO₂e is calculated in the opening year of 2022, and a reduction in emissions of 0.34ktCO₂e by 2032. This is due to small changes in vehicle flows and vehicles speeds following the introduction of BEE in the opening year; between the two assessment years, the effects of committed developments such as HS2 affect the number of vehicles, the distance travelled and vehicle speeds such that the effect of BEE on the network changes between 2022 and 2032. In both 2022 and 2032, these changes are very small and the BEE is broadly considered to have a neutral impact on the road transport network in terms of total GHG emissions in the Birmingham area.

5.16.8 As noted in paragraph 5.5.6 some energy saving techniques will be implemented on the trams to minimise the energy consumption of the BEE. These techniques are predicted to lower the energy demand of the system by around 20%, and represent savings in source 4 emissions of around by 0.04 ktCO₂e per year for the BEE section in 2022 (i.e. using the present day emission factors, the change from the baseline would be 0.08 ktCO₂e if regenerative braking was not part of BEE).

5.17 Cumulative Effects

5.17.1 *No changes have been made to this section from the 2016 ES chapter other than the changes presented below.*

Paragraph 12.9.2 in the ES

- 5.17.2 The assessment has also considered the committed developments as documented within Chapter 6: ES Methodology as part of the baseline case for the existing road network (source 6). However, the transport modelling does not include Edgbaston extension in the Do-Minimum Scenario, but does in the Do-Something Scenario.

5.18 Summary

- 5.18.1 *No changes have been made to this section from the 2016 ES chapter other than the changes presented below.*

Paragraph 12.10.4 in the ES

- 5.18.2 The BEE will lead to an increase in emissions of GHG due to its use of energy from powering the scheme and its associated infrastructure. Emissions from the traction energy (source 4) are predicted to increase by 0.32ktCO₂e per year due to higher electricity use compared to the baseline. A decrease in emissions from the road network (source 6) is predicted in the opening year (0.13ktCO₂e per year), and in 2032 (0.34ktCO₂e per year).

5.19 Comparison to 2016 ES

- 5.19.1 As per the 2016 ES, the changes in GHG emissions associated with BEE are predicted to be very small in the context of existing emissions from the transport network in Birmingham and are not considered to be significant.

6 Conclusion

6.1 Summary of Significant Effects

- 6.1.1 The significant effects identified in the 2016 ES were summarised in Tables 20.1 and 20.2 for the construction and operation phases respectively. This update has focused on operational changes, and for ease of comparison, Table 20.2, the summary of significant operational stage effects, has been reproduced in Table 6.1 below, along with an additional column identifying whether the conclusions of this update have changed the significance of the effect. It should be noted that not every chapter in the 2016 ES identified significant effects, only chapters 7 (Land Use and Land Take), 9 (Traffic and Transport), 10 (Noise and Vibration) and 18 (Socio-economic).
- 6.1.2 The key changes on a topic by topic basis are as follows:
- 6.1.3 Traffic and transport: compared to the 2016 ES, no significant adverse effects are now predicted during the operation of the BEE. Of the significant effects identified these are all now predicted to be beneficial.
- 6.1.4 Noise and vibration: with regard to the conclusion of the 2016 ES, there is no change to the significant adverse effect previously identified, as summarised in Table 6.1 in the Conclusion.
- 6.1.5 Air Quality: the overall conclusions of this report match those that were reported in the 2016 ES.
- 6.1.6 Greenhouse gases: as per the 2016 ES, the changes in GHG emissions associated with BEE are predicted to be very small in the context of existing emissions from the transport network in Birmingham and are not considered to be significant.

Table 6.1: Summary of potential impacts that are likely to cause significant effects during the operational phase of the BEE

ES Chapter Mitigation measures	Impact Description	Impact Duration	Significance of Effect (2016 ES)	Change compared to 2016 ES
Chapter 7: Land Use and Land Take				
The optioneering exercise has sought to avoid and minimise, where possible the need to take third party land and associated demolition of buildings and structures.	The operation of the BEE will result in the loss of existing retail and commercial floorspace, albeit this is limited to a small number of locations where it is not possible to accommodate the alignment of the tramway without affecting third party land. These include Corner of Corporation Street and Lower Bull Street (258m ²), Corner of Albert Street and Lower Bull Street (1507m ²), Temporary Surface Car Park Land (1035m ²), Area of Open Space (6690m ²), New Canal Street (664m ²), Commercial Land 96-98 Coventry Street (2701m ²), Corner of Meriden Street and High Street Deritend (1578m ²). The BEE does lead to some effects on land take. The extent of this permanent land take is considered to have a moderate adverse effect that is considered to be significant.	Permanent	Moderate adverse significant effect	No change
Chapter 9: Traffic and Transport				
Embedded operational mitigation:	Increase in driver delay on Heath Mill Lane / Liverpool Street	Permanent	Moderate adverse significant effect	Now assessed to be no adverse significant effect.
Junction capacity assessments have enabled junction mitigation to ensure junctions operate within capacity in future years.	Increase in driver delay on High Street Deritend (east of Alcester Street).	Permanent	Moderate adverse significant effect	Now assessed to be no adverse significant effect.
- Relocation of bus stops which potentially may have been negatively impacted by the BEE. - Diversion of bus routes which potentially may have been negatively impacted by the BEE.	Reduction in pedestrian severance and improvement to pedestrian amenity and experience of fear and intimidation on New Canal Street to Curzon Street. (North of junction with Bordesley St)	Permanent	Moderate beneficial significant effect	No change
Retention or rerouting of pedestrian and cycling routes.	Reduction in pedestrian severance and intimidation on New Canal	Permanent	Moderate beneficial significant effect	No change

ES Chapter Mitigation measures	Impact Description	Impact Duration	Significance of Effect (2016 ES)	Change compared to 2016 ES
	Street (north of junction with Fazeley Street).			
	Reduction in pedestrian severance and experience of fear and intimidation on High Street Deritend (east of Milk Street).	Permanent	Moderate beneficial significant effect	Now major beneficial significant effect
	Reduction in pedestrian experience of fear and intimidation on High Street Deritend (east of Heath Mill Lane).	Permanent	Moderate beneficial significant effect	No change
	Improvement to pedestrian amenity and experience of fear and intimidation on Dale End.	Permanent	Moderate beneficial significant effect	Now major beneficial significant effect
	Changes to the experience of fear and intimidation and improvement to pedestrian amenity on Milk Street (directly off High Street Deritend).	Permanent	Major beneficial significant effect	No change
	Changes to the experience of pedestrian fear and intimidation on Heath Mill Lane (directly off High Street Deritend).	Permanent	Moderate beneficial significant effect	Now assessed to be no beneficial significant effect
	Changes to the experience of pedestrian severance and fear and intimidation on Fazeley Street (west of junction with New Canal Street).	Permanent	Major beneficial significant effect	Now major beneficial significant effect
	Changes to the experience of pedestrian severance and improvement to pedestrian amenity on Moor St Queensway (between Albert Street and Masshouse Lane)	Permanent	Assessed to be no beneficial significant effects	Now major beneficial significant effect
	Improvement to pedestrian amenity on New Canal St (south of junction with Fazeley St)	Permanent	Assessed to be no beneficial significant effects	Now moderate beneficial significant effect
	Improvement to pedestrian amenity on Floodgate Street (directly off High Street Deritend)	Permanent	Assessed to be no beneficial significant effects	Now major beneficial significant effect
	Improvement to pedestrian amenity on Fazeley St (east of junction with New Canal St)	Permanent	Assessed to be no beneficial significant effects	Now moderate beneficial significant effect

ES Chapter Mitigation measures	Impact Description	Impact Duration	Significance of Effect (2016 ES)	Change compared to 2016 ES
	Improvement to pedestrian amenity on Bordesley St (west of junction with New Canal Street)	Permanent	Assessed to be no beneficial significant effects	Now moderate beneficial significant effect
	Improvement to pedestrian amenity on Coventry Street (east of Meriden St)	Permanent	Assessed to be no beneficial significant effects	Now major beneficial significant effect
	Improvement on pedestrian amenity on Coventry St (west of Meriden St)	Permanent	Assessed to be no beneficial significant effects	Now major beneficial significant effect
Chapter 10: Noise and Vibration				
No embedded operational mitigation	Indirect noise impacts due to changes in road traffic noise affecting dwellings and other sensitive receptors. In the short-term, this applies to 55 receptors during the daytime and 39 at night. In the long-term, this applies to 413 receptors during the daytime and 43 receptors at night.	Permanent	Significant adverse effect	No change
Chapter 18: Socio-economic				
No embedded operational mitigation	Support for economic growth and development/regeneration of Digbeth and Eastside	Permanent	Major beneficial impact. Significant.	No change
	Some 110 to 230 jobs will be created as a result of the operation of the BEE scheme. This will result in approximately £4.7m to £9.5m in GVA growth in the local area.	Permanent	Major beneficial impact. Significant.	No change
	Improved accessibility through reduced journey times.	Permanent	Major beneficial impact. Significant.	No change

Source: ES, 2016

7 References

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Appendices

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A. Air Quality Model Validation

A.1 Overview

- A.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.
- A.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.
- A.1.3 Verification of NO₂ has been carried out using 2016 monitored results from selected BCC roadside diffusion tube sites and a scheme specific monitoring survey undertaken in 2016 within the study area. Base Year (2016) traffic data was obtained from the SATURN traffic model. Meteorological data from 2016 for Birmingham Elmdon meteorological station was used in the modelling and all other inputs were as per the main assessment as presented in this report and the 2016 ES.
- A.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.

A.2 Methodology

- A.1.5 Guidance produced by DEFRA (2016) provides a methodology for model verification including calculation methods and directions on the suitability of monitoring data.
- A.1.6 Verification of NO₂ concentrations has been carried out using 2016 monitoring results from nine 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.
- A.1.7 Background concentrations used in model verification have been taken from DEFRA and are presented in Table 7.1. The DEFRA background concentrations used in the model verification were sector removed.

Table 7-1: Background concentrations used in model verification

Verification site ID	Annual mean concentration ($\mu\text{g}/\text{m}^3$)	
	NO _x	NO ₂
12	55.9	33.3
11	55.9	33.3
2016-4	55.9	33.3
Site 1a/1b	55.9	33.3
Site 2a/2b	55.9	33.3
Stop 4A/4B	47.7	30.2
Site 5A/5B	47.5	30.2
MSQ A/B/C	47.7	30.2
Moor Street Queensway auto	47.7	30.2

Source: Defra Air

A.1.8 Table 7.2 presents the monitored data used within the verification, the classification of the monitoring sites and monitored pollutant concentrations.

Table 7-2: Monitored data used in model verification

Verification site ID	Classification	Annual mean monitored NO ₂ concentration 2016 ($\mu\text{g}/\text{m}^3$)
12	Roadside	54.2
11	Roadside	52.6
2016-4	Roadside	54.5
Site 1a/1b	Roadside	36.5
Site 2a/2b	Roadside	35.3
Stop 4A/4B	Roadside	36.7
Site 5A/5B	Roadside	39.7
MSQ A/B/C	Roadside	45.0
Moor Street Queensway auto	Roadside	50.0

A.3 Verification Results

A.1.9 Table 7.3 and Figure A.1 present a comparison of monitored and modelled concentrations of NO₂ at the diffusion tube sites for the year 2016. 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:

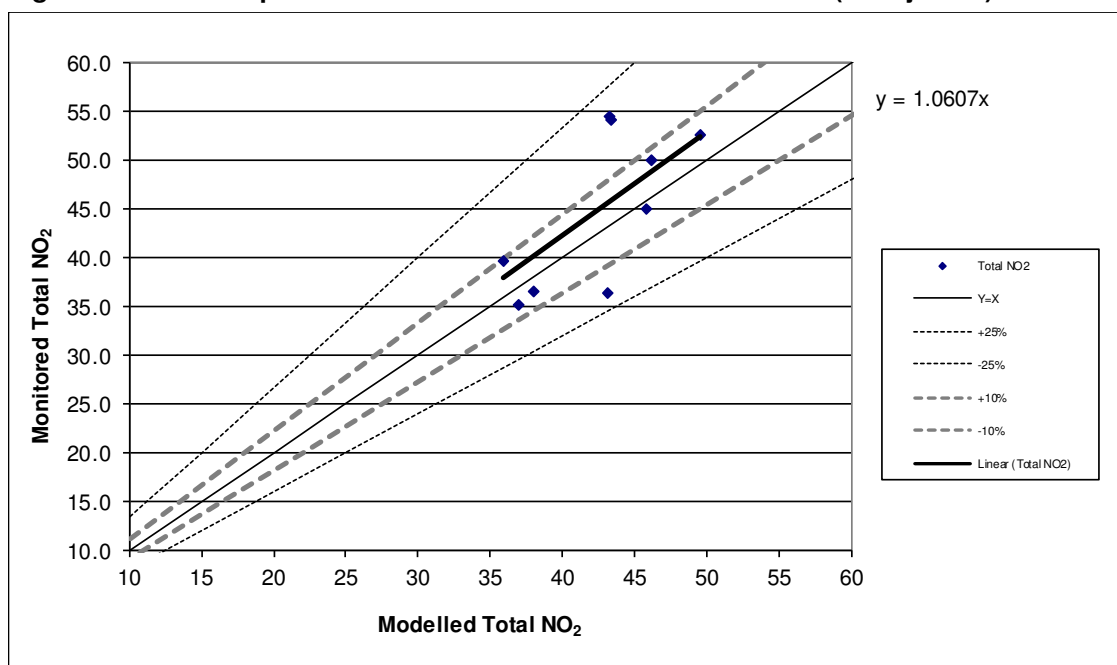
- Receptors which are adjacent to segregated bus lanes and bus stopes; and
- All other modelled receptor locations.

A.1.10 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 7-3: Base Year 2016 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
Other	12	54.2	43.4	-20.0
Other	11	52.6	49.5	-5.9
Other	2016-4	54.5	43.3	-20.6
Other	Site 1a/1b	36.5	43.1	18.2
Bus lane	Site 2a/2b	35.3	36.9	4.6
Bus lane	Stop 4A/4B	36.7	38.0	3.5
Bus lane	Site 5A/5B	39.7	35.9	-9.6
Bus stop	MSQ A/B/C	45.0	45.8	1.7
Bus stop	Moor Street Queensway auto	50.0	46.2	-7.6

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



A.1.11

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 7.4 presents modelled and monitored road NO_x concentrations at the diffusion tube sites.

Table 7-4: Base Year 2016 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)
Other	12	48.7	22.0
Other	11	44.5	36.7
Other	2016-4	49.6	21.8
Other	Site 1a/1b	6.7	21.5

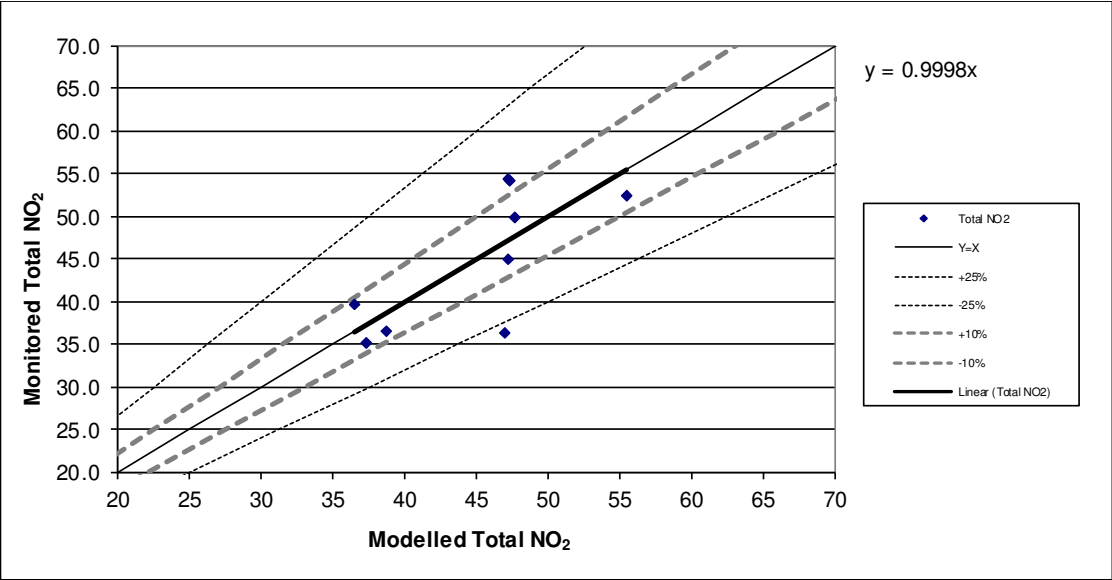
Model area	Site ID	Monitored Road NO _x (µg/m ³)	Modelled Total NO _x (µg/m ³)
Bus lane	Site 2a/2b	4.2	7.7
Bus lane	Stop 4A/4B	13.7	16.6
Bus lane	Site 5A/5B	20.3	11.9
Bus stop	MSQ A/B/C	32.7	34.6
Bus stop	Moor Street Queensway auto	45.1	35.6

- A.1.12 An adjustment factor of 1.10 was derived for diffusion tubes 16, 17, 18, 14 and 9 which are presentative of receptors adjacent to segregated bus lanes or bus stopes which have been included in the dispersion.
- A.1.13 An adjustment factor of 1.42 was derived for diffusion tubes 3, 4, 5 and 15. These diffusion tube sites are considered representative of at all other modelled receptors.
- A.1.14 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 5.27 and fractional bias is 0.001. These values are considered acceptable within DEFRA guidance which suggests that these values should be below 10 and 2 respectively. Table 7.5 and Figure A.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 six out of nine sites and are within 25% of monitoring at eight of the nine sites.
- A.1.15 On the basis of the above adjustment factors it can be concluded that the dispersion model is performing adequately to inform the assessment.

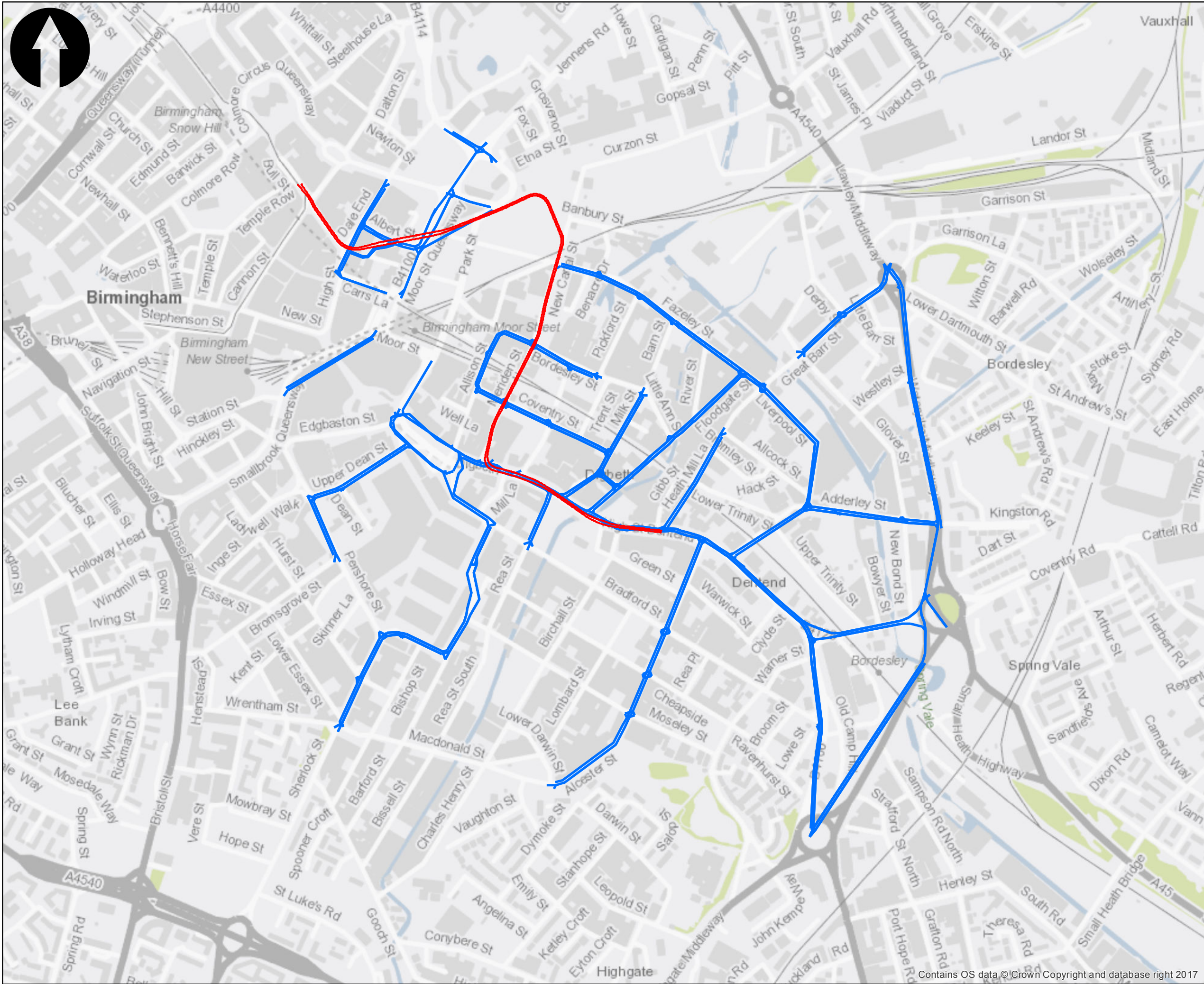
Table 7-5: Base Year 2016 verified modelled results for NO₂ (adjusted)

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
12	1.42	54.2	47.3	-12.8
11		52.6	55.5	5.5
2016-4		54.5	47.2	-13.5
Site 1a/1b		36.5	47.0	28.7
Site 2a/2b		35.3	37.3	5.6
Stop 4A/4B	1.10	36.7	38.7	5.5
Site 5A/5B		39.7	36.4	-8.2
MSQ A/B/C		45.0	47.2	4.9
Moor Street Queensway auto		50.0	47.6	-4.7

Figure A.2: 2016 monitored and modelled road contribution NO₂ (adjusted)



B. Air Quality Figures



Key to Symbols

Birmingham Eastside Extension

Affected Road Network

A1	Sept 2017	SO	Affected Road Network	CM	CM
Rev	Date	Drawn	Description	Ch'k'd	App'd

M

M

MOTT
MACDONALD

Mott MacDonald House
8-10 Sydenham Road
Croydon, CR0 2EE
United Kingdom
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W mottmac.com

Client

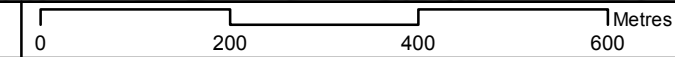
West Midlands Combined Authority

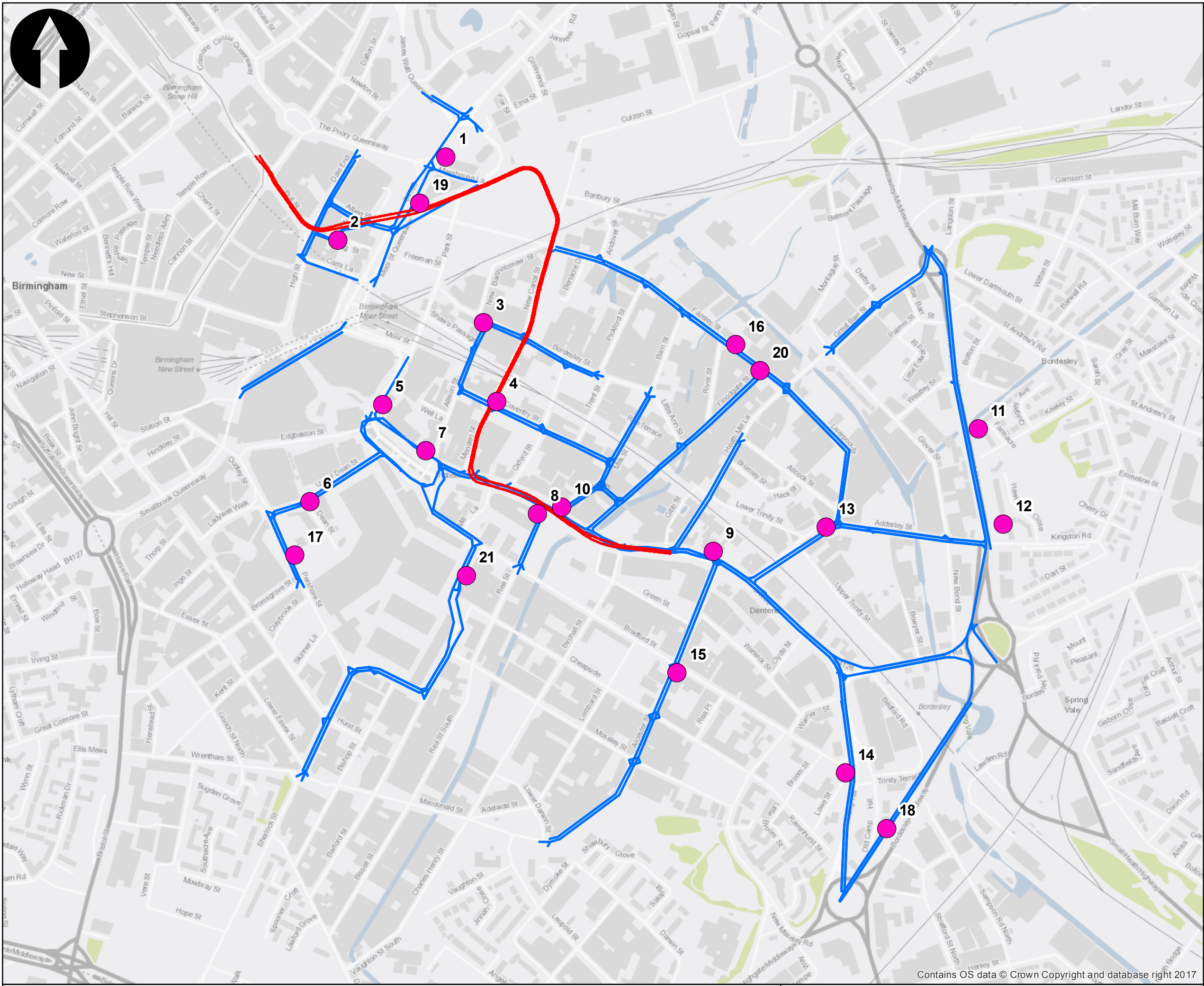
Title

Figure 4.2 - Affected Road Network

Drawn	S Oliver
Check	C Mills
Approve	C Mills

Scale at A3	Status	Rev	Security
1:8,000	PRE	P1	STD

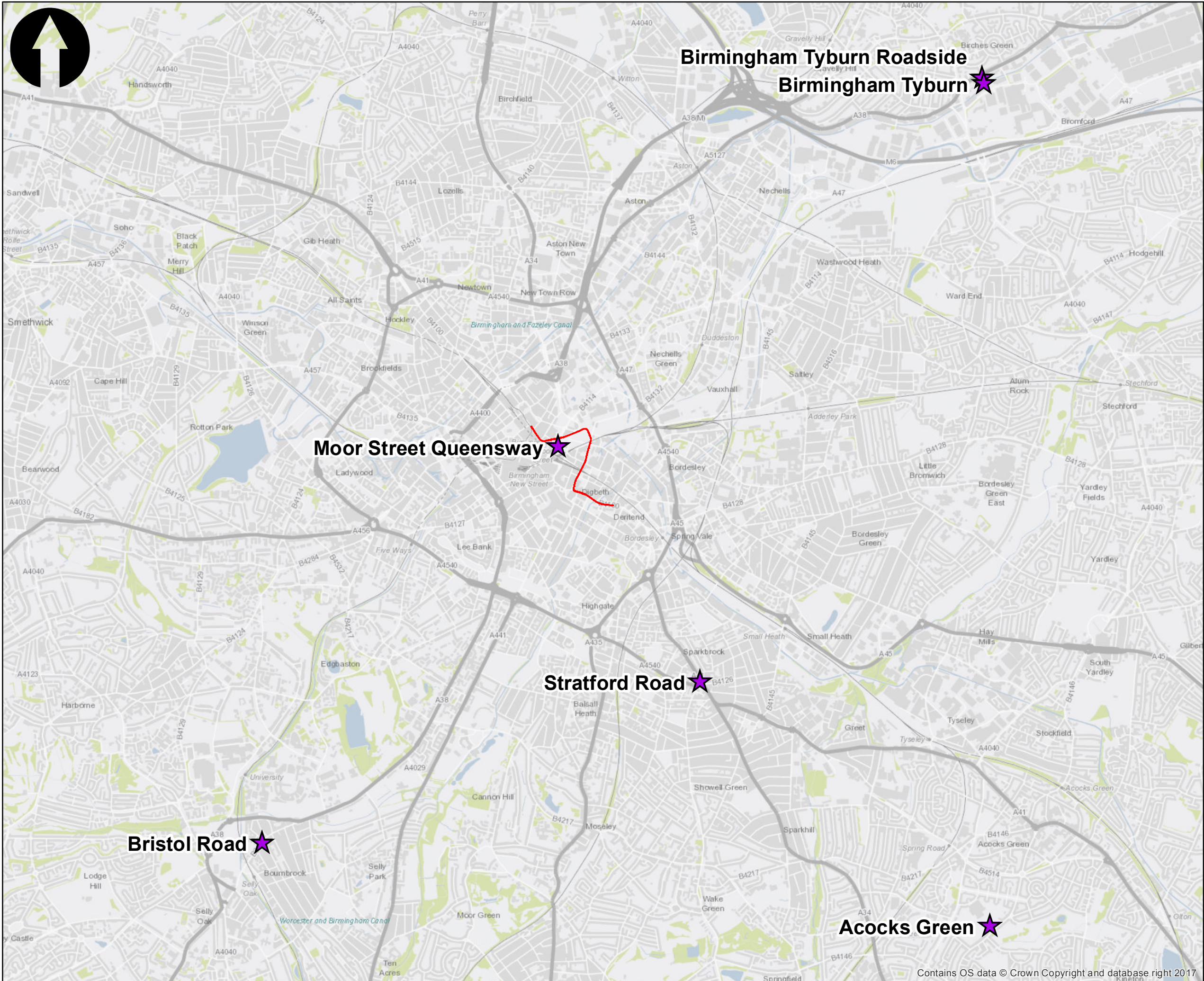




Key to Symbols

- Modelled Receptors
- Birmingham Eastside Extension
- Affected Road Network

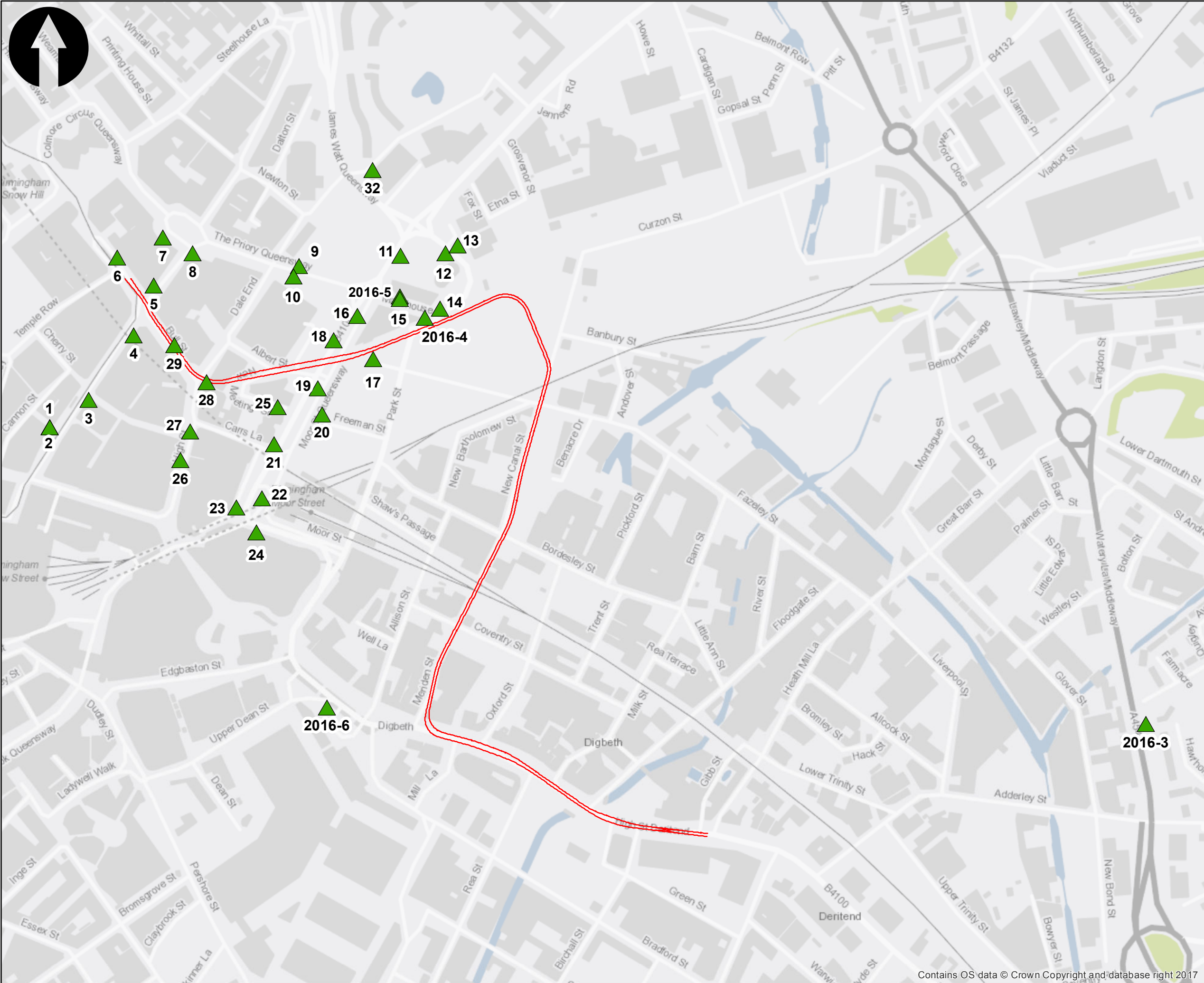
A1	Sept 2017	SO	Receptors	CM	CM
Rev	Date	Drawn	Description	Ch'k'd	App'd
M M MOTT MACDONALD			Mott MacDonald House 8-10 Sydenham Road Croydon, CR0 2EE United Kingdom T +44 (0)20 8774 2000 F +44 (0)20 8681 5706 W mottmac.com		
Client					
West Midlands Combined Authority					
Title					
Figure 4.3 - Human Health Receptors					
Drawn	S Oliver				
Check	C Mills				
Approve	C Mills				
Scale at A3		Status	Rev	Security	
1:7,000		PRE	P1	STD	



 Automatic Monitoring Sites
 Birmingham Eastside Extension

A1	Sept 2017	SO	Monitoring	CM	CM
Rev	Date	Drawn	Description	Ch'k'd	App'd
			Mott MacDonald House 8-10 Sydenham Road Croydon, CR0 2EE United Kingdom T +44 (0)20 8774 2000 F +44 (0)20 8681 5706 W mottmac.com		
Client					
West Midlands Combined Authority					
Title					
Figure 4.4 - Automatic Monitoring Sites					
Drawn	S Oliver				
Check	C Mills				
Approve	C Mills				
Scale at A3		Status	Rev	Security	
1:35,000		PRE	P1	STD	

A number line from 0 to 3 with a step function graphed above it. The graph is at height 1 from 0 to 1, height 0 from 1 to 2, and height 1 from 2 to 3. The x-axis is labeled 'Kilometres'.



Key to Symbols

Non-Automatic Monitoring Sites (Diffusion Tubes)

Birmingham Eastside Extension

A1	Sept 2017	SO	Monitoring	CM	CM
Rev	Date	Drawn	Description	Ch'k'd	App'd
M MOTT MACDONALD			Mott MacDonald House 8-10 Sydenham Road Croydon, CR0 2EE United Kingdom T +44 (0)20 8774 2000 F +44 (0)20 8681 5706 W mottmac.com		
Client					
West Midlands Combined Authority					
Title					
Figure 4.5 - Non-Automatic Monitoring Sites					
Drawn		S Oliver			
Check		C Mills			
Approve		C Mills			
Scale at A3		Status	Rev	Security	
1:5,000		PRE	P1	STD	

